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RESEARCH ON POLLEN VITALITY CORRELATED TO METEOROLOGICAL CONDITIONS AT ROMANIAN VARIETIES OF PEACH AND NECTARIN
/
CERCETĂRI PRIVIND VITALITATEA POLENULUI ÎN CORELARE CU CONDIŢIILE METEOROLOGICE LA SOIURI ROMÂNEŞTI DE PIERSIC ŞI NECTARIN

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Keywords: *pollen, viability, yield germination, in vitro.*

ABSTRACT

In order to know exactly the productive potential of a variety(genotype) and for choosing pollinator (genitor), to create new varieties, as well as for the anticipated appreciation of the economic results, methods are used to verify the viability of pollen by specific enzymatic methods, as well as its germination, on different cultural backgrounds. In the present paper it is investigated in vitro and it is evaluated microscopically, the vitality of pollen in some Romanian peaches and nectarine varieties, in order to evaluate the yield of pollen %R(G/V) germination in the conditions given by the experiment, relationship expressed through germination capacity and mature pollen viability from fresh anthers.There were evaluated three peach varieties Amalia, Congress and Splendid, and also two varieties of nectarines Tina and Mihaela. The best performance (yield) in germination was recorded in the liquid medium with sucrose of 20%, having as leaders for peach Amalia and Splendid varieties, and for nectarine having as leader Mihaela variety.

REZUMAT

Pentru a cunoaşte cât mai exact potenţialul productiv al unui soi (genotip) în vederea alegerii ca polenizator (genitor) pentru crearea de noi soiuri, cât şi în vederea aprecierii anticipate a rezultatelor economice, se practică metode de verificare a viabilităţii prin metode specifice enzimatice precum şi de germinare a acestuia pe medii diferite de cultură. În prezenta lucrare se cercetează in vitro şi se evaluează microscopic vitalitatea polenului la unele soiuri romaneşti de piersic şi nectarin în scopul aprecierii randamentului în germinare %R(G/V) al polenului în condiţiile date de experiment, relaţie exprimată prin intermediul capacităţii germinative şi a viabilităţii polenului matur eliberat proaspăt din antere. Au fost evaluate trei soiuri de piersic Amalia, Congres şi Splendid, cat si doua soiuri de nectarin Tina şi Mihaela. Cel mai bun randament in germinare a fost inregistrat pe mediul lichid cu zaharoza 20%, avand ca lider pentru piersic soiul Amalia urmat de Splendid, iar la nectarin avand ca lider soiul Mihaela.

INTRODUCTION

The importance of this study consists in the "Evaluation of the pollen vitality in correlation with the weather conditions of three Romanian varieties of Amalia, Congres and Splendid peaches, and two Romanian varieties of Tina and Mihaela nectarines, as well as the highlighting of the relationship between the composition of culture media, variants of media culture with germination proportion and germination yield (as biological value of pollen) for forecasting fruit harvest. Some varieties of fruit trees created in Romania have not been researched and characterized and from the point of view of vitality pollen. The vitality of pollen (as a biological feature) is an important factor in amphimatic (binding) reproduction. Therefore, many Romanian and foreign researchers, have "in vitro" experimented the germination of pollen grains on some fruit trees and the pollen of other horticultural plants. The used nutrient media *in vitro,* were either liquid or solids of various concentrations in sucrose with 0.01% boric acid using temperatures (TºC) for pollen germination of 18 ° C to 25 ° C at fruit trees (*Butac M., 2006, Blidariu A.,2008, Ivascu A., 2001, Cociu V., Oprea St.,1989, Iordache M., 2009*) and (*Pădureanu S., 2007*) investigated at Ampelopsis brevipedunculata, Ampelopsis aconitifolia, Vitis vinifera. Coloring methods were used with Acetic Carmin, Methyl Blue, and Ferrous Hematoxylin to highlight both the initial nucleus and the two generative and vegetative nuclei (*Dvornic V.,1960*). Other foreign researchers have used different methods (directly / indirectly) following the quality and vigor of pollen (*Sulusoglu M., 2014*);The indirect methods represented by cytological parameters such as pollen colony intensity with TTC and IKI (*Abdelgardir H.A., 2012,, Burke I.C., 2007, quoted by*

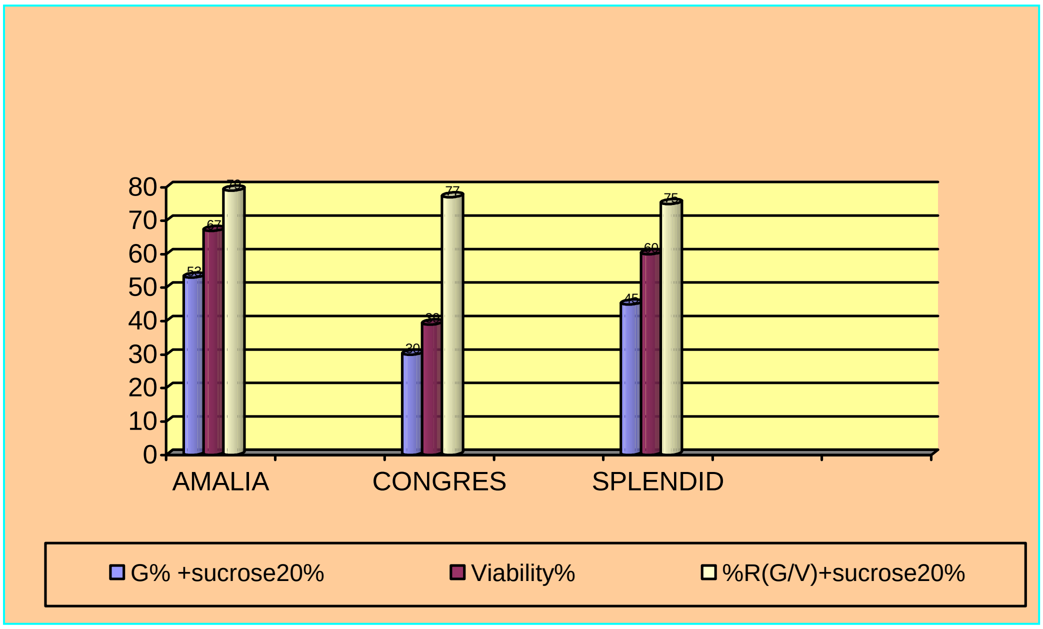
Soares T.L., 2013); and the direct methods such as "in vitro" germination of various pollen types of peach, nectarine, cherry, agave, Passiflora, etc. (*Acar I., 2010, Alcaraz M.L.,2011, quated by Soares T.L.,2013, Radicevic S.,2013, Sulusoglu M.,2014, Sharafi Y.,2011*). The influence of pollen hydration onto germination, has a great importance, because the degree of varied humidity (varied) of fresh pollen, influences the proportion and the rhythm of germination, both in fresh pollen and in the preserved pollen (experimented with Kunzea and Zea mays, XIE B.,2010). Thus, pollen is hydrated in the first phase and then stimulated to germinate in vitro on various media (solid / liquid) covered with cellulosic substrate using experimentally controled temperatures in Arabidopsis thaliana (*Boavida LC, 2017, Rodriguez MJ., 2013*). The need for hydration to precede germination has also been observed and verified by other researchers such as (*Cresti M., 1978, Kaufmane E., 2004, Hedhly A., 2004*) who have experienced in vitro germination of pollen in apricot and peach from Latvia. Also, (*Herrero M.,1989, quoted by Alburquerque N., 2004*) it has found that at the apricot in the first stage of germination the more pollen granules on the stigma, the more germination is stimulated and the kinetics of the polinic tube on the stigma is favored by the enzymatic secretion of the stigma. The pollen viability test shows the ability of pollen to perform the cellular transport function (pollen spermatic cells) in the embryobag, following the compatible pollination (Diaz-Lopez S, 2008). The objective of this paper is the pollen analysis by microscopic methods, determination of germination capacity and pollen viability by correlation of the parameters with the degree of binding of fruits to those researched / evaluated - Romanian peach and nectarine species. The analysis was based on the documentation regarding the research stage in the field approached, correlating our results with those of the specialty literature.

MATERIAL AND METHOD

In the second decade of April 2011, at the first bloom of our fruit plantation, flower samples were taken from several varieties of peaches and nectarines, which consisted of open flowers (anthesis) as well as in course of blooming or in the bud phase. Pollen of flowers was analyzed, from three Amalia pear varieties, Congress and Splendid, as well as from two varieties of nectarine Tina and Mihaela. It was also considered that all three ripening periods (early, medium and late) should be included in the choice of varieties. For the viability assessment (V%) and germination capacity (G%) of pollen for each variety, we used extracted anthers from several flowers (to have a homogeneous sample and to represent as accurately as possible the biological potential of pollen at that time). For the viability assessment (V%) of the pollen of a particular variety, the anthers were detached from the stamens of the open flowers or fresh blossoms. The pollen was deposited on a glass slide and the specific enzymatic method for determination of "pollen viability" (Andrei M. and Paraschivoiu R., 2003) was applied. Always the viability on pollen is working without the presence of anther. Viability (V%) was expressed as percentage by the viable pollenat the ratio of the total granules in the examined microscopic fields. For the germination capacity assessment (G%) of the pollen, the anthers were put in a small clock bottle, plus a few drops of distilled water to release the pollen from the anther. According to the results of the experiments of the previous years, (Iordache M., 2009, Iordache M., 2010), we have chosen to sow the media only with pre-hydrated pollen, (XIE, B.,2010, Cresti,1978, Kaufmane E.,2004, Hedhly A.,2004). The pollen content in each watch bottle consists in a medium sample (one experiment) for the examined variety . From the average sample of each variety, the seedings of germination media were made in 2 different concentrations of sucrose. For each sucrose concentration three test variants (v1, v2, v3) were seeded to test the action of floral parts on germination. The media used to evaluate the pollen germination are liquid media - distilled water (a.d.). To verify and ensure the safety results were made 3 identical re[petition of germination (parallel sowings). Each microscopical lamella was a testing variant (v1, v2, v3). The two culture media were used in sowing in 2 concentrations of sucrose, namely 15% and 20% for peach and nectarine. In addition, each medium contained 0.01% boric acid (H_3BO_3). These concentrations of sucrose have been chosen becouse, in tests on apple pollen, for example in previous years, germination has been very low and oscillating and therefore inconclusive. To limit the risk of contamination and to avoid environmental damage of germination, all utensils, filter paper and culture media were sterilized. As a novelty of experimentation, in sowing the hydrated pollen from the average sample of each variety, in germination medium some floral elements (pistil, anthers) were applied as follows: (v1) -The liquid medium drop was sown only with pollen; (v2) -The liquid medium drop was seeded with pollen accompanied by pestle; (v3) -The liquid medium drop was seeded with pollen accompanied by empty anthers. The pistil was introduced into the liquid medium , to try a simulating condition in vivo, with reference to the stimulating effects that ginacea induces upon the onset of germination (on the stigma) and then on the development of the pollen tube. However, the pistil may also have a negative effect because of environmental contamination with Saprophytes (yeasts, molds) and can itself constitutes an undesirable nutritional support for the development of these germs. In this purpose, I kept 3-5 emptied anthers in the drop (v3), for pursuing these possible negative processes. Lamellas with liquid medium , were kept at a temperature of 17°C to 20°C in a humid atmosphere, so that the liquid medium does not evaporate. Concentration of the culture medium by evaporation of water is avoided and consequently the concentration of boric acid (H3BO3) and sucrose is constantly maintained. The humid atmosphere was maintained by introducing of each variant from the "portobject lamellas" (in 8.5 cm diameter Petry glass boxes), lined with wetted filter paper with sterilized distilled water (Andrei M and Paraschivoiu R, 2003 and Andrei M. and Rădulescu, D., 1972). After sowing, the first laboratory tests were done after a 5-hour cheking interval and at 24 hours. For the microscopic exam, the IOR type ML4-M optical microscope was used. The examination was done in the transmitted light and in contrast to the 10x ocular phase and the lenses 10x, 20x, 40x. The germination was expressed as a percentage (G%) by reporting the pollen germinated to the total of the existing and counted granules. As is currently practiced, there were considered that the granules having the pollen tube length at least equal to twice the diameter of the pollen are germinated. The obtained results at the 3 repetitions/experiments were expressed as a percentage based on the suitable arithmetic mean. Then the germination values (G%) were also reported to the viability values (V%) corresponding to the variety (G / V). The yield of pollen germination% R (G / V) was obtained.

RESULTS

On peach, the germinations on 15% and 20% sucrose culture media in the three variants (v1, v2, v3) have very similar results for the same variety **(Table 1, Graphic 1, Figure 1 and Figure 2).** In the **Splendid** variety the results are identical,and namely the germination in the total pollen was 45% for both 15% and 20% sucrose suitable and the% R (G / V) is 75% identical for both sucrose media. The best germination was for Amalia variety of 50% for the medium with 15% sucrose and 53% for germination for the medium by 20%. Sucrose. Although , Congres peach variety has recorded relatively close but low values, having the lowest viability (V%) of 39% and the poor germination of approx. 32% on both cultural media, it has a very good germination rate of% R(G/V) of 82% for the medium with 15% sucrose and for the 20% sucrose medium the yield% R(G/V) is 77%. In general, it may be considered as being satisfactory a germination of approx. 30%, as it can ensure the binding of the fruit to a normal production.



Graphic 1 - The germination relationship, viability and germination yeld

Table 1

The relationship between germination G%, viability V% and germination yield % R(G/V) at PEACH (2011) on the medium with 15% sucrose and 20% sucrose

VARIETY	Mature pollen				
	Germination max(G%) of the total pollen		Viability (V%)*	Yield of Germination % R(G/V) **	
	sucrose15%	sucrose20%		sucrose15%	sucrose 20%
AMALIA	50	53	67	74	79
CONGRES	32	30	39	82	77
SPLENDID	45	45	60	75	75
(*)Determined Viability(V%) by the staining method with 2,3,5, triphenyltetrazole chloride. (**) Germination yield% R (G / V) calculated by ratio between germination / viability (%)					

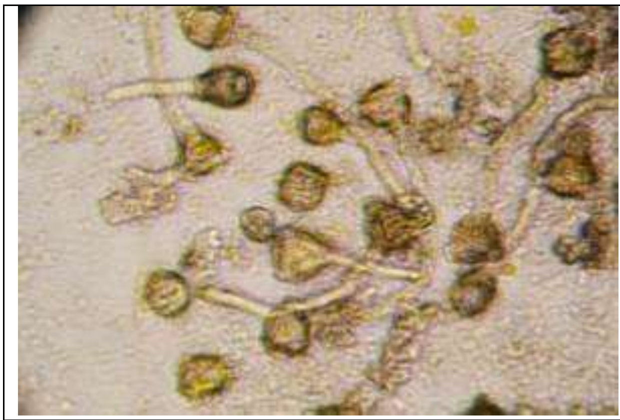
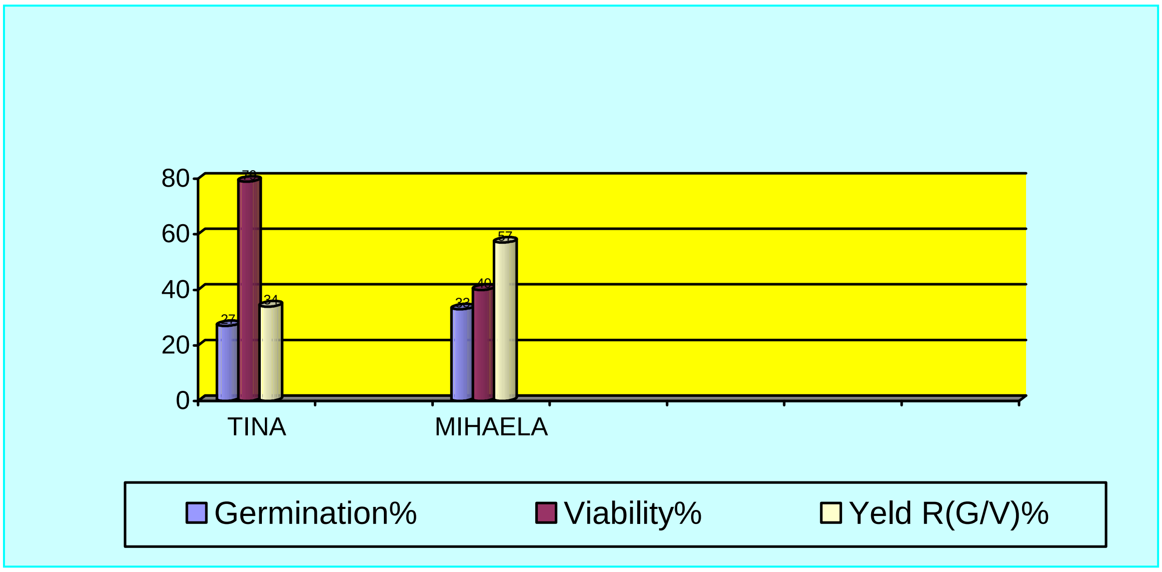


Fig.1- Overview: granules with Pollen tube developed with "apical peack" formation; In transmitted light; Ob.10x; to the peach variety AMALIA (sample from 18.04.2011)

Fig. 2. Detail: pollinic tube in "phase contrast" with evident protoplasmic granulation and the two nuclei (vegetative and germinating); Ob. 20x; to the peach CONGRES variety (sample from 16.04.2011)

For **nectarine (Table 2, Graphic 2, Figure 3 and figure 4),** the viability between the two varieties is very different, so the Tina variety has almost double the value of 79%, while the Mihaela variety has only 40%. Such as the nectarine Tina variety has a much lower germination than Mihaela, meaning 18% and 27% for 15% and 20% sucrose cultures and as a result and% R (G / V) is low.



Graphic 2 - The germination relationship, viability and germination yield on sucrose medium

Table 2

The relationship between germination G%, viability V% and germination yield % R(G/V) at nectarin (2011) on the medium with 15% sucrose and 20% sucrose

Variety	Mature pollen				
	Germination max (G%) of the total pollen		Viability (V%)*	Yield of Germination % R(G/V) **	
	Sucrose15%	Sucrose20%		Sucrose15%	Sucrose20%
TINA	18	27	79	23	34
MIHAELA	23	33	40	57	82
(*) Determined Viability by the staining method with 2,3,5, triphenyltetrazole chloride; (**)The germination yield% R (G / V) calculated by ratio between germination / viability (%)					

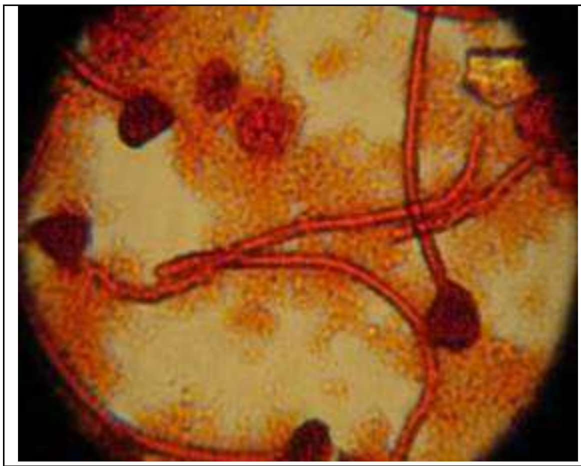


Fig.3-Overview: pollen granules predominate with developed poline tubes; Staining with diluted Safranin; Ob.10x; To nectarine Mihaela variety (sample from 16.04.2011)

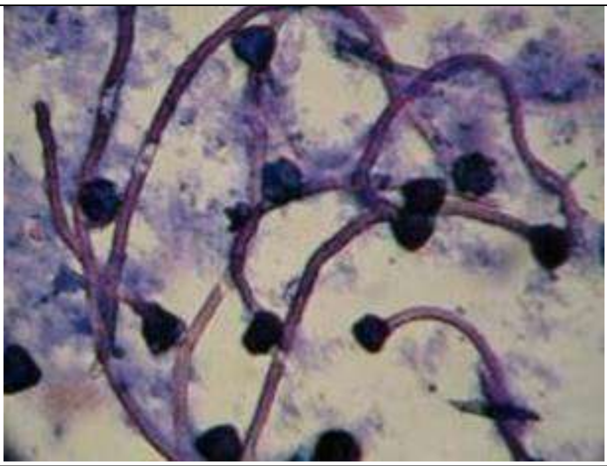


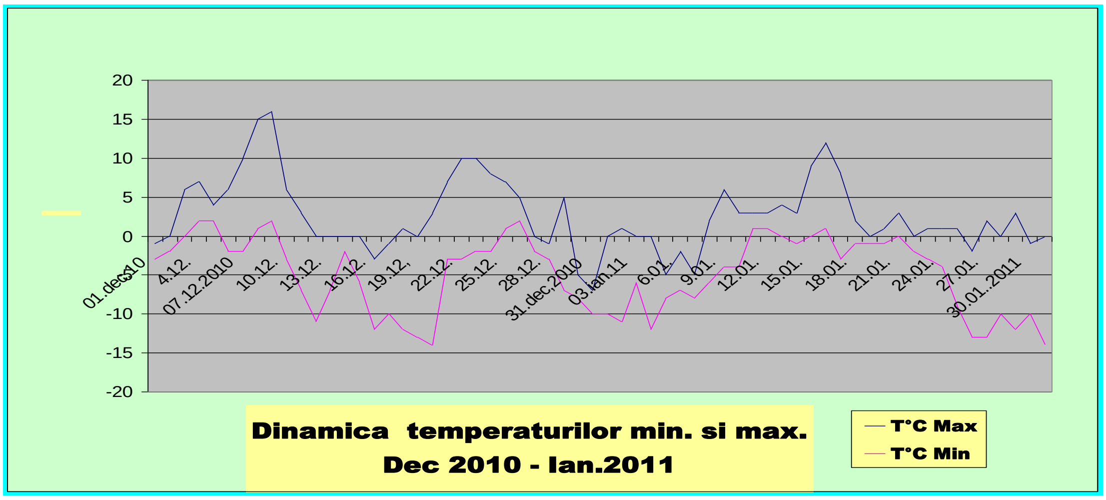
Fig.4-Overview: Pollen granules predominate with developed poline tubes; Toluidine blue staining; Ob.10x; To the nectarine TINA variety (sample from 16.04.2011)

Regarding the weather conditions between December 2010 and April 2011 and the influence on the viability and germination capacity of peach and nectarine varieties. **(Graphic 3, Table 3, graphic 4),** we specify the following: If excessive or alternating temperatures had been at the basis of declining germination rates in 2011, then all varieties would have been strongly and almost uniformly affected, as they would have been in the same phenophase and with the same degree of sensitivity, (such as it would have been happened , the appricot and peach calamity in winter 2009 - 2010) (*Iordache M, Andrei M, Şesan E, 2010*).

In December 2010 - January 2011, the monthly average temperature was comparable to the multiannual average, without excessive temperatures deviating in addition or in minus. There have been no deviant and rapid passage differences to disturb the natural adaptation rate of the floral buds. The average temperature of December 2010 was -0.4ºC and the multi-annual average of -0.1ºC. Decades of December 2010 had average temperatures of + 3.2 ° C; -4.5ºC; + 0.3ºC. Month January 2011 had a monthly average of -2ºC and a multi-annual average of -3.1ºC. For the decades of January, average temperatures were: -3.6ºC; +2.0ºC; -3.7ºC. In the period 15-17 January 2011 there were 3 days when the maximum temperature (daytime) was + 8ºC to + 12ºC.

The temperature was not enough to cause the buds to decay and the period before microsporogenesis did not pose any risk. Towards the end of the month between January 26 and January 31, 2011, the minimum temperature fell from -10ºC to -14ºC and continued between February 1-5 with minimum temperatures (-17ºC) to (-8ºC). This prolonged interval of 11-day moderate cold had favorable consequences because its thermal value did not present a danger of injury (did not reach -20ºC). On the other hand, the uninterrupted cold protected the decaying flower buds and of the risk of accelerated preparation for entering the vegetation; Also the uninterrupted cold kept cellular low breathing as well as consumption from the starch reserve. In this period, a "winter stabilization" was in fact provided to protect flowering buds. In February, the minimum (nocturnal) temperatures were permanently negative and recorded in the multi-annual thermal oscillation. Thus, buds did not receive any heat stimulus that would lead to the exit from latent state of low metabolism. This correlation between severe weather factors and low metabolism has protected the physiological potential of flowering buds in apricot, peach and nectarine. The average of February 2011 was -1.9 ° C, and the multi-annual average of -0.7ºC, and the decades of February in thermal terms were -2.6ºC; -0.4ºC, -3.0ºC.

In March the medium temperature (daily average between minimum and maximum temperature) was of + 5ºC, while the multiannual average is +4.2ºC. Starting with the second decade of March, temperatures were only positive and the temperature for decades was -0.3ºC; +7.1ºC, +8.0ºC. Month average in April was + 9.9ºC, and the multi-annual media of +11.3ºC. Compared with winter 2009-2010 (year with calamity effects for varieties of apricot, peach and nectarine), this year 2011 microsporogenesis had a normal evolution, unaffected by weather conditions. Therefore, differences between varieties of germination capacity and pollen viability are determined by the variety-specific characters. These characters may be influenced by the interaction of the plant with different phytopathogenic agents (viruses, moniloses), of plant age, and the time manifestation of the negative consequences of meteorological and phytopathogenic accidents from previous years.

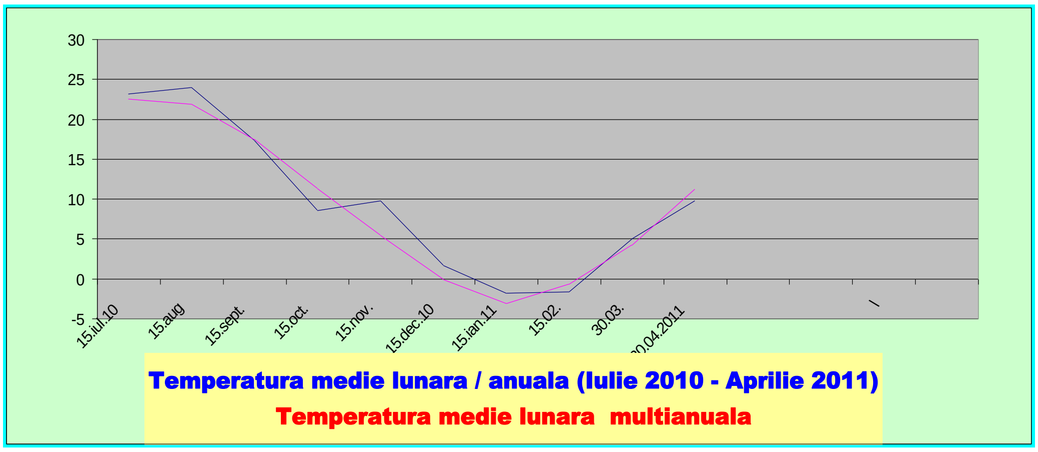


Graphic 3 - Dynamics (TºC) of min. and max for Dec. 2010 - Jan. 2011

Table 3

Temperatures (ºC) and rainfall (L / mp), multiannual averages December 2010 -April 2011

Average temperatures	December 2010	January 2011	February 2011	March 2011	April 2011
Monthly average Tº C	-0.4	-2.0	-1.9	+5.0	+9.9
Multi-annual average Tº C	-0.1	-3.1	-0.7	+4.2	+11.3
Sum of precipitation L / mp	73.5	3.0	1.4	0.3	6.4



Graphic 4 - Monthly average/ annual temperature (July 2010 - April 2011) and monthly multiannual average

CONCLUSIONS

Following the experiments performed in 2011, where the viability (V%), the germination capacity (G%) and the pollination yield% R (G / V) of pollen were evaluated for the 3 peach varieties and 2 varieties of nectarine, the following conclusions can be drawn: The pollen maturation was carried out under normal physiological uninterrupted conditions in accordance with the favorable evolution of weather conditions. The flowering at peach in the year of our research started on 18.04.2011 and at nectarine the flowering started on 13.04.2011. **At peach,** mature pollen showed V% = 39% -67% (determined by 2,3,5, TTC), G% = 30% - 53% and% RG / V = 74-82%, having The Amalia leader followed by the Splendid variety. The Congress had the worst germination. **To nectarin,** mature pollen showed V% = 40% -79% (determined by 2,3,5, TTC), G% = 18% -33% and% RG / V = 23-82% having as a lider Mihaela variety, and Tina had a low germination. The best germination in all varieties analyzed by peach and nectarin, was recorded in the liquid medium with zh. 20% and H_3BO_3 -0.01%. Size relationship between variants (v1, v2, v3) is the following: v2 has a maximum value, v1 has an average value, and v3 has a minimum value. This relationship expresses the germination yield of viable pollen (under experimental conditions) such that: In variant 2 (v2 / medium + pollen + pistil), the highest germination values are observed and it is confirmed the stimulating role of the pistil in the germination and the pollen tube increase. Variant 3 (v3 / medium + anthers) usually has the lowest value with the lowest germination in all varieties as a result of a possible negative influence on the germination of the anther's tissue. The results G% / V% express a vital correlation for the variety / species, but also very important for the practical consequence, meaning for fruit binding and fruit production. In practice, under the conditions of SCPP Baneasa, 30% germination capacity of the pollen ensures the binding of fruits and a normal fruit production. Our experimental results from 2010-2011 are new contributions to the studied subject, referring to an assortment of Romanian varieties not studied yet. The Romanian varieties analyzed, namely peach and nectarine, gave birth in 2011 to the specific potential of each, and confirmed the proper germination and proper binding of the fruits, not disturbed by weather conditions during microsporogenesis and flowering.

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HYDRAULIC MODELING FOR BETTER OPERATIONAL PERFORMANCE OF EXISTING IRRIGATION CANAL
/
ХИДРАВЛИЧНО МОДЕЛИРАНЕ ЗА ПО-ДОБРА ОПЕРАТИВНА ЕФЕКТИВНОСТ НА СЪЩЕСТВУВАЩ НАПОИТЕЛЕН КАНАЛ

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Keywords: *Irrigation Canal, Simulation Model, Hydraulic modeling, diagnostics, analysis.*

ABSTRACT
Mathematical simulation model is a suitable tool for understanding the hydraulic behavior of an open irrigation canal and obtaining information on actual hydraulic parameters of water flow. In this paper, a simulation model of an open irrigation canal created using hydraulic software HEC-RAS is presented. The model was calibrated with observed flow data in steady state conditions and optimal roughness value and actual canal carrying capacity were determined. Computer simulations for different values of roughness and operating discharge were carried out in order to diagnose the condition of the lining and defining the limits of the hydraulic parameters of the studied canal.

РЕЗЮМЕ
Математическият симулационен модел е подходящ инструмент за изследване на хидравличното поведение на открит напоителен канал и за получаване на информация за действителните стойности на параметрите на течението. В този доклад е представен симулационен модел на открит напоителен канал, създаден с хидравличния софтуер HEC-RAS. Моделът беше калибриран с реални данни при стационарен режим на течението в канала и бяха определени оптимална стойност на грапавина и действителния му капацитет. Извършени са компютърни симулации за различни стойности на грапавината и за работно водно количество, за да се диагностицира състоянието на облицовката и да се определят границите на хидравличните параметри на изследвания канал.

INTRODUCTION
In irrigation systems the flow parameters are measured in a limited number of points along the canal course, which does not provide sufficient information for effective management - supply of needed water for irrigation of the agricultural crops without deficiency or excess spillage.

Mathematical simulation model is a suitable tool for understanding the hydraulic behavior of the open irrigation canal and for obtaining information about the actual values of the flow parameters. As a result of the hydraulic analysis of the flow in the canal carried out with a model, complete information is obtained about the changes in water levels along the canal occurring after each change of water supply at the head of the canal and/ or change of the water discharge in the canal offtakes (*Baume et al,*.1994). The roughness factor is an essential parameter of the mathematical models of the open canals as it participates in the calculations of the friction slope and influences the hydraulic parameter determination accuracy. Models should be calibrated by roughness parameter.

Computer analysis can be very useful in assessing the existing situation of an old irrigation system with open canals and in searching for possible solutions to improve water management. With the calibrated steady flow model, in terms of roughness hydraulic studies and assessing the influence of operating conditions can be carried out.

In this paper, a simulation model of an open irrigation canal created using hydraulic software HEC-RAS is presented. The model was calibrated with observed flow data in steady state conditions and optimal roughness value and actual canal carrying capacity was determined. Computer simulations for different values of roughness and operating discharge were carried out in order to diagnose the condition of the lining and defining the limits of the hydraulic parameters of the studied canal.

MATERIALS AND METHODS

Description of software used

In this study, the freeware software HEC-RAS, Version 4.1 (Hydrologic Engineering Center - River Analysis System) developed by U.S. Army Corps of Engineers, is selected to create a simulation model of the study canal. Using this software, one-dimensional hydraulic calculations are performed in a branched network of natural and / or artificial channels. The software system includes a user interface, steady flow model, unsteady flow model and modules that provide graphical and tabular presentation of the results. It can simulate steady and unsteady flows in open channel. For the steady state conditions, water surface profile can be simulated in critical, supercritical and mixed flow regimes (*US Army Corps of Engineers*, 2010).

For conducting hydraulic modeling and simulation of the water surface profile in irrigation canal data are required for its geometry, the boundary conditions, the water discharge, the canal roughness, geometric description of the hydraulic structures along the canal course, such as gates, culverts, weirs. Introducing the geometry of the canal includes defining the profile of the canal bed of the study reach by setting series of cross-sections that longitudinally define its shape.

For the calculation of the longitudinal water surface profile at steady flow, the one-dimensional equation of energy (Bernoulli equation) is integrated by the standard step method. In order to be able to start the calculation, a discharge upstream of the canal and a stage downstream are set as boundary conditions. For the interior points the stage is estimated keeping the water discharge constant.

As results of canal flow simulation the following hydraulic parameters: depth/ water surface elevation, energy grade line elevation, friction slope, flow velocity, critical depth/critical depths line elevation, water volume in the canal and others can be determined.

The roughness coefficient cannot be measured directly and therefore it is necessary to determine it by other methods. One of the methods used to assess the roughness is by simulation with a mathematical model. The classic approach for evaluation and calibration of the parameter roughness is associated with modeling of the steady flow in the canal *(Malaterre et al, 2010)*.

The computational procedure is iterative and simulations with the irrigation canal model are carried out for a series of roughness values. For the determination of the roughness coefficient, the values of the hydraulic parameters in the observation points along the irrigation canal course and the numerical results of the computer experiments are compared according to a certain criterion. Nguyen and Fenton investigate the application of three main types of target function and show that least squares minimization gives the best results (*Nguyen and Fenton D.,* 2004). The best match between the observed and calculated values for the hydraulic parameter, according to the selected criterion, determines the optimal roughness value.

Description of the studied canal

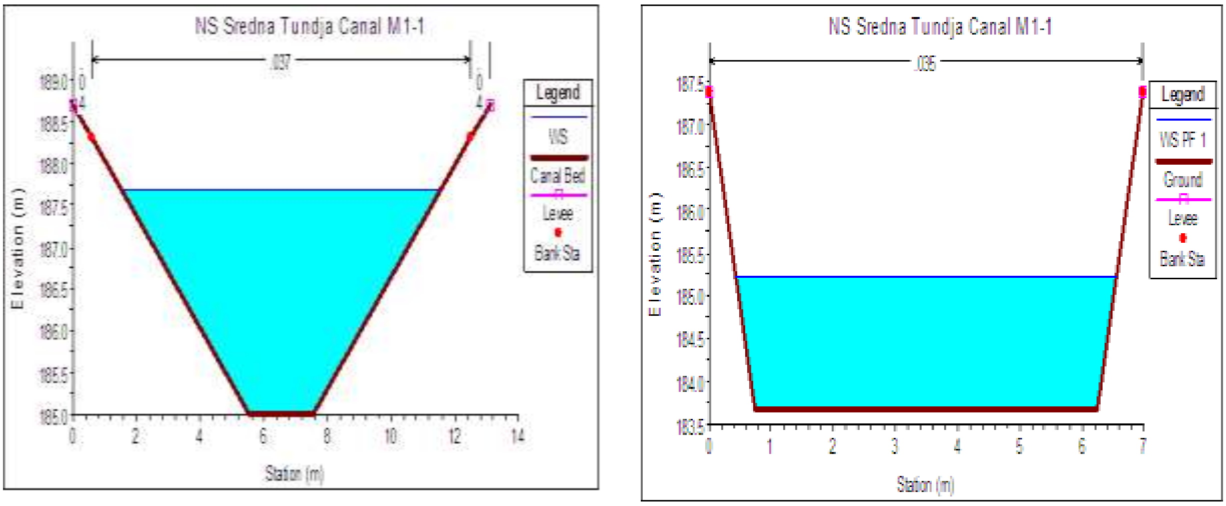
The studied canal is a first part of an existing irrigation canal - the main canal M1-1 of „Sredna Tundja“ irrigation system, in length 7.586 km, which starts from an attachment facility from the Binkus bent on the Tundzha river from an elevation of 185 m to a distribution shaft in the region of village Gavrailovo 7.586 km in length (fig. 1.) The canal is designed up to discharge 41 m^3/s.

The canal has trapezoidal cross-section and consists of 3 sections, two of them lined with concrete 2.642 km and 3.403 km in length with 2 m bottom width, a side slope of 1.5, the average bottom

Fig. 1 - Map of main canal M-1-1 of „Sredna Tundja“ irrigation system and vicinity area (*www.topomaps.info)*

RESULTS

Hydraulic simulation model of the studied canal was created using hydraulic software HEC-RAS. It was built on the basis of the design parameters of main irrigation canal M 1-1. When creating the simulation model a realistic representation of the existing situation was sought. To reproduce the real geometry of the canal, three cross sections are set - at the canal inlet, at the head of rocky canal section and at the head of lined canal section in the canal end. The irrigation canal has a simplified geometry and the cross sections can be introduced with four points and a value of the coefficient of roughness. Since two of the canal sections are not completely lined, they were introduced with six points and changes in the lining are recorded by entering two values of the roughness coefficient for the lined and unlined part of the bank (Figure 2a). As boundary conditions rating curve at the head of the canal and critical depth at the end were set.



(a)

(b)

Fig. 2 - Canal cross sections

Calibration of HEC-RAS model of the M1-1 canal for roughness coefficient n

The HEC-RAS model of the M1-1 canal was calibrated using data for observed inlet water discharge and one depth at the end of the canal before the distribution shaft in the area of the village of Gavrailovo. Calibration data was selected from the daily operational information for canal depth measurements during the period from 14th of May to 29th of July 2012 under steady state of canal conditions.

The model has been used to simulate the steady flow in the canal M1-1 for increasing values of the roughness coefficient of the lined part of the canal cross sections in the range of 0.014 to 0.04 and the roughness coefficient equal to 0.035 for the unlined part and the rocky section in the steady state conditions. The initial value of the roughness for concrete lined canal and grassed surface of unlined part of the banks were selected in tables published in (*Chow*, 1959). A total of 20 experiments were conducted.

The simulated and measured values of the depth in the end of the canal for different values of the roughness coefficient are presented in Table 1. The simulated depth hydrographs were compared with observed depth hydrograph using linear regression. No significant deviation between the measured and estimated values is available and high correlation (R^2>0.9) between the observed and simulation depths was achieved for the respective water discharges. An optimum value of the roughness n = 0.037 is determined for which the correlation coefficient is the highest (Figure 3).

Table 1

Measured and simulated depth hydrographs for different values of the roughness coefficient

Q_{in} *- inlet discharge, h_o - measured depth in canal end, h_s - simulated depth in canal end, n- roughness coefficient*

Q_{in}, m^3/s	h_o, m	h_s, m			
		n=0.014	n=0.025	n=0.035	n=0.037
3.5	0.83	0.69	0.76	0.81	0.82
9.5	1.39	1.15	1.24	1.31	1.33
12.5	1.61	1.33	1.42	1.49	1.51
15.68	1.66	1.48	1.58	1.65	1.67
18.44	1.78	1.59	1.69	1.77	1.78

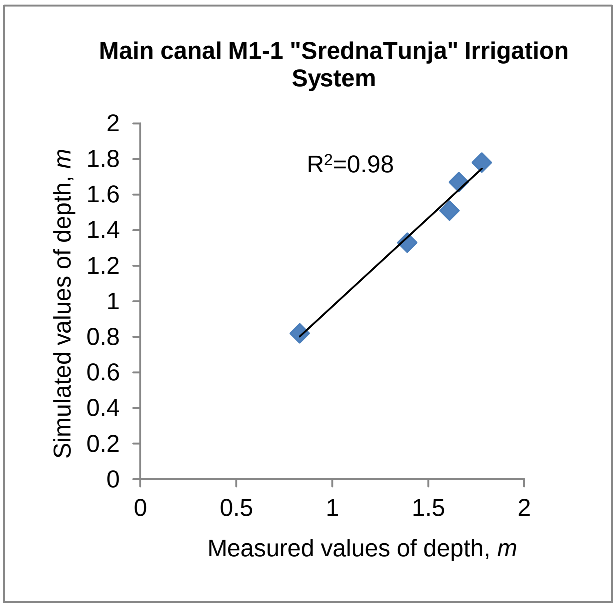


Fig. 3 - Comparison of measured values of depth in the tail of canal versus simulated values for roughness coefficient n =0.037 using linear regression

By simulations of steady flow in the canal for estimated optimum value of the roughness n = 0.037 and increasing values of the inlet water discharge the current canal carrying capacity of 20 m^3/s is determined, as water discharge for which the depth in the lined canal section reaches the maximum 3.3 m, determined by the height of the lining. A 50% reduction in capacity shows a significant worsening of the operational performance of the canal.

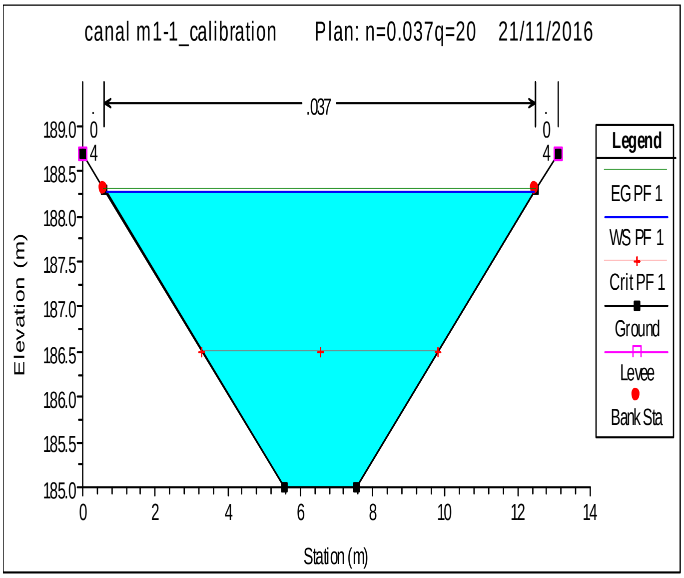


Fig. 4 - Canal cross section plot for roughness coefficient n =0.037and inlet discharge Q_{in} =20 m^3/s.

Simulation of steady flow in the canal for different value of roughness coefficient n

With the model of canal M1-1 simulations were conducted for different values of roughness in order to diagnose the condition of the lining and study the parameters of flow in canal and determining their limits. For several values of the roughness coefficient of the lined part of the cross section: n=0.017, 00.025, 0.035, 0.037 and inlet water discharge 18.5 m^3/s, a steady flow in the canal was simulated.

The analysis of the modeling results shows the influence of the roughness on the flow parameters in the irrigation canal. Figure 5 shows a longitudinal profile along the canal axis and water surface profiles for the different values of roughness coefficient. Increasing the roughness in the canal leads to an increase in canal depths. With further increases in roughness, the depths in the canal will reach the maximum of 3.3 m, set at design with the height of the lining. Therefore, in the poor condition of the irrigation canal lining the operating discharge should be reduced.

The simulated water surface profiles obtained can be used as reference for estimating the roughness in the presence of updated data for observed depths at characteristic points along the canal course.

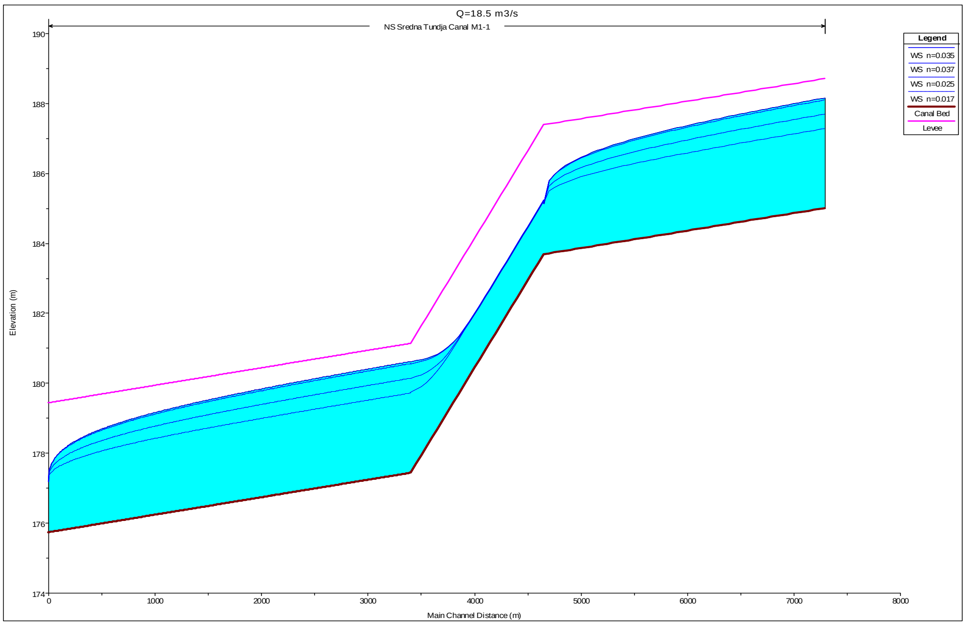


Fig. 5 - Water surface profiles for different values of roughness coefficient n= 0.017, 0.025, 0.035, 0.037 and water discharge Q = 18.5 m^3/s

CONCLUSION

Using the HEC-RAS hydraulic software, a simulation model of the M-1-1 canal of „Sredna Tundja" irrigation system was established, which was calibrated under steady-state conditions with available operating data for observed depths. The results obtained in the hydraulic model studies have shown:

For roughness coefficient equal to 0.037 there is a good match to the simulated with the measured values of the depth at the end of the canal at a high degree of correlation (R^2= 0.987).

By determining the estimated value of the canal roughness, an actual value of the canal carrying capacity 20 m^3/s can be determined. A 50% reduction in capacity shows a significant worsening of the operational performance of the canal.

With the increase of the coefficient of roughness, which simulates the deterioration of the lining, the depth in the canal increases and it can reach the maximum determined during design.

The results of computer analysis can be used in the redesign and rehabilitation of existing canals and to select the appropriate procedure for the operational management.

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DOLJANA, A NEW VARIETY OF COWPEA (Vigna unguiculata L.Walp.) RECOMMENDED ON SANDY SOILS
/
DOLJANA, UN NOU SOI DE FASOLIȚĂ (Vigna unguiculata L.Walp.) RECOMANDAT PE SOLURILE NISIPOASE

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Keywords: *plant, drought, improvement, productivity, quality*

ABSTRACT
The new variety of cowpea, Doljana, was created at the Development Research Center for Agricultural Plants on Sands, Dabuleni, in the field of cowpea amelioration and registered in the Official Catalog starting with 2017. This variety was obtained by repeated individual selection in a natural hybrid of cowpea population. Doljana is a cowpea variety highly resistant to pathogens and tolerant to pest and has a high productivity and an early age of about 11 days compared to the Jiana variety. The Doljana variety,performed an average yield of 2697 kg / ha over a period of 8 years, with a production difference of 893.4 kg / ha, compared to the Jiana variety, very statistically significant. Also, compared to the witness variety, Jiana, the Doljana cowpea variety records an early harvest of about 11 days and a higher ecological plasticity. The grain yield obtained from the cowpea has varied according to the climatic conditions of the years of study. Thus, there were significant positive correlations between the cowpea production and the average air temperature of the cowpea growing season (May-August) and insignificant correlations between the precipitation regime and the production obtained.

REZUMAT
Noul soi de fasoliță, Doljana, a fost creat la Centrul de Cercetare Dezvoltare pentru Cultura Plantelor pe Nisipuri Dăbuleni, în câmpul de ameliorare a fasoliței și înregistrat în Catalogul oficial, incepând cu anul 2017. Acest soi a fost obținut prin selecţie individuală repetată în cadrul unei populaţii de fasoliță hibride natural. Doljana este un soi de fasoliță foarte rezistent la agenții patogeni și tolerant la atacul dăunătorilor și are o productivitate ridicată și o timpurietate de cca 11 zile, față de soiul martor, Jiana. Soiul Doljana a realizat o producție medie de 2697 kg/ha, pe o perioadă de 8 ani, înregistrând o diferență de producție de 893,4 kg/ha, față de soiul martor (Jiana), foarte semnificativă din punct de vedere statistic. Deasemenea, comparativ cu soiul martor, Jiana, soiul de fasoliță Doljana înregistrează o timpurietate la recoltare de cca 11 zile și o plasticitate ecologică mai mare. Rezultatele de producție au variat în funcție de condițiile climatice ale anilor de studiu. Astfel, s-au au înregistrat corelații semnificativ pozitive între producție și temperatura medie din aer a perioadei de vegetație a fasoliței (mai-august) și corelații nesemnificative între regimul precipitațiilor și producția obținută.

INTRODUCTION
The spread of cowpea on a large area has led to its cultivation under different climatic, geographic and edaphic conditions, being exposed under the influence of environmental conditions to rigorous natural and artificial selections (*Hall A. E. și grantz D. A., 1981, Zăvoi A. și Bleoju Maria, 1989, Reddy K. C., J. Van Der Ploeg, Maga I., 1990*). Originally from Central Africa, cowpea (Vigna unguiculata L. Walp), through plant biology, increased drought resistance and reduced soil fertility requirements, this plant being a good alternative for bean and soybean culture, plants that are very sensitive to stress factors in areas with excessive drought (*Boukar O șicolab., 2010, Drăghici Reta, 2012, Thomas R. Sinclair și colab., 2015*). Also, research by H.A. Ajeigbe and B.B. Singh, 2010 at the International Institute of Tropical Agriculture (IITA), Kano, Nigeria highlighted the role of cultivated cowpea in a sustainable farming system, by using it in animal feed and helping to maintain the soil fertility by using manure. The use of sandy soils in southern Oltenia implies a specific, rational and integrated farming system with less pretentious plants than soil fertility and

tolerant to stress factors that ensure profitability and protection of the environment (*Drăghici Reta și colab, 2016, Marinica Gh.,1994*). The study of the plant-soil-climate relation, in the context of diversification of species and varieties, preservation and protection of the environment, is in line with the National Strategy for mitigating the effects of drought and combating soil degradation and desertification elaborated by MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT. In this respect, the choice of plant variety and the improvement of plants adapted to a particular area, by example cowpea, is a necessity for obtaining high, safe and stable production.

MATERIAL AND METHOD

The research was carried out in a 3-year rotation: sorghum-cowpea-rye on a moist phreatic clayey-alluvial soil with reduced natural fertility, low in humus (0.38%) and high in coarse sand (76%). The study was conducted in irrigated system, by applying 3-4 watering with a norm of 300 m³ water per hectare, to plant growth, differentiation of floral buds and blooming-fructified. The Doljana variety was obtained by repeated individual selection within a natural hybrid of cowpea. The objectives, which were the basis for selection were: colour, shape and grain size, productivity, grain quality, resistance to diseases and pests, drought resistance, and adaptability to mechanical harvesting precocity. Following the repeated selection in 2005-2008, was obtained the T-20 cowpea line, which was multiplied and experienced in comparative orientation cultures between 2009-2011 and then in 2012-2014 in comparative culture and competition. Based on the results, the T-20 line was promoted in 2015 to the ISTIS network, for verification, and in 2017 it was registered as Doljana name. The exploitation of the experimental results was done by statistical methods, specific to each improvement step. The paper presents research results obtained under the conditions of CCDCPN Dăbuleni in 2009-2016, referring to the biology, productivity and quality of the plant in the Doljana variety (T-20), compared to the Jiana variety, taken as a witness. The relationship between the results obtained in the Doljana variety and those of the control variety, Jiana, was described by calculating linear regressions, and the stability of production and productivity is reflected by the calculation of the standard deviation and the coefficient of variation.

RESULTS

The analysis of the climatic conditions recorded during the vegetation of the coewpea plant (May-August), during the experiment period (2009-2016), highlights the dryness of most of the years studied, compared to the multiannual average (Figure 1). It is noted that the average air temperature increases by 0.81^{0}C during experimentation, compared to the multiannual average, which is why the selection of species and varieties of sandy soils should be chosen with great caution. Although the amount of precipitation recorded during the vegetation period of the cowpea (May-August 2009-2016) is higher than the multiannual average, it is unevenly distributed and insufficient in the phases of maximum consumption of plants, requiring the hydrological deficit to be filled by irrigation.

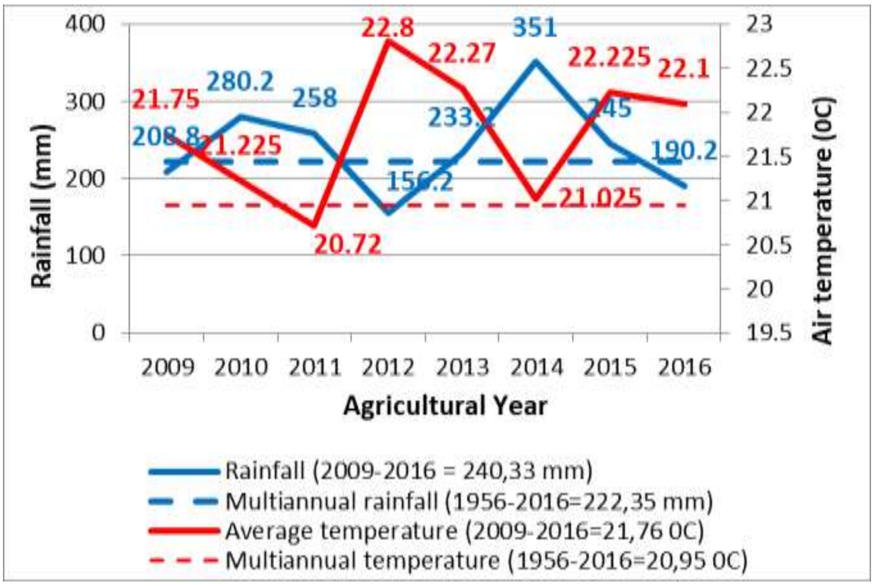

Fig. 1 - Climatic conditions recorded during the vegetation period of the cowpea (May-August)

The statistical analysis of the research results on some of the biological and productivity characteristics obtained in the Doljana variety, compared to the Jiana variety, reveals a differentiation of the degree of variability (Table 1). The Doljana variety is distinguished by the better stability of the characters pursued in the breeding process, compared to the Jiana witness. The coefficient of variation (s%) of the number of pods per plant, the number of grains in pod, the vegetation period and the production of grains, are lower in Doljana, compared to Jiana variety, which gives a better stability of these characters . Considering the length of pods and one thousand grains weight (TGW), the Doljana variety recorded higher values of the coefficient of variation, compared to the Jiana variety, but it was within the limits of the experimental error.

Table 1

The degree of variability of some biological and productivity characteristics in the Doljana cowpea variety, compared to the Jiana variety (Dăbuleni 2009-2016)

Variety	Statistical analysis	No. pods / plant	No. Grains / pod	Length of pods cm	Vegetation period -days-	Production Kg/ha	TGW g
Jiana (control variety)	Variation limits	6-12.8	9.2-13.7	14.2-18.4	99-119	1452-2142	154-195
	Average	9.09	11.53	16.26	108.5	1803.6	172.13
	Standard deviation(σ)	2.4	1.65	1.24	7.53	220.65	14.52
	Coefficient of variation (s%)	26.41	14.35	7.63	6.94	12.23	8.43
Doljana	Variation limits	14.3-23	8.2-12.7	11.4-16.2	93-104	2421-2900	113-150
	Average	19.35	11.23	14.2	97.12	2697	129.5
	Standard deviation(σ)	2.89	1.54	1.49	3.47	177.61	11.64
	Coefficient of variation (s%)	14.97	13.69	10.49	3.58	6.5	8.98
					LSD 5%	561.6	
					LSD1%	829.5	
					LSD 0.1%	1282	

The analysis of the correlated distributions of the yields obtained in Doljana variety compared to the Jiana variety for a period of 8 years shows the superiority of the Doljana variety, whose production variation was lower (coefficient of variation 6.5% versus 12.23%), which gives a better stability of the harvests of this variety (Figure 2). Also, the Doljana variety recorded a production difference of 893.4 kg / ha, statistically insured as significant.

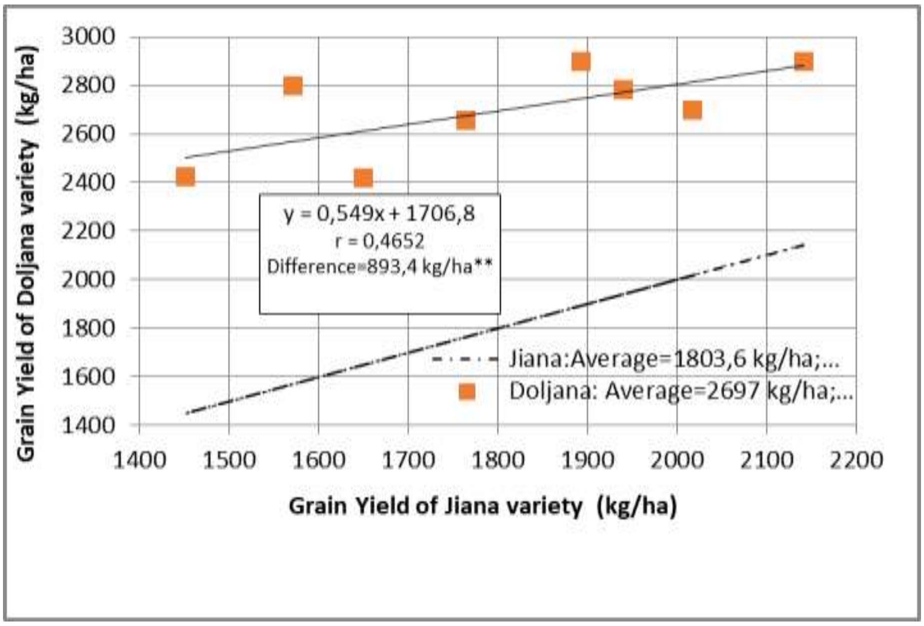

Fig. 2 - Comparison of the yields of grains obtained in the Jiana and Doljana varieties (Dăbuleni 2009-2016)

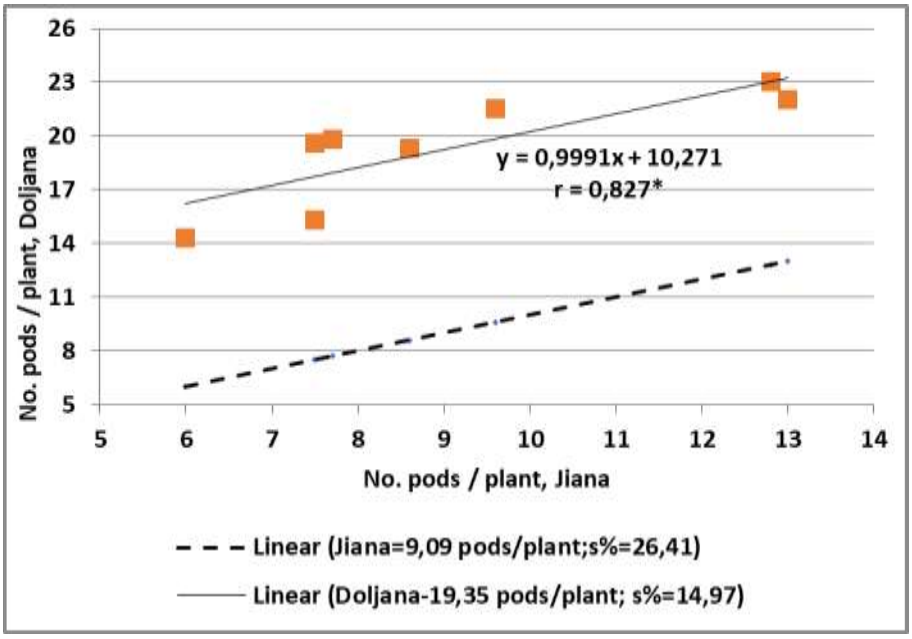

Fig. 3 - Comparison of the number of pods / plant registered in the Jiana and Doljana (Dăbuleni 2009-2016)

The weight of the grain is a variety characteristic, which varies depending on the climate and technological factors (Figure 4). However, the two varieties were experimented under the same conditions, which shows that the genetic material is the basis of the weight values of a thousand grains. The Doljana variety has on average a TGW value of 129.5 g, and the Jiana variety has a TGW = 172.13 g. Both varieties show good stability of this productivity element (s% = 8.43-8.98). The study of the relationship between grain weight and the number of grains in the pod (Figure 5) shows a negative correlation for both varieties, but the stability of the grain number in the pod is higher for the Doljana variety (s% = 13.69).

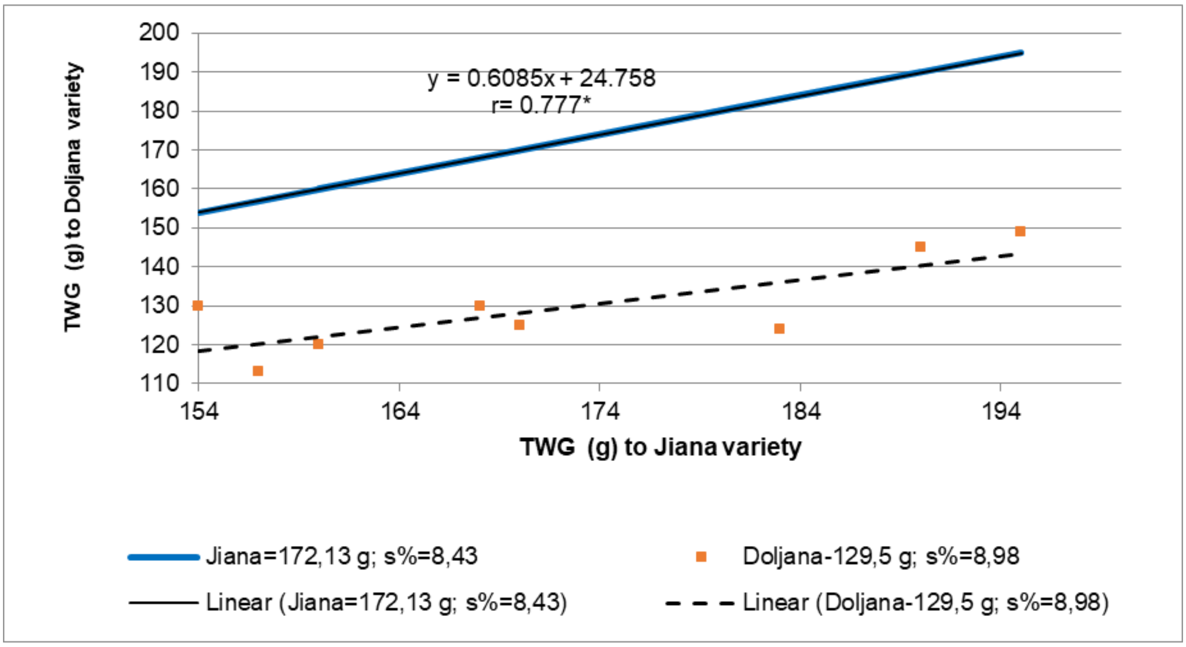

Fig. 4 - Comparison of the weight of one thousand grains (TWG) recorded in the Jiana and Doljana cowpea varieties (Dăbuleni 2009-2016)

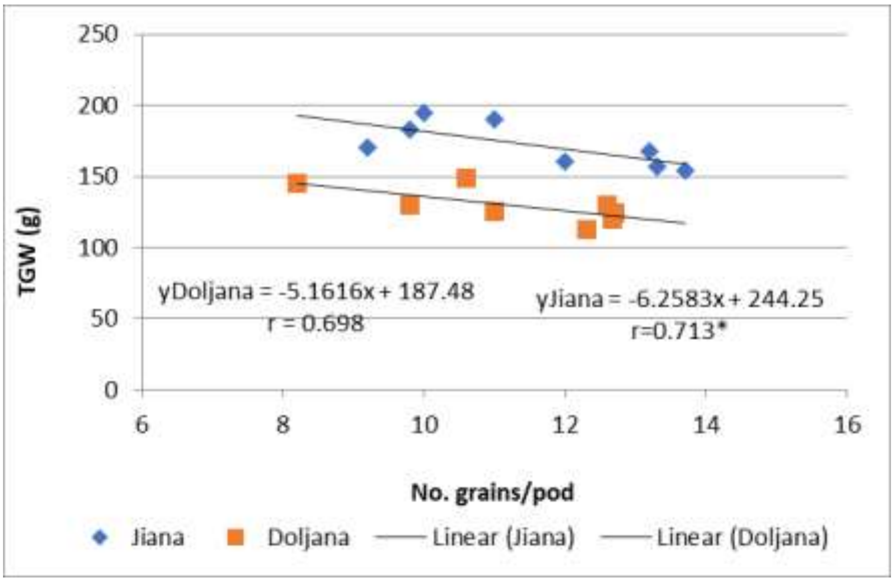

Fig. 5 - Correlation between the grain weight and the number of grains in the pods recorded in Jiana and Doljana cowpea varieties

The grain quality analysis (Table 2) highlights the higher levels of chemical components in the new Doljana variety. Compared to the control variety (Jiana), in the chemical composition of the grain to the Doljana variety there was an increase of 0.4% to the crude protein and 0.3% to the fat content. Among the morphological characteristics of differentiation of the Doljana variety, compared to the Jiana variety, there is also the colour of the grain, which is white, which gives it a more pleasant commercial appearance. The boiling time and the percentage of shells of the Doljana grains are lower compared to the Jiana variety, which determines the consumer's appreciation.

Table 2

The qualities of the grain in the Jiana and Doljana cawpea varieties (Dăbuleni 2009-2016)

Variety	Crud Protein (%)	Fats (%)	Shells (%)	Colour of the grain	Boiling time (minutes)
Jiana	21.8	2.2	11.36	Brown-red	85
Doljana	22.2	2.7	7.52	White	60

CONCLUSIONS

The Doljana cowpea variety is suitable for the conditions of sandy soils, achieving an average grain yield of 2697 kg / ha, with a statistically significant difference, as distinctly significant, compared to the Jiana variety witness and an early harvest of about 11 days.

Doljana variety of cowpea are distinguished by good stability of the elements of productivity (s% = 8.98 to 14.97) and the production of grain (s% = 6.5).

The quality of the grains in the Doljana variety is superior to the Jiana control variety, due to the pleasant commercial appearance (white color), the reduced boiling time, the percentage of the smaller shells and the higher content in the crude protein (22.2%) and the fats (2.7%).

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PRELIMINARY RESULTS REGARDING THE INFLUENCE OF SOWING AND SEEDBED PREPARATION WORKS ON THE PRODUCTION OF RYE
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REZULTATE PRELIMINARE PRIVIND INFLUENȚA SEMĂNATULUI ȘI A LUCRĂRILOR DE PREGĂTIRE A PATULUI GERMINATIV ASUPRA PRODUCȚIEI LA SECARĂ

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Keywords: *sand, period of sowing, density, productivity, quality.*

ABSTRACT
The sandy soils from southern Oltenia provide a favorable microclimate for growing rye, a plant that capitalizes very well the poor lands within the sandy soils category. Having a well-developed radicular system with a high absorption capacity, rye is a little pretentious plant to the natural fertility of the soil, being recommended in crops on those lands, that are unfavorable to wheat crops. The study, initiated in 2015, in the conditions of sandy soil at the Development Research Center for Agricultural Plants on Sands, Dabuleni, highlights the importance of technological factors, respectively: soil works, sowing season and plant density, on the results obtained in the autumn rye. Under the conditions of 2016, the rye culture recorded a maximum yield of 3774 kg / ha by sowing in September 15, providing a density of 500 germinable seeds / square meter *and a germination bed prepared by a* plowing at a depth of 22-25 cm + disked at a depth of 10-15 cm*. Grain production, obtained from rye produced in this experimental variant, had the following qualitative parameters: Crude protein - 12.6%, Gluten-22%, Zeleny - 32 ml, Falling Number - 330 s.*

REZUMAT
Zona solurilor nisipoase din sudul Olteniei asigură un microclimat favorabil pentru cultura de secară, plantă care valorifică foarte bine terenurile sărace, din categoria solurilor nisipoase. Având un sistem radicular bine dezvoltat, cu o mare capacitate de absorbție, secara este o plantă puțin pretenţioasă faţă fertilitatea naturală a solului, fiind recomandată în asolamente pe acele terenuri care sunt nefavorabile culturii grâului. Studiul inițiat în anul 2015, în condițiile unui sol nisipos de la Centrul de cercetare Dezvoltare pentru Cultura Plantelor pe Nisipuri Dăbuleni subliniază importanța unor factori tehnologici, respectiv lucrările solului, epoca de semănat și densitatea plantelor, asupra rezultatelor obținute la secara de toamnă. În condițiile anului 2016, secara a înregistrat un maxim de producție de 3774 kg/ha prin semănatul pe 15 septembrie, asigurând o densitate de 500 b.g./mp și un pat germinativ pregătit printr-o lucrare de arat la adâncimea de 22-25 cm + discuit la 10-15 cm. Producția de boabe obținută în cadrul acestei variante experimentale a avut următori parametri calitativi:Proteina brută -12,6%, Gluten- 22%, Indicele Zeleny- 32 ml, Indicele de cădere (Falling Number) - 330 s.

INTRODUCTION
Rye recovered well the poor land, being less demanding due to deep root system and large absorption capacity. It succeeds on soils where wheat does not give results, such as sandy soils (*Matei Gh. et al., 2009*). After wheat, rye is the second grain used to make bread. Having a chemical composition similar to that of wheat, rye flour is used to prepare bread, called "Graham Bread". Rye bread is darker than wheat, it has a specific taste, slightly sour and less digestible. The soil works for autumn cereals must ensure: the accumulation and preservation in the soil of all the water from the summer and autumn rainfall; the accumulation of as much nutrients as possible in the soil by stimulating nitrification processes; a loose soil layer, but at the same time "settled" for the good rooting of the plants and for the prevention of the "dismantling" process; a seed bed without germination where the seed can contact as closely as possible with soil particles, to grow in a short time and to control weeds, diseases and pests, that cause great damage to the productions (*Lupu, 2009*).

Studying in parallel the classic soil and no-till system for 10 years on a clay-sandy soil, *Curaqueo G. et al. (2011)* observe that apparent density and soil porosity were not significantly influenced by the work carried out, but higher values are noted in the unconventional system of work and increase with depth, results confirmed by Martinez E. et al. (2008). Generally, it appears that soil that has been working for many years in a no-tillage system leads to increased apparent density due to traffick of sowing machines (*Botta G.F. et al., 2009, Guş, P. et al., 2007*), at the same time soil porosity decreases, a phenomenon associated with the reduction of the O_2 reserve necessary for heterotrophic microbial decomposition (Alvaro-Fuentes, J. et al., 2008), thus explaining the large quantities of organic matter accumulated. Compaction can adversely affect plant growth due to increased resistance to soil penetration, which may restrict the development of roots, decrease drainage and water movement in the soil, or loss of nutrients, with direct implications for crop development and level of production. Compaction of soil can also play a role in environmental pollution, such as favoring greenhouse gas emissions (*Ball et al., 1999*).

MATERIAL AND METHOD

The researches were carried out under the terms of the agricultural year 2015/2016, at Dabuleni Development & Research Center for Agricultural Plants on Sand and focused on the implications of the sowing and the soil works on the production of rye in the conditions of sandy soils in southern Oltenia. The experiment was organized according to the parcel subdivision method with three factors: Factor A - soil works (Disked at a depth of 10-15 cm, Scarified at a depth of 55-60 cm, Plowing at a depth of 22-25 cm + Disked at a depth of 10-15 cm); Factor B - the sowing season with three graduations (5 September, 10 September, 15 September); Factor C - sowing density (400 germinable seeds / square meter (g.s./s.m.), 450 germinable seeds / square meter, 500 germinable seeds / square meter. The rye culture was set up on a sandy soil with reduced natural fertility, being poorly supplied in total nitrogen (0.05-0.07%), medium to normal supplied in extractable phosphorus (33-65 ppm), reduced to medium supply in exchangeable potassium (50-121 ppm) and a strong acidic reaction (pH_{H2O} = 4.66-4.79) (Table 1). Analysis of grain quality (protein, wet gluten, Zeleny sedimentation index, Falling number) were made in the laboratory by Perten method. Production and quality results were calculated and interpreted statistically using mathematical functions and variance analysis.

Table 1

Characterization of the state of supply of soil with the main macroelements and organic matter

The depth of the soil	*Total Nitrogen %*	Extractive Phosphorus *(P-AL) ppm*	Potassium changeable *(K-AL) ppm*	*Organic carbon %*	*pH in water*
0-30 cm	0.05	65	64	0.71	4.66
30-60 cm	0.07	33	50	0.07	4.89
60-90 cm	0.07	81	121	0.07	4.79

RESULTS

Analyzing the climatic conditions recorded at the D&RCAPS Dăbuleni weather station (Figure 1), these were favorable for the growth and development of rye plants, within the biological requirements of the plant (the minimum seed germination temperature of 1-2 degrees Celsius, the sum of the temperatures of 1800-2000 °C during the growing season, and in winter the young plants bear temperatures up to -20 degrees Celsius, without being covered by snow).

During the vegetation period of the rye culture (September 2015 - July 2016) there was an average air temperature of 12.4 ° C, higher by 2.05 ° C compared to the multiannual average, thus noticing the arid climate in the area of sandy soils. Although the precipitations have exceeded the multiannual average by about 256.1mm, they have been unevenly distributed over the growing period of the rye, it is necessary to fill the hydric water deficit through a watering of 250 m^3 water / ha, applied during the accumulation period of the dry substance in the bean.

The study, initiated in 2015 under the conditions of a sandy soil at the Development & Research Center for Agricultural Plants on Sands Dabuleni, highlights the importance of the soils works the role of sowing on the results obtained in the autumn rye (Table 2). The best production results were recorded by sowing the rye on September 15, ensuring a density of 500 germinable seeds / square meter and a germinated bed prepared by a plowing + discarding (3774 kg / ha). The differentiation of the soil preparation mode for the sowing of the rye culture influenced the production, so that the highest average production of 3008.45 kg / ha was recorded in the soil preparation by plowing at a depth of 22-25 cm + disked at a depth of

10-15 cm works, with a difference significant 309.78 kg / ha compared to the work only by disking at a depth of 10-15 cm and 124.34 kg / ha compared to scarified work at a depth of 55-60 cm.

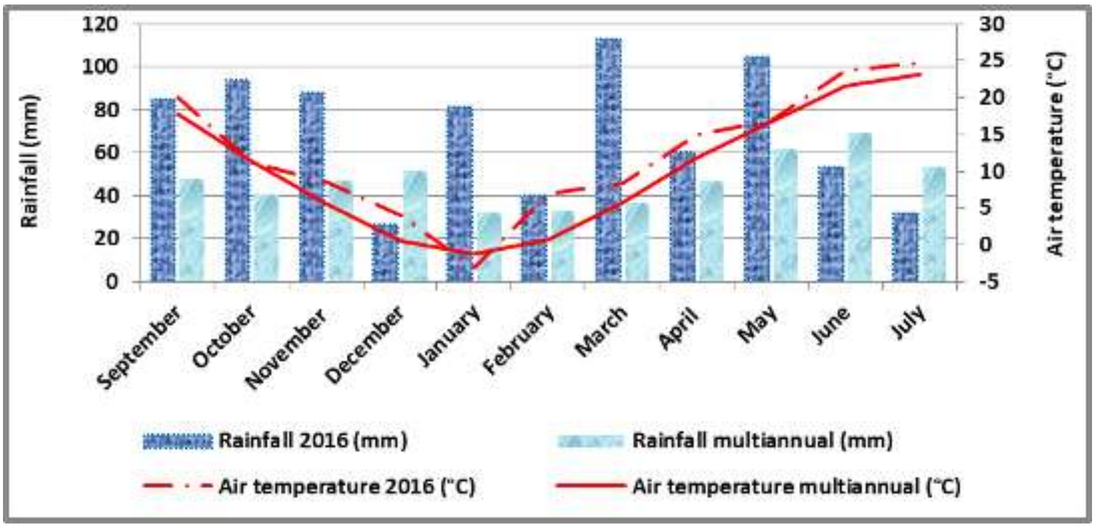

Fig. 1 - Climatic conditions during the growing of rye, 2015-2016

Table 2

The production of grains obtained in the autumn rye depending on the soil works and the sowing of the plant

Sowing variants		***Grain Yield (kg/ha)***			
Period	*Density*	*Disked*	*Scarified*	*Plowing+disked*	*Average*
05 September	400 g.s./s.m.	2223	2254	2422	2299.7
	450 g.s./s.m.	2454	2454	2584	2497.3
	500 g.s./s.m.	2887	3054	3144	3028.3
Average epoch I		2521.33	2587.33	2716.67	2608.4
10 September	400 g.s./s.m.	2484	2544	2655	2561
	450 g.s./s.m.	2814	2888	2916	2872.7
	500 g.s./s.m.	2954	3488	3624	3355.3
Average epoch II		2750.67	2973.33	3065	2929.7
15 September	400 g.s./s.m.	2602	2625	2688	2638,3
	450 g.s./s.m.	2924	3125	3269	3106
	500 g.s./s.m.	2946	3525	3774	3415
Average Epoch III		2824	3091.67	3243.67	3053.11
Average soil works		2698.667	2884.11	3008.45	
LSD 5%		252	287	267	
LSD 1%		321	332	314	
LSD 0.1%		384	398	377	

Compared to the September 5 seeding, the production increase of 404.67-527 kg / ha is noticeable when sowing on September 15 in all variants of soil work (Figure 2). The production of rye is influenced by the number of plants harvested, registering increases of 596-926 kg / ha, by providing for the sowing of 500 germinable seeds / square meter, compared to the density of 450 germinable seeds / square meter (Fig. 3).

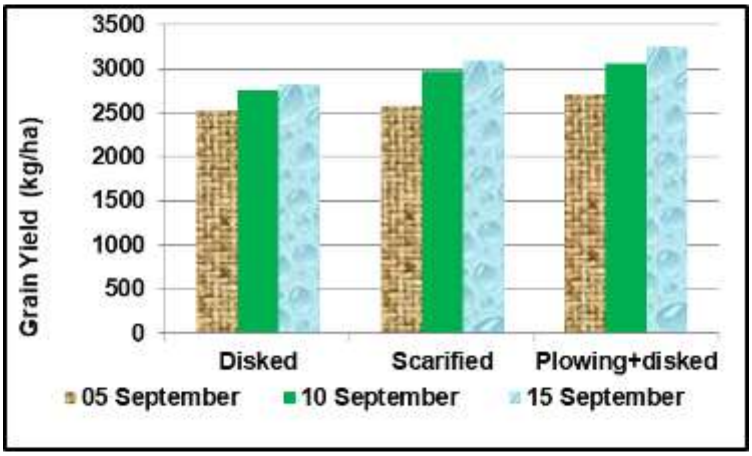

Fig. 2 - The yield obtained on rye depending on the sowing season and the soil works

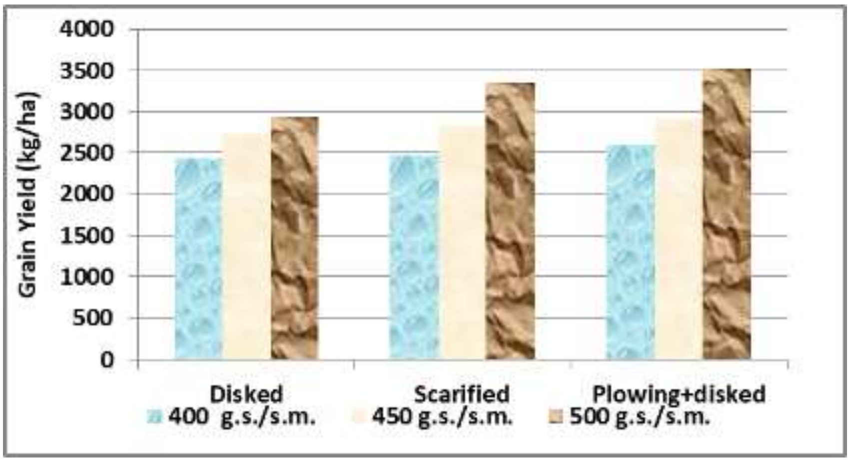

Fig. 3 - The yield obtained on rye depending on sowing density and soil work

Mathematical analysis using polynomial functions emphasizes great functional links between grain production and experimental factors studied in rye (Figure 4). Significant positive correlations are highlighted between the production obtained in the three soil cultivation methods and the different sowing variants (r = 0.722 * -0.782 *). Rye grain production is also dependent on the weight of one thousand grains (TGW), with a significant positive correlation represented by a linear function (Fig. 5).

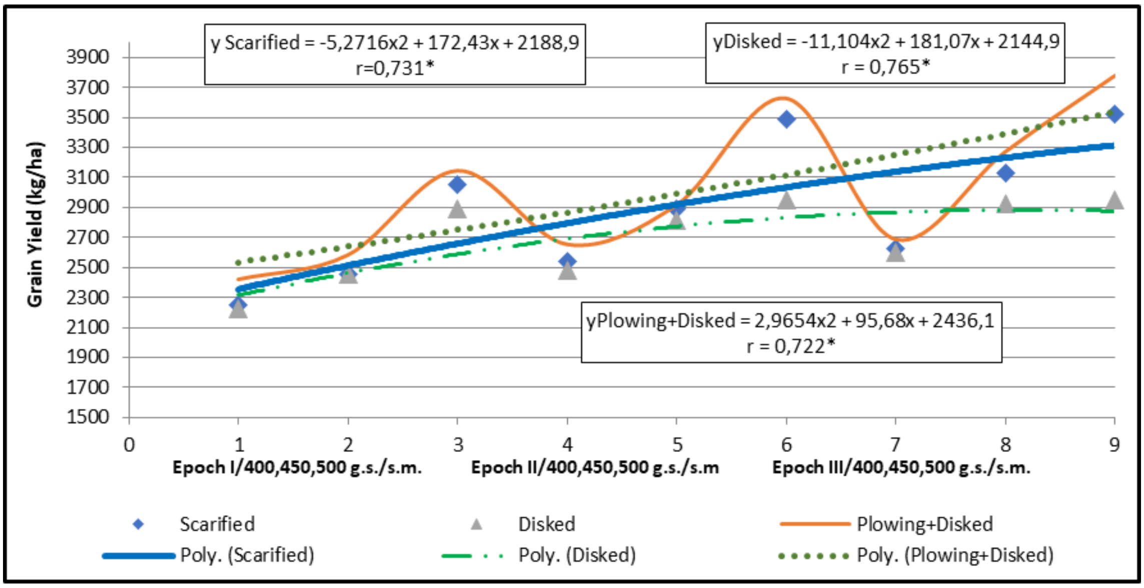

Fig. 4 - Correlations between production and different sowing variants in rye culture studied within soil work systems

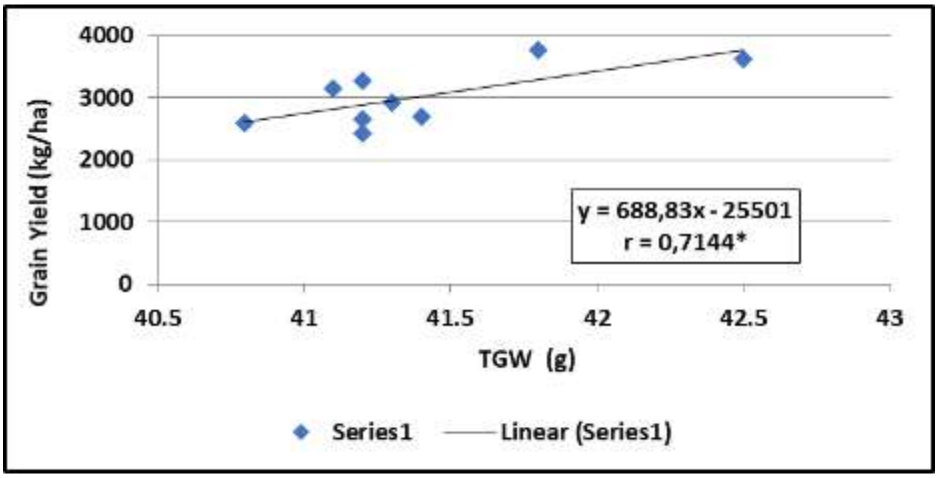

Fig. 5 - Correlation between production and the weight of one thousand grains (TGW) for autumn rye grown under sandy soil

Analysis of the quality of grain rye in working the soil by plowing + disking variant, shows differentiation of the protein content, gluten index Zeleny and of the Falling test, depending on the period and density of seeding (Table 3). Iuliana Banu, 2003 shows that the protein content of rye can be a good indicator of its baking quality. The chemical composition of the grains of rye, shows the values of crude protein in the range of 10.1 to 12.6%, with a tendency to increase with increased density of plants and sowing in the optimal period of 15 September.

The content of wet gluten grains and the Zeleny sedimentary index are very important quality indicators for the technological process, contributing to the characterization of the dough, especially the processing capacity and its baking potential. With a high gluten content of 22%, we noticed the sowing variant in Sept. 15, at which the Zeleny sedimentation index recorded values of 31.5-32 ml. Fall index values (Falling Number test) were in the range of 329-347 seconds, revealing a deficiency of alpha-amylase activity but that can be corrected in the process.

Table 3

The quality of rye harvest, depending on the time and density used for sowing, in the *Plowing+disked* variant

Period of sowing	Density	Protein (%)	Gluten (%)	Zeleny index (ml)	Falling Number (s)
05 September	400 g.s./s.m.	10.1	21.9	34	347
	450 g.s./s.m.	11.2	21.8	32	338
	500 g.s./s.m.	12.3	22	32	329
Average		***11.2***	***21.9***	***32.67***	***338***
10 September	400 g.s./s.m.	10.3	21.8	32	343
	450 g.s./s.m.	11.6	21.8	33	329
	500 g.s./s.m.	12.4	21.9	33	331
Average		***11.43***	***21.83***	***32.67***	***334.33***
15 September	400 g.s./s.m.	10.4	22	31.5	336
	450 g.s./s.m.	12.2	22	32	332
	500 g.s./s.m.	12.6	22	32	330
Average		***11.73***	***22***	***31.83***	***332.67***

CONCLUSIONS

The differentiation of the soil preparation mode for the sowing of the rye culture influenced the production, so that the highest average yield, of 3008.45 kg / ha, was recorded in the soil preparation by the works Plowing at a depth of 22-25 cm + Disked at a depth of 10-15 cm, with a significant difference of 309.78 kg / ha, compared with Disked work at a depth of 10-15 cm and a insignificant difference of 124.34 kg / ha, compared to the 55-60 cm Scarified work at a depth a 55-60 cm.

We showed a significant positive correlation between the yield obtained from the three methods of working the soil and sowing different variants (r = -0.782 * 0.722 *).

Rye production recorded a maximum of 3774 kg / ha, by sowing in September 15, providing a density of 500 b.g./mp a prepared seed bed by Plowing at a depth of 22-25 cm + Disked at a depth of 10-15 cm. The grain yield obtained in this experimental variant had the following qualitative parameters: Crude protein - 12.6%, Gluten - 22%, Zelenny - 32 ml index, Falling Number - 330 s.

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INFLUENCE OF THE PLANTING TIME IN FIELD ON THE TUBERS PRODUCTION OBTAINED FROM SWEET POTATO VARIETIES UNDER THE CONDITIONS OF SANDY SOILS
/
INFLUENȚA EPOCII DE PLANTARE ÎN CÂMP ASUPRA PRODUCȚIEI DE TUBERCULI OBȚINUTĂ LA UNELE SOIURI DE CARTOF DULCE ÎN CONDIȚIILE SOLURILOR NISIPOASE

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Keywords: *production, biometrics, physiology, quality.*

ABSTRACT
Sweet potato is a plant well suited to tropical and subtropical climates but can grow successfully in a wide range of climatic conditions in which the average of the cold season is not more than 5 months. Taking into account the plant biological requirements the sweet potato culture finds favorable conditions for growth and development in areas with sandy soils in Romania. The researches carried out during the period 2015-2016 at the Development Research Center for Agricultural Plants on Sands, Dabuleni highlights the variety and the planting time in the field as determining factors in plant productivity. The results obtained from five sweet potato varieties (Yulmi, Juhwangmi, Hayanmi, KSP 1 and KSC 1) studied during 3 planting times (10-15 May, 25 May-05 June, 10-15 June) highlight the variety Juhwangmi, planted in the first period with an average production over the two years of 43,750 kg / ha. The delay of planting of sweet potato shoots in the field diminishes the tuber production by 13,068.27 kg / ha. Also, the percentage of the commercial tuber (with a diameter of more than 3 cm) decreases along with the planting delay in the field. The results on the monitoring of the physiological reactions of the sweet potato plant, emphasize the influence of the planting time on the processes of photosynthesis and perspiration depending on the variety.

REZUMAT
Cartoful dulce este o plantă bine adaptată la climate tropicale și subtropicale, dar poate crește cu succes într-o gamă largă de condiții climatice în care media sezonului rece sa nu fie mai mare de 5 luni. Prin cerințele biologice ale plantei cultura de cartof dulce găsește condiții prielnice de creștere și dezvoltare în zonele cu soluri nisipoase din România. Cercetările efectuate în perioada 2015-2016 la Centrul de Cercetare Dezvoltare pentru Cultura Plantelor pe Nisipuri, Dăbuleni subliniază soiul și epoca de plantare în câmp ca factori determinanți în productivitatea plantei. Rezultatele obținute la cinci soiuri de cartof dulce (Yulmi, Juhwangmi, Hayanmi, KSP 1 și KSC 1) studiate în cadrul a 3 epoci de plantare în câmp (10-15 Mai, 25 Mai-05 Iunie, 10-15 Iunie) evidențiază soiul Juhwangmi, plantat în cadrul primei epoci cu o producție medie pe cei doi ani de 43750 kg/ha. Întârzierea plantării în câmp a lăstarilor de cartof dulce determină diminuarea producției de tuberculi cu 13.068,27 kg/ha. Deasemenea procentul de tubercul comerciabili (cu diametru peste 3 cm) scade odata cu întârzierea plantării în câmp. Rezultatele privind monitorizarea reacțiilor fiziologice ale plantei de cartof dulce, subliniază influența epocii de plantare asupra desfășurării proceselor de fotosinteză și transpirație în funcție de soi.

INTRODUCTION
Ipomoea batatas L. (Lam.) is an important plant grown for food security in many of the poorest regions of the world, being tolerant to a wide range of edaphic and climatic conditions (*Woolfe, 1992, Lebot, 2009*) . In Asia, sweet potato is a very important crop for starch production. Approximately 74.3% of total sweet potato production is produced in Asia (*FAO, 2014*), and China is the largest sweet potato producer. Bitter nutrition and fiber (of which 40% soluble fiber, which help to lower blood sugar and cholesterol), sweet potato is the ideal food for diabetics, pregnant women and children (*Betty J. Burri, 2011*). The usefulness of the sweet potato plant is also expanded in cows' diet, the use of cheese as a supplement to a basal diet of other fodder, increasing milk production (*Etela et al., 2008*). Researches conducted in Louisiana by Ramón A.

Arancibia et al., 2014, show that the yield of sweet potato production depends on the planting season, pointing out that it was 47% higher at early planting (1-7 June) compared to late planting (June 30 - July 8). Also, the biologic material planted by the use of varieties with a different vegetation period, contributes to the resumption of supply on the sweet potato market (Mohammed Ahmed et al., 2012). The values of the physiological indexes of the sweet potato cultivated in the climatic conditions of the sandy soils in southern Oltenia showed that it easily adapts to the conditions with a thermal excess, being a loving plant of heat and light (*Aurelia Diaconu et al., 2017*).

MATERIAL AND METHOD

Research on sweet potato culture was carried out between 2015 and 2016 at CCDCPN Dabuleni, on a sandy soils, poorly supplied with (0.05-0.0) nitrogen, well supplied with phosphorus (73 ppm and 103 ppm), reduced to medium potassium (59 ppm and 94 ppm), low in organic carbon (0.12% - 0.48%), and a soil reaction (pH) slightly acid to neutral (pH =5.6 and 6.93). The purpose of the research was to determine the moment of field planting of different varieties of sweet potatoes of Korean origin. The experience was based on the parcel sub-division method with two factors. There were studied 3 planting periods (10-15 May, 25 May to 5 June, 10-15 June) to five sweet potato genotypes: Yulmi, Juhwangmi, Hayanmi, KSP 1, KSC 1. The experience was established in the field by seedlings obtained in solarium with double protection by planting of tubers during March 20-25. At 35-40 days of growing, the shoots were cut, kept for 24 hours at room temperature and then on the 2 nd day, after 17 o'clock, they were planted on ridged field, the mulch foil PPE and drip irrigation system. During the vegetation period, in the root tuberization phase, it was determined photosynthesis rate and leaf perspiration rate at leaf level with the LCpro + Portable Photosynthesis System, in 3 moments of the day. At harvest, were determined the tuber production and quality, as follows: water content and total dry substance (%) by gravimetric method; Soluble dry substance content (%) by refractometric method; Simple soluble glucosides (%) by Fehling Soxhlet method; Vitamin C content (mg / 100g s, p) by iodometric method; Starch content (%) by gravimetric method. The obtained results were interpreted by the analysis of variance and mathematical functions.

RESULTS

Analyzing the climatic conditions during the growing of sweet potato (May-September), it highlights increased drought in the studied period, compared to the multiannual average, recording a plus of 1.49 ° C (Figure 1). Under these circumstances, the choice of species and genotypes are essential factors in practising an efficient agriculture system in drought areas. The five sweet potato varieties, experienced in the sandy soils in southern Oltenia, in the phenophases of vegetation have gone through at an average air temperature of 21.81^{0}C, by accumulation in the soil of approx. 278.8 mm of rainfall. Although it is a drought-tolerant plant that can survive longer drought periods in summer, the sweet potato plant needs moisture in the soil for normal physiological processes (*Drăghici Reta et al., 2013*). Therefore, soil moisture deficiency was completed by irrigation using the drip method to provide 80% of the active humidity range.

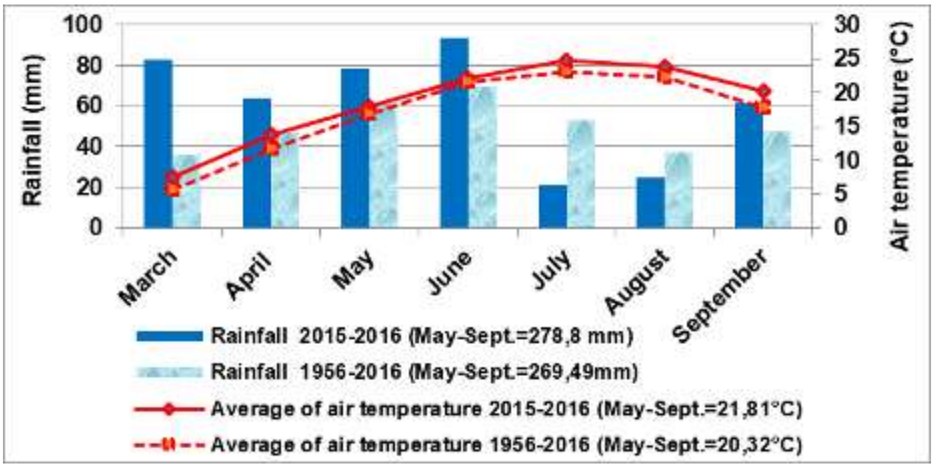

Fig. 1 - Climatic conditions of the growing season of sweet potatoes cultivated under the conditions of sandy soils

Analyzing the production of tubers obtained from the 5 varieties of sweet potatoes, harvested 120 days after planting of the shoots, according to the planting age, there are significant and very significant statistically differences in production (Table 1). The maximum yield (43,750 kg / ha) was recorded in the Juhwangmi variety planted on May 10-15. Also, all 5 varieties of sweet potato have made better use of pedoclimatic conditions by early planting in the 1st age. Compared to the control variety, KSP 1, production differences statistically ensured for the Yulmi and Juhwangmi varieties. Planting delay of 30 days, has led to a decrease in average production of all sweet potato varieties in the following percentages: 44.7% in the Yulmi variety, 34.2% in the Juhwangmi variety, 32.2% in the Hayanmi variety, 47.1% in the KSP 1 variety, and 42.1% for KSC 1 variety. The late planting caused a decrease of 13,068.27 kg / ha in the average production of the five varieties. The main cause of these losses is the high percentage of plants that have perished due to atmospheric drought, although the soil has been permanently dripped. Also, the late planting of the shoots led to a reduced percentage of tubers, because many of the plant's roots did not tuberize anymore, they only increased in length.

Table 1

Influence the time of planting and variety on the tuber production obtained in sweet potato under the conditions of sandy soils in southern Oltenia

Planting period	Variety	Kg/ha	Difference kg/ha	Significance
Planted on May 10-15	Yulmi	36400	5833.5	*
	Juhwangmi	43750	13183.5	***
	Hayanmi	24499.84	-6066.66	00
	KSP 1 (Mt)	30566.5	0	Mt
	KSC 1	28000	-2566.5	-
Planted on 25 May-05 June	Yulmi	34781.25	14656.25	***
	Juhwangmi	42287.5	22162.5	***
	Hayanmi	22636.25	2511.25	-
	KSP 1 (Mt)	20125	0	Mt.
	KSC 1	19600	-525	-
Planted on June 10-15	Yulmi	20113.75	3960	*
	Juhwangmi	28787.5	12633.75	***
	Hayanmi	16601.25	447.5	-
	KSP 1 (Mt)	16153.75	0	Mt.
	KSC 1	16218.75	65	-

LSD 5%= 4417.2 kg/ha
LSD 1%= 5889.7 kg/ha
LSD 0.1%= 7669.8 kg/ha

The percentage of commercial tubers (tubers> 3 cm in diameter) ranges from 62.79-94.78%, differentiated according to variety and planting age (Figure 2). The highest values were registered for the Juhwangmi variety (90.06-94.76%), regardless of the planting epoch, and the lowest percentage of commercial tubers of 62.79% was recorded for KSP 1, planted on June 10-15. The functional link between plant variants of the five varieties in three calendar periods is reproduced through a polynomial function, showing a significant negative correlation (r = -0.569 *), and demonstrating that the plantation delay leads to a decrease in the percentage of tubers larger than 3 cm in diameter.

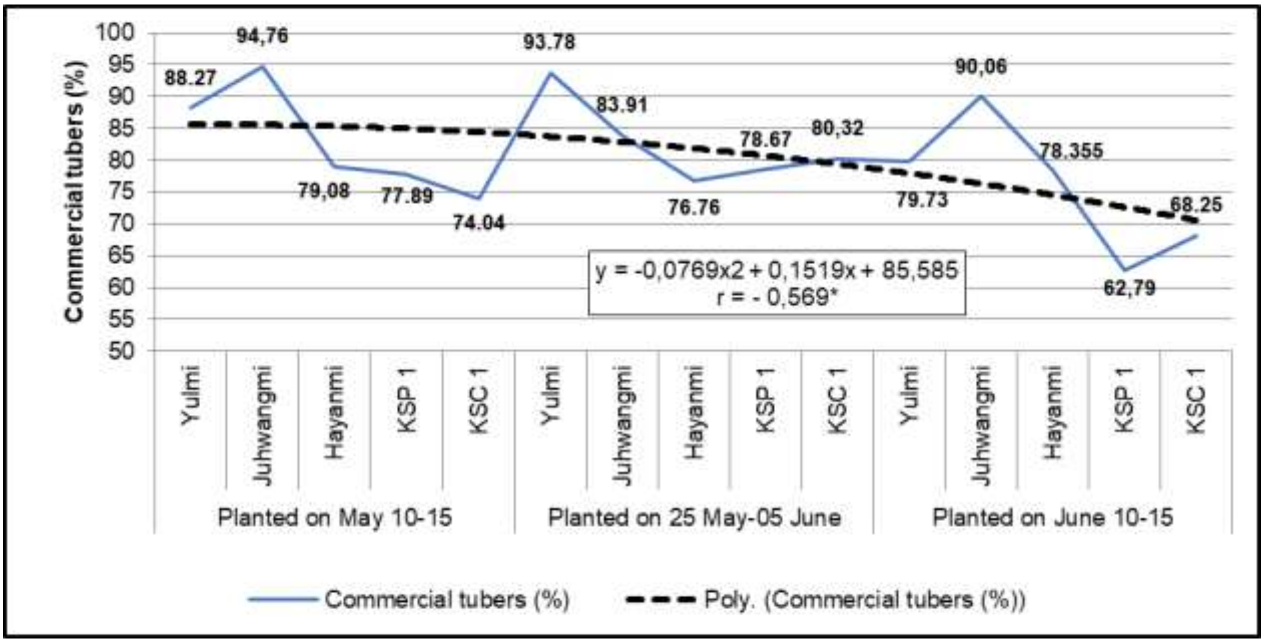

Fig. 2 - Influence of the planting season of some potato varieties on the percentage of commercial tubers (diameter> 3 cm)

The results on the monitoring of the physiological reactions of the sweet potato plant underline the influence of the planting age on the photosynthesis and perspiration processes according to the variety (Figure 3). At the stage where the sweet potato plant is in the process of growing and developing and tuberizing the root, it is observed that the highest values of the rates of photosynthesis were recorded in the Juhwangmi variety planted on May 10-15 (30.32 μmol $CO2$ / $m2$ / s), when plants lost most of the water through sweat (4.82 mmol $H2O$ / $m2$ / s. Climatic conditions have had a decisive role in the physiological processes of the plant (Table 3). The process of photosynthesis is positively related to the photosynthetic active radiation and plant transpiration increases with the temperature recorded at the leaf surface.

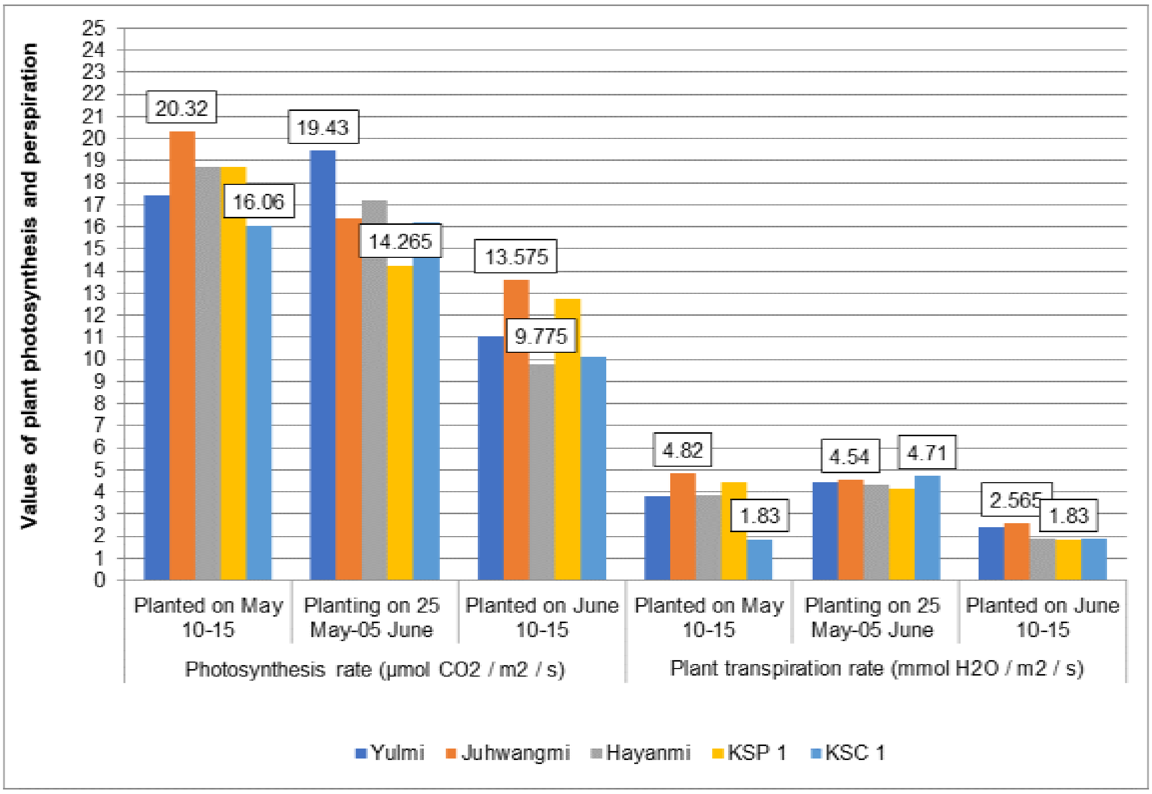

Fig. 3 - Variation of physiological processes in some sweet potato varieties depending on the season of planting of shoots in the field

Table 2

Climatic conditions recorded at physiological determinations of sweet potato plants

Photosynthesis rate (µmol CO_2 / m^2 / s)			Plant transpiration rate (mmol H_2O / m^2 / s)		
Epoch I	Epoch II	Epoch III	Epoch I	Epoch II	Epoch III
18.246	16.695	11.448	3.748	4.433	2.113
Radiation active in photosynthesis (µmol $m^{-2}s^{-1)}$			Temperature at leaf level (^{0}C)		
460.2-1710.6	947-1857	480-1666.7	28-35.4	29.4-36.3	28-31.7

The correlation analysis. established by the 2 nd grade polynomial function between the daily average values of the sweat and the photosynthesis of the sweet potato plant reveals a distinct significant positive functional relationship (r = 0.8785 **), which shows that the Juhwangmi variety, although registered a maximum of perspiration of the plant the water lost through sweating was efficiently utilized by the accumulation of dry matter (Figure 4). Between the plant photosynthesis rate and the tuber production obtained in the five varieties of sweet potatoes planted in three epochs there is a distinctly significant positive correlation, that emphasizes the importance of the optimal planting time on the sweet potato (Figure 5).

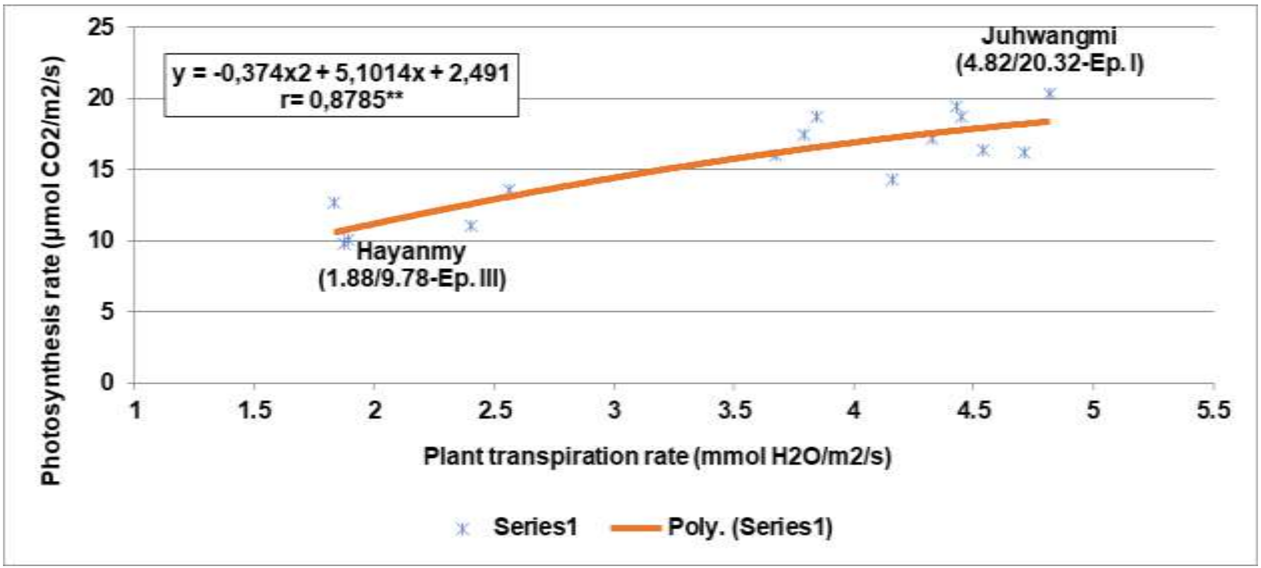

Fig. 4 - Correlation between the average values of transpiration and photosynthesis plant daily to five varieties of sweet potatoes planted at three calendar ages

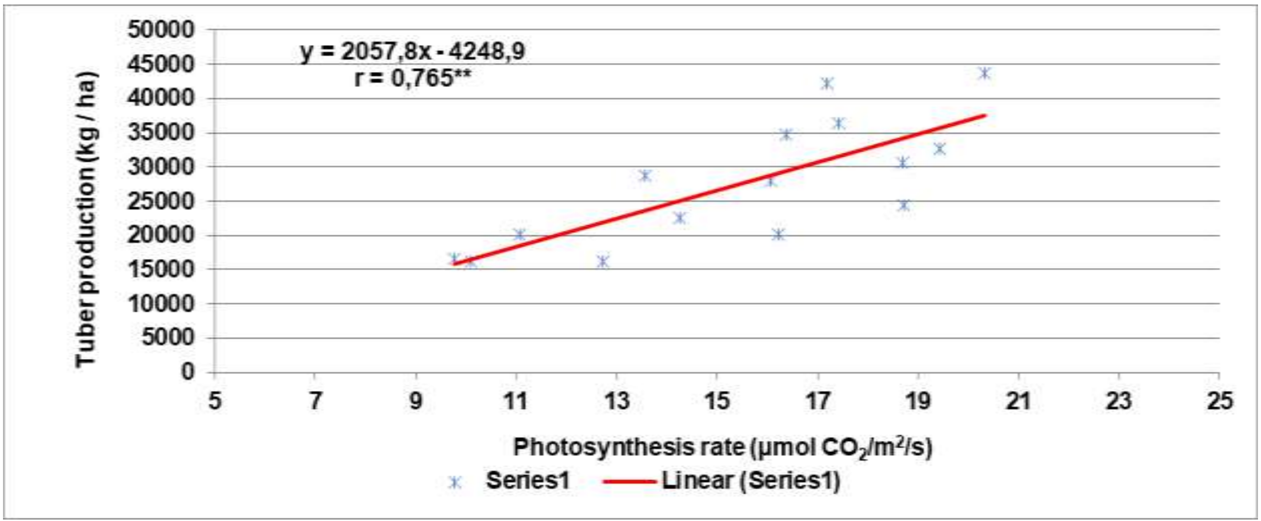

Fig. 5 - The correlation between the rate of photosynthesis and tuber production of the five varieties of sweet potato planted in three calendar periods

Biochemical determinations carried out on sweet potato tubers at 120 days after planting reveal differences in biochemical components depending on the variety and planting age (Figure 6). Thus,the total dry matter content was over 30% at all planting periods of the five varieties with a maximum accumulation (40.62%) in the Hayanmi variety planted between 10-15 May. The data from the literature show that the dry substance in the ordinary potato reaches at a maximum during the drying period of spiders and decreases if harvesting is delayed (Adina Lorinczi. 1997).

This statement also applies to sweet potatoes reaching a maximum of 100-120 from planting depending on the variety. Early varieties (Yulmi. Juhwangmi) reach the maximum at 100-110 days and late varieties at 110-120 days (*Aurelia Diaconu et al.. 2017*). Determinations on the content of sweet potato tubers in simple soluble glucosides (%)and starch show an average accumulation over the two years of 6.16-8.71% - simple soluble glucosides (%)and 10.99-19.2% - variety-dependent starch and the planting age. Regarding the average influence of the variety. the highest value of starch was recorded in the Juhwangmi variety (15.24% - the average of the three epochs). and the lowest in the KSP 1 variety (14.17%). From the point of view of the planting age. the maximum starch value was recorded at planting during June 10-15. when the accumulation phase of this chemical component coincided with the decrease of air temperatures.

These results are supported by the literature (*Gheorghe Olteanu et al.. 2011*). which shows that the average weight of a tuber and the amount of starch are higher as the soil temperature is lower. If the average soil temperature is greater than 23^{0}C. then the formation of the secondary roots is observed. Experimental sweet potato varieties did not significantly differ in terms of simple soluble glucosides content the planting time being the technological element that contributed to the major differentiation of this biochemical element. Planting delay causes reduction of the percentage of simple soluble glucosides on average by 1.39%. The C vitamin is the main vitamin synthesized by plants that participate in the processes of formation of unsaturated fatty acids, the degradation of some amino acids in carbohydrate metabolism, iron metabolism. etc. The C vitamin content of vegetables and fruits. varies very widely depending on the species, variety and agro-climatic conditions. Specialty literature highlights for ordinary potato tubers a vitamin C content of between 15 mg and 22 mg / 100 g of fresh substance with an average of 17mg / 100g f.s. (Cieslike. 1994). The results of this study show that the sweet potato tubers have accumulated in the content of C vitamin of between 6.88 mg and 10.52 mg / 100 g f.s... depending on the variety and planting time.

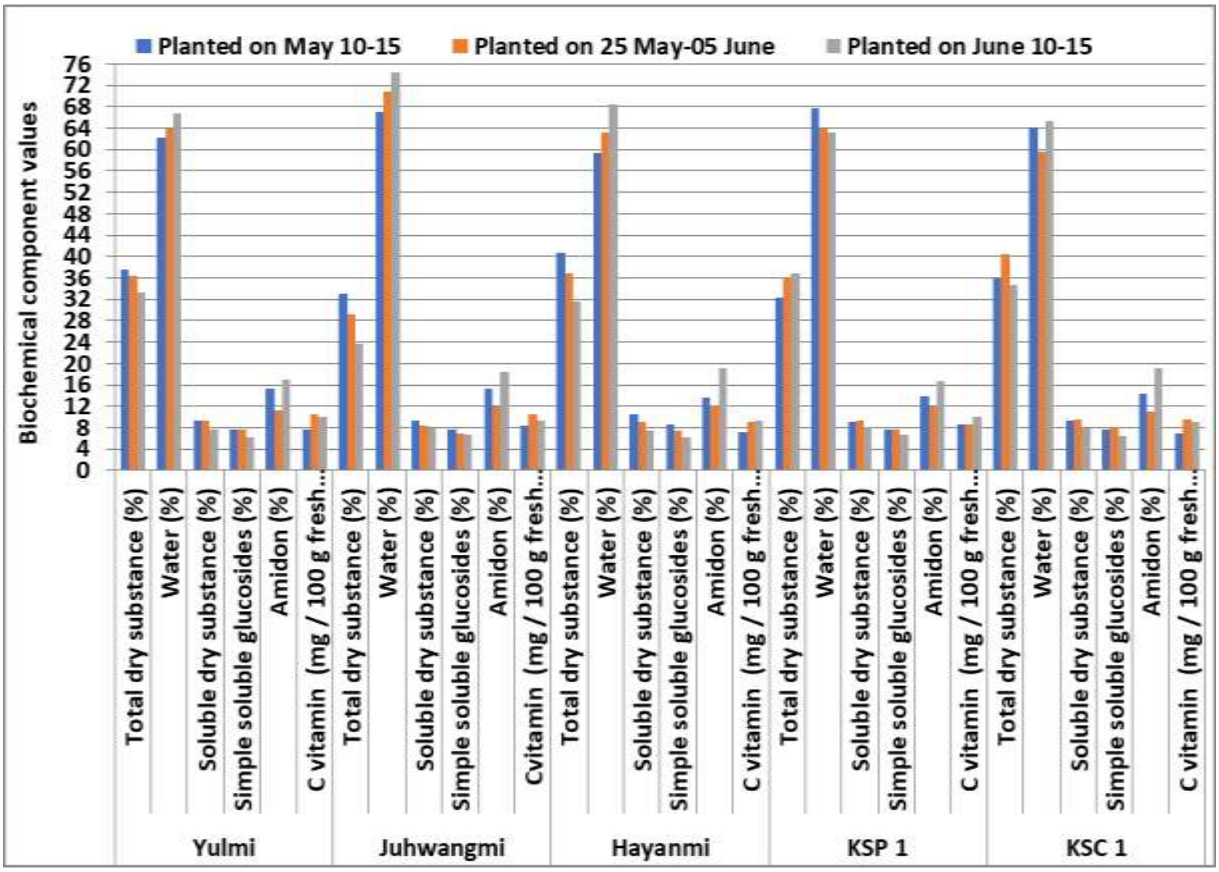

Fig.6 - Biochemical quality of sweet potato tubers depending on variety and planting time

CONCLUSIONS

By the biological requirements of the plant the sweet potato culture finds favorable conditions for growth and development in areas with sandy soils in Romania.

The results obtained in five sweet potato varieties (Yulmi. Juhwangmi. Hayanmi. KSP 1 and KSC 1) studied during 3 planting epochs (10-15 May. 25 May-05 June. 10-15 June) highlight The largest production (43.750 kg / ha) of the Juhwangmi variety planted in May 10-15 has led to a decrease in average tuber production of 13.068.27 kg / ha. and the percentage on the varieties: 44.7% for the Yulmi variety. 34.2% for the Juhwangmi variety. 32.2% for the Hayanmi variety. 47.1% for the KSP 1 variety and 42.1% for the KSC 1 variety.

The percentage of commercial tubers is between 62.79-94.78%. being differentiated according to variety and planting time.

The highest rates of photosynthesis were recorded in the Juhwangmi variety planted on May 10-15 (30.32 µmol CO_2 / m^2 / s). when the plants have lost by sweating the largest amount of water (4.82 mmol H_2O / m^2 / s).

The biochemical components of sweet potato tubers harvested at 120 days differ according to the variety and time of planting.

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STIMULATION OF TOMATO SEEDS BY INFRARED RADIATION
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СТИМУЛИРОВАНИЕ СЕМЯН ТОМАТОВ ИНФРАКРАСНЫМ ИЗЛУЧЕНИЕМ

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Keywords: *seeds, tomatoes, stimulation, infrared radiation, pulse, persistent.*

ABSTRACT
The article examines the influence of infrared radiation on sowing qualities of seeds and tomatoes growth. The assessment of sowing qualities of seeds being irradiated depending on exposure time, radiation type(persistent and pulsed) is done. The investigation results of further growth of the crop are presented.

REZUMAT
В статье рассматривается влияние инфракрасного излучения на посевные качества семян и рост томатов. Проведена оценка посевных качеств семян. облученных в зависимости от времени экспозиции. от типа излучения: постоянного и импульсного. Представлены результаты исследований дальнейшего роста данной культуры.

INTRODUCTION
Modern state of science and technology is characterized by new promising directions that considerably contribute to the world country economy. One of these directions are nanotechnologies (Borodin I.F.. 2008; Matyukhin S.I. et al. 2016; Matyukhin S.I. et al. 2011; Matyukhin S.I. et al. 2012; Polishuk S.D. et al. 2014). Today the concept “nanotechnologies” implicates technologies in particular connected with nanoobjects or processes taking place at nanolevel. Perhaps the processes taking place in seeds at radiation with infrared radiation can be referred to them (Borodin I.F.. 2008. Grishina S.Yu. et al. 2014. Polishuk S.D. et al. 2014).

Unforeseen climatic changes are one of the factors influencing on the world economy. Generally. losses are attributed to agriculture (Parakhin N.V.. 2011). There is a need to estimate objectively the zone peculiarities of farming as well as possible weather changes.

More than that dealing with the production efficiency it is necessary to pay attention to increasing ecological problem, connected with the increasing tendency of application of chemical agents in the world (Parakhin N.V.. 2011). Because of vital necessity to overcome negative chemical and anthropogenic consequences the strategy of the world community on activation of farming ecologization and biologization processes appears.

In these conditions, the considerable yield gain can generate one of the strategic directions of agriculture which is seed breeding (Borodin I.F.. 2008).

The determining factors of seed breeding efficiency and its sustainability are variety and sowing indicators of seed quality. Implementation of new varieties and hybrids is connected with the definite increase of additional costs but the obtained yield gain allows not only to compensate these expenses but also increases net income by 3 times. The sowing qualities are purity, humidity, germination energy, germination capacity and the degree of pest contamination and diseases (Borodin I.F.. 2008).

In production conditions the problem of low quality of sowing material is solved by increase of sowing rate, but however seed overconsumption reaches on the average according to statistical data 0.6 dt/ha. Improvement of seed quality gives the opportunity to reduce the sowing rate and to obtain yield gain (Borodin I.F.. 2008).

To increase the quality of viable seeds is possible owing to their presowing treatment with physical, chemical and other methods (Polishuk S.D. et al. 2014; Stepanova L.P. et al. 2010). Numerous investigations data show that different types of influence on seeds produce positive effect on activation of plant vital processes. In practice, in agriculture the stimulating factors are widely used.

Seed stimulation is used for long time increasing the energy of germination and germination capacity, seed wakening speed-up and yield ripening, rise of resistance to adverse environment. It should be pointed out that stimulation cannot improve yields over the biological limit or remove from quiescence the nonliving seeds. Since in our country in the north areas yield capacity is below the biological limit of the crop, then their stimulation in adverse environment provides considerable yield gain.

Today the most common among the existing stimulating effects on seeds are: chemical treatment, solar heating and seed preheating in forced blowing bins or grain driers before sowing. Besides, in recent years the investigations on seed treatment by gamma radiation, SHF energy, heat radiation, magnetic and electromagnetic fields and their combinations are carried out.

In Orel State Agrarian University at the chair of Physics the research work on electromagnetic field irradiation and particularly infrared radiation of cultivated plants seeds mustard, peppers, tomatoes, pea, maize etc. is carried out for many years. Special attention is paid to the influence of infrared radiation on seeds as one of the stimulating factors (Grishin A.V. et al. 2016; Grishina S.Yu. et al. 2014. Parshikova Yu. et al. 2016; Sharenov A.V.. 2014; Sharenova N.V.. 2010). This method of seed material treatment has known beforehand a variety of advantages: treatment safety for seeds and service personnel, short duration of influence.

In the present paper, the results of investigation of infrared radiation stimulating effect on tomato seeds are presented.

The crop choice for the experiment is determined by the following arguments: availability of getting seed material, simplicity and possibility to grow it in planting boxes. As well as there was the necessity to use for the experiment nonstandard seeds with low biological activity that laid in the land for several years.

MATERIAL AND METHOD

The goal of research was to study the infrared radiation influence on tomato crop as stimulating factor.

To reach the goal the following tasks were put forward:

- to estimate microclimatic conditions at seeds irradiation;
- to estimate sowing qualities of tomato seeds irradiated by infrared radiation depending on treatment time;
- to estimate sowing qualities of radiated seeds depending on irradiation type: persistent and pulsed;
- to investigate further tomato growth subjected to presowing treatment with infrared radiation in different doses depending on treatment time and irradiation type;
- after analysis of the obtained results, to determine stimulating or inhibiting effect of infrared radiation on tomato seeds;
- to determine optimal mode of tomato radiation (type and exposure time).

Nonstandard mustard seeds of reproduction of 2012 were the object of infrared radiation effect.

For the experiment, the digital laboratory and irradiator being like a semiconductor diode were used. One of the main parameters of the installation is radiation wave length which is 890 nm, while in operation in stationary conditions the installation is powered from 220 V network. To determine indoor microclimate when doing the experiment the digital laboratory sensors of temperature humidity, illumination and magnetic field were applied (figure 1).

The researches were done in the separate room of the educational building of Federal State Budgetary Educational Establishment of Higher Education “Orel State Agrarian University named after N.V. Parakhin” The selected seed group was exposed to radiation according to the preset mode (type and time exposition). The experiment was planned in three replications according to the developed scheme:

- persistent radiation influence according to the exposition time:

2 min; 3 min; 5 min; 7 min; 10 min; 15 min; 20 min; 25 min; 30 min; 1 h; 1.5 h;

- pulsed radiation influence according to the exposure time is the same as previous.

Each seed group was given a reference number. Besides, together with seed radiation the measurements of effect temperature, air humidity, illumination and magnetic field between the irradiator and the experiment object were done.

Fig. 1 – Seed radiation and microclimate measurements

The ground surface in the boxes was divided into eleven plots, ten of which were sown with seeds that were irradiated with different exposition time. The tenth plot was sown as control. We obtained three boxes with seeds irradiated by infrared radiation and three boxes with seeds radiated by pulsed radiation (figure 3).

Observations over wakening, germination and growth of the whole sowing were carried out during four weeks. The data were tabulated for further processing.

RESULTS

According to our investigations during tomato seeds infrared radiation between irradiator and seeds the air temperature was from 29^{0}C to 33 ^{0}C, air humidity - from 22% to 33% depending on temperature and air humidity of the room at the preset day. More than that depending on exposure time the temperature was increasing within the limits up to 2.5^{0}C. and humidity was decreasing up to 3%. Illumination was from 55 to 85 lux. magnetic field – 0.018 to 0.028 Gs (figure 2).

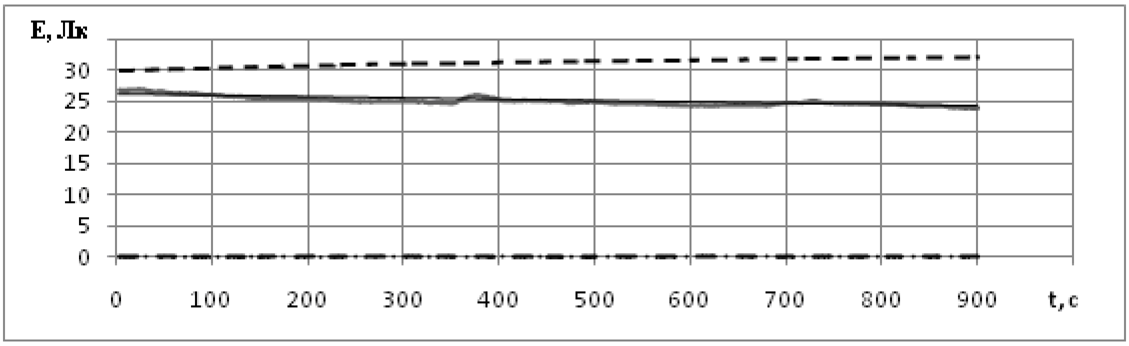

Fig. 2 - Dependence of illumination from time exposition

temperature *humidity* *magnetic field*

Seeds wakening is of great importance in agronomy. Further yield capacity and its safety depend on this factor. Unlike persistent radiation (figure 5). pulse radiation (figure 4) is characterized with the best speeding-up of tomato seed wakening according to our experiments. In both cases the best result of time exposition was 10 minutes. Good acceleration rate of exit from seed quiescence at persistent radiation is from 8 to 10 min. at pulse radiation – from 2 min to 5 min. from 10 min to 25 min. However, seed wakening suppression at persistent radiation – 2 min and from 10 min. at pulse radiation – 1 min. 7 min was observed.

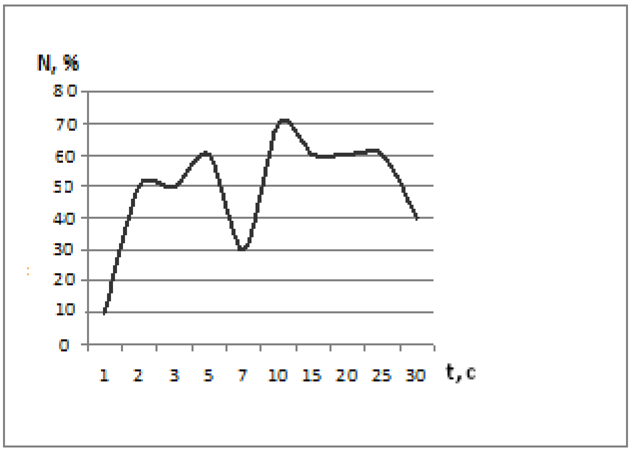

Fig. 3 - Dependence of the number of woken seeds from the exposure time of infrared pulse radiation

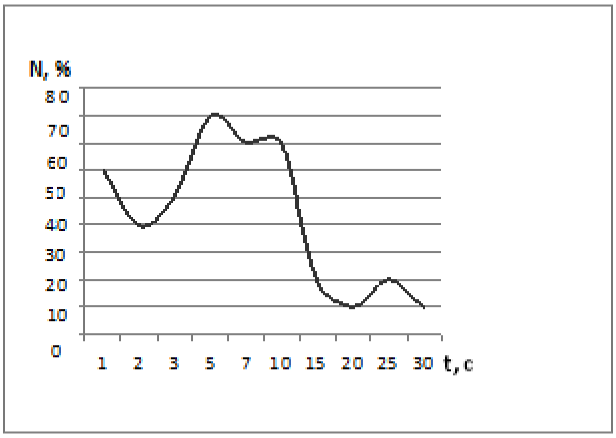

Fig. 4 - Dependence of the number of woken seeds from the exposure time of infrared persistent radiation

Comparing irradiated and unirradiated samples it is possible to conclude about considerable tomato seed wakening acceleration by infrared radiation.

According to the investigation results tomato seed radiation by infrared radiation also significantly increases its germination.

Seeds radiation showed excellent result – 10 min. But at incorrect doze suppression can be observed. Thus at persistent radiation it is 7 min and from 15 min.. at pulse radiation – 2 min. 7 min. from 25 min. Also value has a form of radiation: pulse or persistent. Germination indicators of tomato seeds irradiated by pulse radiation (figure 6) are better than by persistent radiation (figure 7).

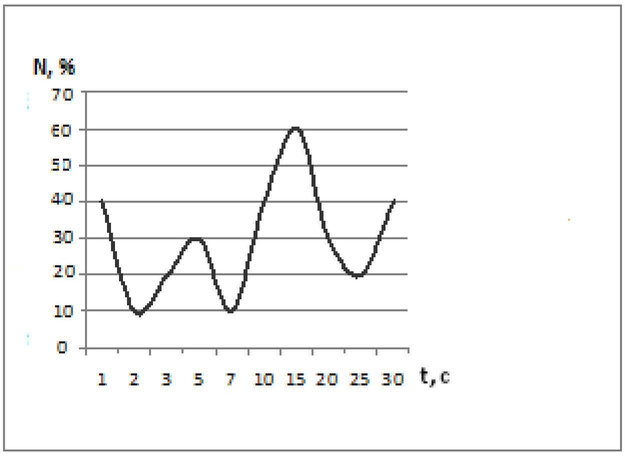

Fig. 5 -Dependence of the number of sprouts with the first natural leaves from exposure time by pulse infrared radiation

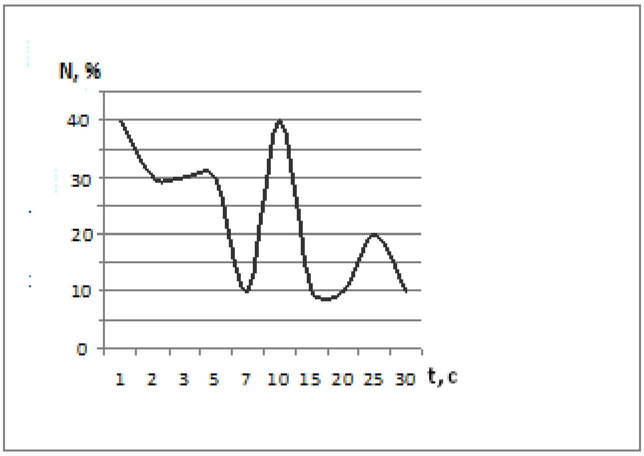

Fig. 6 - Dependence of the number of sprouts with the first natural leaves from exposure time by persistent infrared radiation

Based on the investigation data, it possible to conclude that the plants treated with pulse radiation even in single range of exposure time grow unevenly. Maximum variation according to growth at seed radiation is 10 minutes and 20 minutes. At seed radiation with pulse and persistent radiation the "best sprouts" are observed in the range of 10 minutes of influence.

CONCLUSIONS

- It is proved that the effect of infrared radiation on sowing qualities of seeds has non-linear dependence.
- It is demonstrated that the application of pulse infrared radiation produces more favorable effect on wakening energy and seed germination in comparison with persistent radiation.
- Stimulating properties of infrared radiation for the sowing qualities of seeds and their further growth are proved. Nevertheless, at some doses of radiation suppression of initial plant development was observed.

It must be stressed that at choosing type and exposure time of seed stimulation by infrared radiation it is necessary to consider the given properties effect on plant development. Incorrect chosen dose of seed pretreatment influences on obtaining the desired result and yield gain but also results in its reduction.

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THE INFLUENCE OF *THYMUS VULGARIS* L. ESSENTIAL OIL ON GERMINATION OF *ZEA MAYS* CARYOPSES
/
INFLUENTA ULEIULUI ESENTIAL DE CIMBRU ASUPRA GERMINATIEI CARIOPSELOR DE PORUMB

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Key words: *Zea mays, essential oil, seed germination*.

ABSTRACT

There is a constant concern over the growing level of food insecurity dictated by global climate change. Therefore, new and innovative methods are being explored using different natural substances potential to increase crop productivity. In the context of sustainable agriculture and organic farming the use of natural resources to protect crops becomes very important. The use of various aromatic and medicinal herbs as precursors for plant protection enriches biodiversity and the spectrum of valuable economic crops. In this study, the action of essential oil of Thymus vulgaris on the germination and root growth of Zea mays caryopses following seed treatment is presented.

REZUMAT

Există o preocupare constantă asupra nivelului în creștere a insecurității alimentare dictată de schimbările climatice la nivel planetar. Prin urmare. sunt studiate metode noi și inovative cu privire la utilizarea potențialului diferitelor substanțe naturale pentru a crșste productivitatea culturilor. În contextul agriculturii durabile și a celei organice. utilizarea resurselor naturale pentru protecția culturilor devine foarte importantă. Utilizarea diferitelor plante aromatice și medicinale ca precursori pentru protecția plantelor îmbogățește biodiversitatea și spectrul culturilor valoroase economic. În acest studiu este prezentată acțiunea uleiului esențial de Thymus vulgaris asupra germinației și creșterii radiculare a cariopselor de Zea mays în urma tratamentului la sământă.

INTRODUCTION

Maize cultivation represents an important agricultural activity in Romania which is currently facing various problems induced by the influence of biotic and abiotic factors.

Among the main biotic factors with negative impact on maize crop are pests such as *Agriotes* spp. (*Pălăgeşiu et al.. 2000*). *Diabrotica v. virgifera* Le conte (*Pălăgeşiu et al.. 1998*). *Tanymecus dilaticollis* Gyll (*Georgescu et al.. 2014*) and *Anoxia villosa* F. (*Chireceanu et al.. 2009*). The limitative abiotic factor for maize crop according to the suitability simulation map using crop parameters indexed in FAO Ecocrop database DIVA-GIS software and climate database (1950-2000) is the temperature. Although the air average monthly temperature for April and May has a positive deviation between 0.3 and 0.6ºC. the maximum monthly average recorded in soil is decreasing due to the precipitation temporal migration level, from the warm season, respectively the middle of the year to the cold seasons, respectively the beginning and end of the year (ANMH. 2014).

On the basis of climate information regarding the average temperature of the soil. the farmers tend to advance the sowing date exposing the crop to the risk of a suboptimal germination. In the context of late sowing of maize the risk of poor germination determined by temperature is removed, but the crop may be affected in June and July by depleting the soil water as a consequence of absent soil shading. In these terms, along with the legislative limitations regarding the pesticides use the first research direction on removing these stress factors is genetic breeding. However, another research area is focused on the possibility of using plant extracts with pest repellent, antimicrobial properties and crop metabolism stimulation as an alternative to classical breeding methods. In this regards, various aromatic and medicinal plants can be used due to its essential oils content that can be extracted through hydrodistillation. Economic and ecological cost of production for these plants is low and can bring substantial incomes for farmers. EOs are volatile substances typically produced by plants to ensures itself a competition advantage for nutrient and protection against pest agents. EOs can be liquid at room temperature and showing different colors ranging from pale yellow to emerald green and from blue to dark brownish red .They are synthesized by all plant organs and are stored in secretary cells, cavitie, canals, epidermis cells or glandular trichomes (*Bakkali et al.. 2008*).

The aim of this study is to evaluate the influence of *Thymus vulgaris* essential oil activity on maize seed germination process. *Thymus vulgaris* is a member of the family of Lamiaceae which are strongly aromatic and consist of approximately 38 species that are distributed in subtropical countries. This essential volatile oil has anti-oxidant properties (*Zeghad et al.. 2013*). insecticide activity against *Agriotes* spp. (*Walwitiya et al.. 2005*) and fungicide properties (*Nguefack et al.. 2008*). The main components of *Thymus vulgaris* are the phenols, thymol (40%) and carvacrol (15%) (*Klarić et al.. 2007*).

MATERIALS AND METHODS

The maize caryopses used for the experiments were collected from a private storage unit for cereals. The samples were taken from areas with high susceptibility to pathogenic fungi infection: wet floors, cold corners and vents.

All samples were mixed together and stored in a chamber with low humidity condition until the grain bulk has reached 10% moisture. For the experiment, were selected 1200 maize caryopses with their own unaltered microbial load, morphological homogeneous and without mechanical damage. The total amount of seeds was separated in 24 lots of 50 seeds each in Petri dishes with vents.

The experimental design consisted in six treatment variants, each of them in four replicates. The seed lots from V1 to V5 were treated with *Thymus vulgaris* essential oil in different increasing concentrations. The control variant V6 was treated with water. The experiment was performed three times with *Thymus vulgaris* essential oil from three different batches of a private commercial company. The essential oil was conditioned as an emulsion of 95 ml water, 5% essential oil and 0.2% agar (*Remmal et al.. 1993*).

The seed treatment was performed by using the stock solution of 5% EO in doses ranging from 500 to 5000 ppm and water up to 3 ml in order to ensure a uniform distribution of volatile oil emulsion within the Petri plate (Table 1).

Table 1

Treatment variants

	V1-500 ppm	V2-1000 ppm	V3-2000 ppm	V4 -3000 ppm	V5 -5000 ppm	V6- control
5% EO (µl)	154.975	309.95	619.9	929.85	1549.75	0
Sterilized water (µl)	2845.025	2690.05	2380.1	2070.15	1450.25	3000

The germination trials were performed in Petri dishes (92x16 mm) with vents; into the lid above the treated seeds were placed 5 layers of cellulosic paper disks waterlogged with 10 ml distilled water in order to provide the necessary humidity for a 3 days period. The corn seeds were placed 3 days in an incubator at 24 ±2 ºC for germination (fig. 1).

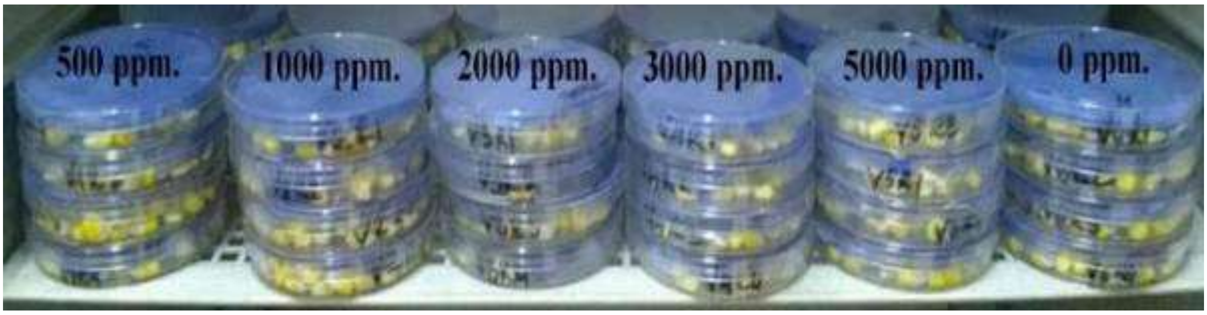

Fig. 1 - Different concentrations of *Thymus vulgaris* essential oil

At the end of the experiments, the geminated seeds were counted in order to establish the average germination rate and the radicle length was measured with a digital micrometer (fig. 2).

Fig. 2 - Radicle length measurement

For the validation of the germination experiments it was used the “Germination tool box” application which is available freely from ISTA (International Seed Testing Association). The statistics and graphics were obtained using GraphPad Prism program.

RESULTS AND DISCUSSIONS

The results of the experiments (Table 2) highlighted that between the 6 treatment variants are no significant statistical differences (fig. 3) regarding the number of germinated maize seeds, although the average germination percentage of all 3 experiments varied between 61% and 67%. According to the comments generated by the Germination tool box application, some of the treatment variants did not comply with the regulation imposed by ISTA.

This situation indicates the fact that there are multiple variables within the experimental design such as the seeds microbial load distribution, treatment homogeneity and the natural variability of active substances content from the essential oils.

Table 2

Average germination in the three experiments at various EO concentrations (%)

Germination tool box results (ISTA)	V1-500 ppm	V2-1000 ppm	V3-2000 ppm	V4 -3000 ppm	V5 -5000 ppm	V6- control (untreated)
Experiment 1						
Average	80	79	84	81	80	82
Observed Range	18	24	20	12	18	18
Tolerated Range	22	23	21	22	22	22
Comment	OK	Retest	OK	OK	OK	OK
Experiment 2						
Average	60	38	46	49	64	53
Observed Range	22	16	18	6	38	32
Tolerated Range	27	27	28	28	27	28
Comment	OK	OK	OK	OK	Retest	Retest
Experiment 3						
Average	56	70	69	53	59	68
Observed Range	16	18	26	30	6	24
Tolerated Range	28	26	26	28	27	26
Comment	OK	OK	OK	Retest	OK	OK

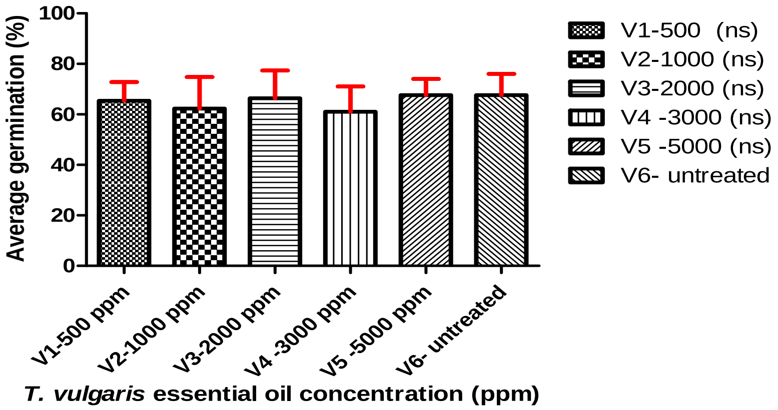

Fig. 3 - Average germination of the three experiments at various EO concentrations; ns not significant (t test)

The average radicular growth (fig. 4) has proven that there is a correlation (fig. 5) between the quantity of *T. vulgaris* essential oil and average radicle length. The average radicle length from the 500 ppm EO treated variant exceeded the average radicle length from the control variant with 2.83 mm, having a growth increase of 15% (fig. 6).

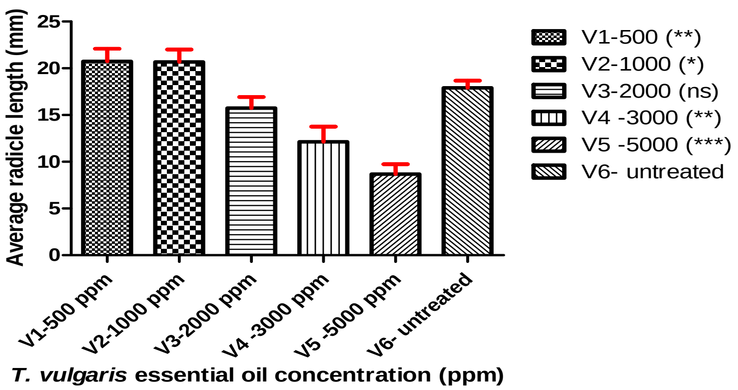

Fig.4 - Average radicle length on the three experiments at various EO concentrations; ns - not significant. *- low significance. **- medium significance. *- high significance (t test).**

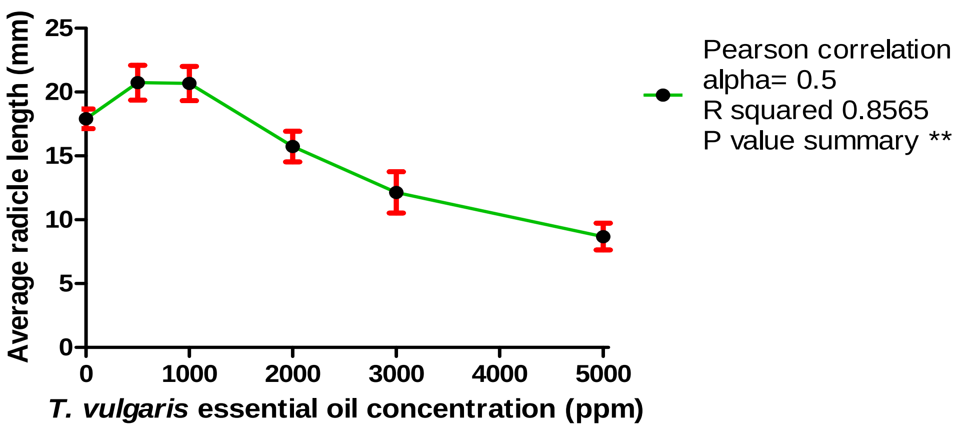

Fig. 5 - Pearson correlation between average radicle length and EO concentration

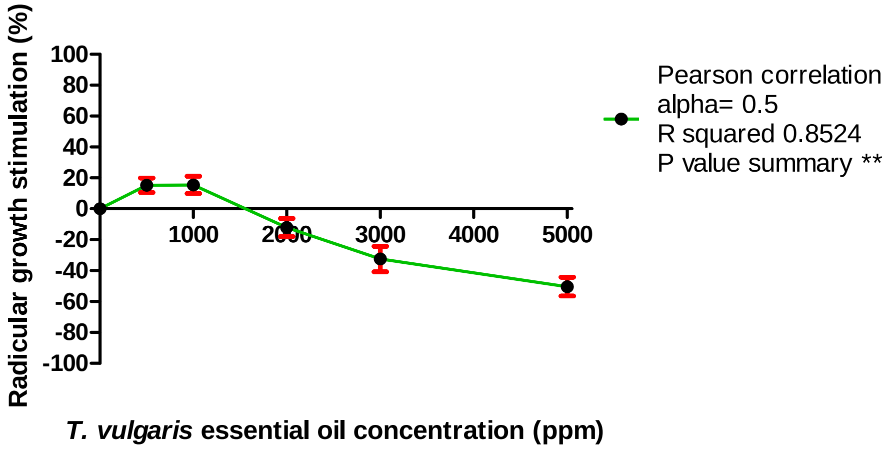

Fig. 6 - Radicular growth stimulation/inhibition at various EO concentrations

In order to establish the performance of the experimental design it was calculated also the average total length of radicular growth expressed as a product between the average number of germinated seeds and the average radicular length (fig. 7).

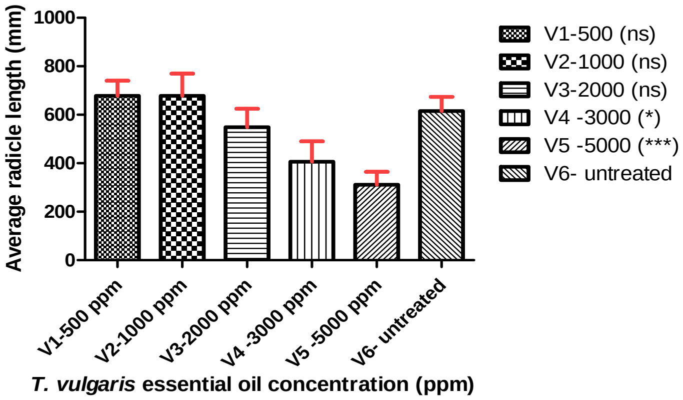

Fig. 7 - Total radicular length (germinated seed x average radicle length)

The non-significant statistic level of treated variants from V1-500 ppm to V3-2000 ppm within the t test compared to control variant indicates an uncertainty factor from the number of germinated seeds. This may be due to the existence of a uniformity lack for the corn seeds germination capacity. as the samples were collected from areas with different exposure to abiotic factors, such as temperature and humidity.

CONCLUSIONS

The use of *T. vulgaris* essential oil for maize seed treatment before sowing represents a viable solution to increase the metabolism pathway involved in radicular growth process. The acceleration of germinative metabolism along with the antimicrobial and pest repellent properties are important qualities that can generate various researches regarding the standardization of seed treatment with ecological products.

Due to the results generated by the three conducted experiments, it can be concluded that standardization of the seed treatment product composition based on essential oils can be performed following a bioassay for each production batch before trading instead of EO conditioning to a specific composition by adding different chemical compounds.

Maintaining the natural variability of the essential oil composition can be a key factor to avoid microorganism resistance development towards products designed for plant protection.

ACKNOWLEDGEMENTS

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EPIZOOTIC PARAMETERS OF *BEAUVERIA BASSIANA* MYCOSIS IN *A LEPTINOTARSA DECEMLINEATA* POPULATION
/
PARAMETRII EPIZOOTICI AI MICOZEI DETERMINATE DE BEAUVERIA BASSIANA INTR-O POPULATIE DE LEPTINOTARSA DECEMLINEATA

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Keywords: *B. Bassiana, L. Decemlineata, epizootiology, entomopathogens.*

ABSTRACT

The epizootic potential of B.bassiana depends on the ability of fungal strains to spread into host population on mode, speed and intensity of sporulation. This paper presents epizootiological parameters of the process by which B. bassiana is transmitted directly from one host to another. Observations were made on the epizootiological dynamics, respectively the number of infected hosts, infectious propagules in soil, mortality rate of host insect in the experimental crop and the post-mortem sporulation degree. Fungal infection had the greatest value when ratio between new micotic infections rate and mortality rate of individuals covered by fungal mycelium was 1.

REZUMAT

Potențialul epizootic al ciupercii B. bassiana depinde de abilitatea tulpinii fungice de a se răspândi în populația gazdă, de modu,. viteza și intensitatea sporulării. În lucrare sunt prezentați parametrii epizootiologici ai procesului prin care B. bassiana se transmite direct de la o gazdă la alta. S-au făcut observații privind dinamica epizootiologică. respectiv numărul de gazde infectate. numărul de propagule infecțioase din sol, rata de mortalitate a insectei gazdă în cultura experimentală. gradul de sporulare post-mortem. Valoarea maximă a infecției fungice s-a înregistrat atunci când raportul dintre rata unor infecții micotice noi și rata de mortalitate a indivizilor micozați a avut valoarea 1.

INTRODUCTION

The factors responsible for triggering an epizootic as well as for a certain dynamic in time and space are represented by the susceptible host population and the pathogen population.

The epizootic potential - the ability to maintain and propagate entomopathogenic microorganisms in natural environment as biological control agents - depends on their transmissibility capability: the mode, the speed and intensity of sporulation, the ability to spread in host population. *Brown (1987)* defines the term epizootiological dynamics as the study of the change in host and pathogen numbers over time and space and the intrinsec and extrinsec factors responsible for the change.

Three primary factors contribute to the cause and development of epizootics of infectious diseases: an effective mean of pathogen transmission, the pathogen population and the host population (*Tanada and Kaya. 1993*). Transmission is the process by wich a pathogen is passed from a source of infection to a new host (*Andreadis. 1987*).

Examples of epizootic models in pest management systems are (i) the use of *Bacillus thuringiensis* as a microbial insecticide (*Brand and Pinnock. 1981*). (ii) the onion maggot (*Delia antiqua*) – *Entomophtora muscae* model (*Carruthers et al.. 1985*). and (iii) the alfalfa weevil *Hypera postica*) – *Erynia* model (*Brown and Nordin. 1982*). Influences on horizontal transmission of entomopahogenic fungi have been evaluated by *Avery et al. (2010). Cárcamo et al. (2015). Lopes et al. (2011). Onstad and Maddox (1989. 1990)* to name a few. Interesting epizootic research model has been developed to predict *Nomurea rileyi* prevalence on velvetbean caterpillar, *Anticarsia gemmatalis* in soybean fields (*Kish and Allen. 1978*). But to predict occurrence of an epizootic is very difficult because not always the same factors initiate epizootic development in different pathogen-host systems (*Augustyniuk-Kram and Kram. 2012*). In ants population, for example, behavioural changes of infectious individuals can influence both the individual course of disease and the transmission to others (*Fabian et al.. 2015*). Also, in natural outbreaks there are inter- and intraspecific mixed infections with entomopathogens with important effects on population dynamics (*Staves* *and Knell. 2010*). Entomopathogenic fungi could also act in synergistic interactions with entomopathogenic bacteria (*Wraight and Ramos. 2017)* and with natural enemies (*Gonzalez et.al. 2016)*.

The aim of our studies was to obtain necessary informations for the evaluation of potential impact of management practices and of *L. decemlineata* - *B. bassiana* dynamics. *B. bassiana* is a soil-borne fungal entomopathogen and can be used for soil inoculations to target pupae and diapausing adults (*Noronha and Goettel. 2008*) Foliar applications of *B. bassiana* could be also significant component of an IPM program (*Wraight and Ramos. 2015*).

Observations on epizootic dynamics are presented: number of infected hosts / number of infectious propagules, mortality rate of host insects - induced by pathogen colonization in experimental crop - and also the degree of postmortem sporulation on insects bodies covered by fungal mycelium.

MATERIAL AND METHOD

Obtaining and multiplying the pathogen

Submerged cultivation procedure under stirring conditions was used for multiplication of *B.bassiana*: 24 hours to obtain vegetative mycelium and 72 hours for conidia ($11.3x10^{10}$conidium\ml).

Obtaining host population (Leptinotarsa decemlineata) "pathogenic inoculum"

L.decemlineata eggs, collected from field (fig. 1) were the source of entomological material for obtaining pathogenic inoculum. Spawns were incubated under laboratory conditions (26^{0}C) and the development of larvae grown on potato plants in vegetation vessels lasted 23 days. Larvae in final stage left the plants and burrow into the soil, transforming into pupae. Adults came out staggered after 9 days.

Fig.1 - *L.decemlineata* eggs. collected from field

Infection of the host population with a conidial suspension

It was made by applying the conidial suspension on pupation substrate and on feeding substrate for adult and larval stages (L1-L4).

Spread of "pathogenic inoculum" in potato culture infested with *L. decemlineata* was done for each stage after 36 hours of treatment between 3 and 20 of June. 2016 (Table 1).

Table 1

Launch schedule of pathogenic inoculum

Date / development stage/ number																		
Var.	3.07	4.07	5.07	6.07	7.07	8.07	9.07	10.07	11.07	12.07	13.07	14.07	15.07	16.07	17.07	18.07	19.07	20.07
I	**L$_1$ 20**		**L$_1$ 10**				**L$_2$ 30**				**L$_3$ 20**			**P 20**		Ad 20		
II	**L$_1$ 10**	**L$_1$ 20**					**L$_2$ 50**					**L$_3$ 30**		**P 20**			Ad 20	
III		**L$_1$ 10**	**L$_1$ 20**						**L$_2$ 50**			**L$_3$ 50**		**P 20**				Ad 20
IV		**L$_1$ 20**	**L$_1$ 10**						**L$_2$ 30**			**L$_3$ 30**		**P 20**				Ad 80

Experimental design of treatments: randomized blocks, 4 variants x 3 replicates x 30 sq.m.

Observations on the epizootic dynamics were made daily for 16 days starting with 48 hours after launching of "pathogenic inoculum". The population of the pathogen was estimated, respectively the number of infected hosts and the number of infectious propagules in soil, as well as the interaction with the host population (the mortality rate of host insect induced by pathogen colonization in the experimental crop and the post-mortem sporulation degree – by examining bodies covered by fungal mycelium).

In order to assess the number of conidia, soil samples were taken from the first 2 cm of soil because most of the fungal inoculum is concentrated in this layer. About 10 g of soil from each sample was suspended in 9 ml of sterile distilled water plus Tween 80 at 0.01%.

The resulting suspensions were serially diluted (10^{-2} si 10^{-3}) and inoculated on agar culture medium. Fungal growth was quantified by determining the number of colony forming units (CFU) after 16 days of incubation in the dark (25 ± 1 ° C). Other samples were used for determination of dry weight of soil (110 ° C. to constant weight).

RESULTS

The epizootic dynamics of the host-pathogen experimental system was evaluated through an analysis of the susceptible and infected hosts.

The number of daily infected individuals of susceptible hosts depends on the number of contacts between susceptible host (*L. decemlineata*) and infectious resistant stage of pathogen (conidium). This contact may or may not result in infection. Considering that a constant proportion of these contacts results in transmission, they will be taken into account for assessing the transmission efficiency or pathogen transmissibility.

Observations made starting with the first day after the launch of the pathogenic inoculum looked at issues related to the epizootiological dynamics of *B. bassiana* entomopathogen and the extent to which infectious propagules were transmitted directly from one individual to another.

a. b. c.

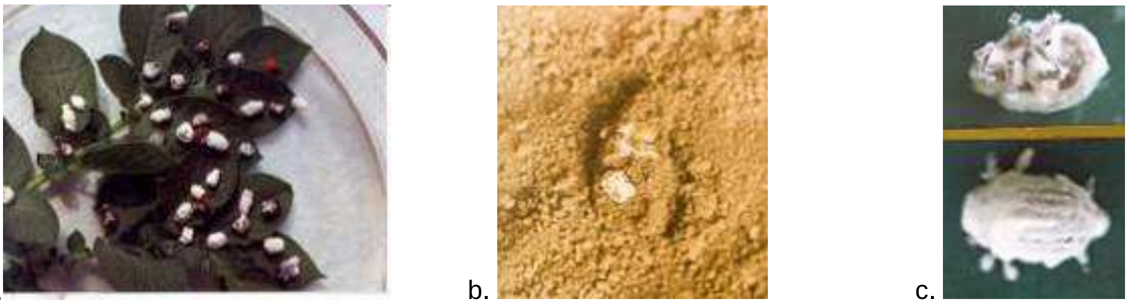

Fig.2 - The pathogenic inoculum (artificially infected in laboratory). larvae (a). pupae (b) and adults (c) of *L. decemlineta* infected with *B. bassiana*.

The amounts of pathogenic inoculum had the following mean values: 3.9 x10^{11}conidium/ sq.m. (var. I). 4.26 x10^{11}conidium/ sq.m. (var. II). 4.61 x10^{11}conidium/ sq.m. (var. III) and 9.48 x10^{11}conidium/ sq.m. (var. IV). Based on the results shown in Table 2., we assess that at a decrease in the amount of pathogen inoculum by 2.05 times (var. III). 2.22 times (var. II) and 2.4 times (var. I) compared with var. IV. the percentage of infected hosts of all susceptible hosts in larval stages 1 and 2 showed differences between 1.7 % (4 days) – 1.76% (6 days) – 2.9% (8 days) – 3.13 (10 days) and in larval stages 3 and 4 showed differences between 1.1% (4 days) – 1.3% (6 days) - 1.1% (8 days) - 1.1% (10 days).

The mortality rate in all variants was strictly dependent on the size of the host population (the number of susceptible hosts). Unlike viral or bacterial infections, the insects retain their general body shape when death is induced by fungal infections except for areas partially covered by the fungus or cuticular melanizated points.

Considering this, after the launch of pathogenic inoculum only host insects from the experimental field whose post-mortem position on the host plants suggested the cryptogamic nature of the pathogen were collected. Results of the infected hosts counting are shown in Table 2. as a percentage of the number of susceptible hosts.

Dead insects. incubated in "wet chambers" revealed during 3-7 days at 27^{0}C. the classic symptomatology of *B. bassiana* fungal infection. Thus, under high humidity conditions the saprophytic development phase of the fungi development began and mycelium from the body cavity crossed the skin covering it with a powdery white patch; fungal growth was initiated in the intersegmental regions of the insect.

Table 2

Infected hosts after treatment

Var.	Dose "pathogen inoculum" (nr. of mycosed individuals /var.)	Number of susceptible hosts		Infected hosts (%)							
				4 days		6 days		8 days		10 days	
		L_{1-2}	L_{3-4}	L_{1-2}	L_{3-4}	L_{1-2}	L_{3-4}	L_{1-2}	L_{3-4}	L_{1-2}	L_{3-4}
I	120	396	388	20.4	19.8	23.4	26.0	25.5	43.2	25.5	48.4
II	150	452	511	19.2	19.5	34.5	35.0	40.0	45.2	44.4	46.7
III	170	911	787	34.5	21.5	41.4	35.9	76.0	45.0	79.9	47.5
IV	190	498	601	19.5	21.0	31.5	35.5	41.0	41.0	41.9	51.5
Control	-	566	498	0	0	0	0	0	0	0	0

Examination of different stages from development cycle of host insect revealed that abundance of sporulation differs from one stage to another. The amount of fungal spores increases proportionally to the amount of nutrient substrate the insect provides for saprophytic pathogen development (Table 3).

Table 3

Quantification of *B. bassiana* post-mortem sporulation on *L. decemlineata*

L. decemlineata host population (larval stage)	"Pathogenic" population (average number of conidia (x10^9) / larva
1	0.95
2	2.0
3	3.2
4	10.05

Characterization and quantification of post-mortem mode of sporulation are essential for assessing the epizootic dynamics of an entomopathogenic agent.

Thus, based on the observations made we consider that horizontal transmission of the pathogen is influenced by the saprophytic development of the fungus characteristic of the host insect habitat with obvious adjustments for efficient transmission of disease; in experiment presented, (a) the pathogen has a characteristic dusty appearance on the host insects from epigean habitats and (b) in soil, depending on the microclimate conditions the pathogen develops mycelium which ensure colonization in hypogean habitats.

These morphological adaptations to microhabitat conditions increase the pathogen chance to contaminate a new host (pathogen transmissibility).

CONCLUSIONS

Epizootic dynamics of entomopathogens is a process dependent on the density of susceptible hosts;

Fungal infection in population of susceptible hosts had the greatest value when ratio between new micotic infections rate and mortality rate of infected individuals is 1. When the susceptible host population exceeds this threshold the incidence of the disease increases and when the host population is below this threshold the incidence decreases.

The number of infected *L.decemlineata* depends on the number of contacts between susceptible and infected hosts.

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CEREAL TYPE INFLUENCE ON THE INSECTICIDAL PROPERTY OF DIATOMACEOUS EARTH AGAINST CONFUSED FLOUR BEETLE. *TRIBOLIUM CONFUSUM* (HERBST)
/
INFLUENȚA TIPULUI DE CEREALE PRIVIND PROPRIETATEA INSECTICIDĂ A DIATOMITULUI ÎMPOTRIVA GÂNDACULUI FĂINII. TRIBOLIUM CONFUSUM (HERBST)

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Keywords: *Tribolium castaneum, diatomaceous earth, stored products, barley, wheat.*

ABSTRACT

The present article aims to present the influence of grain on the insecticidal efficacy of diatomaceous earth (DE) formulations applied in two stored products (wheat and barley), on adults of Tribolium confusum (Jacquelin du Val) (Coleoptera Tenebrionidae). The formulations used in the laboratory trials were two local DE's deposits from Romania (Buzău-Pătârlagele and Adamclisi) which have been compared with the commercial types of SilicoSec and PyriSec. The DE's have been applied at the dose rates of 100, 300, 500 and 900 ppm and mortality of the exposed adults was recorded after 7. 14 and 21 days of exposure.

REZUMAT

Lucrarea urmărește să prezinte influența tipului de cereale asupra eficacității insecticide a formulărilor de diatomit. aplicate peste două produse de depozit grâu și orz. împotriva adulților gândacului făinii. Tribolium confusum (Jacquelin du Val) (Coleoptera Tenebrionidae). Formulările utilizate în studiile de laborator au fost din două depozite locale din România (Valea Buzăului-Pătarlagele și Sudul Dobrogei-Adamclisi). comparativ cu tipurile comerciale SilicoSec și PyriSec. Diatomita au fost aplicate la doze de 100, 300, 500 și 900 ppm (mg / kg de cereale). în timp ce mortalitatea adulților expuși a fost înregistrată după 7. 14 și 21 de zile de la expunere (DLE).

INTRODUCTION

The stored products are suffering high loses because of the pests. The use of the pesticides is one of the preventive measures during the stored period. Choosing the pesticides for the stored products pests is limited because of strong requirements imposed by the necessity of their safely use. For this reason it is necessary to reduce the dependence of chemicals by implementing an alternative method to control the stored products pests. The use of diatomaceous earth (DE) is a promising alternative in stored product protection. DE is a naturally occurred siliceous dust formed by the fossilized remains of unicellular algae species namely diatoms. DE may be different in color because of different minerals and impurities. Sometimes layers are very thick up to a few hundred meters (*Korunic. 2016*). DE's are probably the most efficacious natural dusts used as insecticides (*Korunic. 1998*). DE's act on the insects' exoskeleton (cuticle) causing rapid desiccation and resulting in death through water loss. Also, DE's can be applied with the same application technology with traditional grain protectants, which means that no specialized equipment is required (*Athanassiou et al. 2005*). Several DE's based on natural deposits are now commercially available and have proved very effective against stored grain pests (*Korunic. 2013*). Despite their advantages, the use of DE's in stored-product protection remains rather limited due to their main drawback: DE application reduces grain bulk density (volume/weight ratio). For a satisfactory level of efficacy, the current DE's should be applied at doses between 400 and 1000 ppm (*Fields and Korunic. 2000*). However, according to the compounds of formulated diatomaceous earths, they are expected to have different mode of actions (Ziaee*. 2015. Ziaee et al..2014*). Knowing these we tried to find out whether also products (in this case wheat and barley) play a part in the insecticidal efficacy of the diatomaceous earth (DE) formulations. Insecticide tolerance is defined as the "the natural ability of a population to withstand the toxic effect of a particular insecticide" (*Yu. 2015*).

However the insect may resist penetration through the thickening of the integument *Tribolium* spp. are considered the most tolerant stored-grain beetle species to DE's at the adult stage (*Vayias et al.. 2009*). Although insect behavior may change following insecticide exposure, the behavior of insects is also a major factor in determining insecticide exposure and therefore, insecticide efficacy (*Malia et al.. 2016*).

MATERIAL AND METHODS

The formulations used in the laboratory trials were two local DE's deposits from Romania (Buzău Valey-Pătârlagele and South of Dobroudja-Adamclisi) compared with the commercial type SilicoSec PyriSec (Agrinova. Germany) and SilicoSec (Biofa. Germany). Since the DE's efficacy in some cases is determined by the type of the commodity, the grain type used in this case was wheat and barley.The insects used were adults of the confused flour beetle (*Tribolium confusum* H.) a cosmopolitan pest of stored grains, most abundant and injurious one, a very prolific species that primarily attacks milled grain products such as flour and cereals. We can also find them into our homes in infested flour multiplying in large populations.

The DE's were applied in 1 kg lots of each at the dose rates of 100, 300, 500 and 900 ppm (mg DE per kg of grain) in 3 series with 3 replicates. The lots were placed in plastic jars and shaken manually for approx. 3 min. to achieve equal distribution of the DE dust to the entire grain mass. Untreated lot of grains were used for control. Then, 3 samples (replicates) of 50 g each were taken from each lot, placed in plastic vials (7 x 5 cm), which were closed with driled caps for air. An amount of 30 adults (<21 days old) were placed in each vial. The lots were placed in controlled room at temperature of 25°C. and relative humidity level of 60±5%. Mortality in DE-treated commodities was recorded after 7, 14 and 21 days of exposure. Data were analysed using the software Graph Pad Prism 5. Adult mortality data were corrected using Abbott's formula (*Abbott. 1925*) and the adult mortality was analysed separately for each grain.

RESULTS

The results of our study are presented in the graph from Figures 1 – 4. The mortality of *T. confusum* exposed to treated wheat was low, the exception being the mortality levels of PyriSec. For SilicoSec and the two Romanian DE's, mortality in all dose rates and exposure intervals increased exponentially over time.

After 7 days of exposure at doses above 100 ppm of PyriSec treated wheat and barley, mortality of *T. confusum* combined was 100%. while at the lowest dose mortality was 20% in treated wheat and barley (fig.1). It is well known that PyriSec contains natural pyrethrum and piperonyl butoxide while SilicoSec contains approx. 90% SiO_2. In 14 days after exposure the mortality has started to grow slightly, starting with SilicoSec and continuing with the Romanian DE's (fig.2).

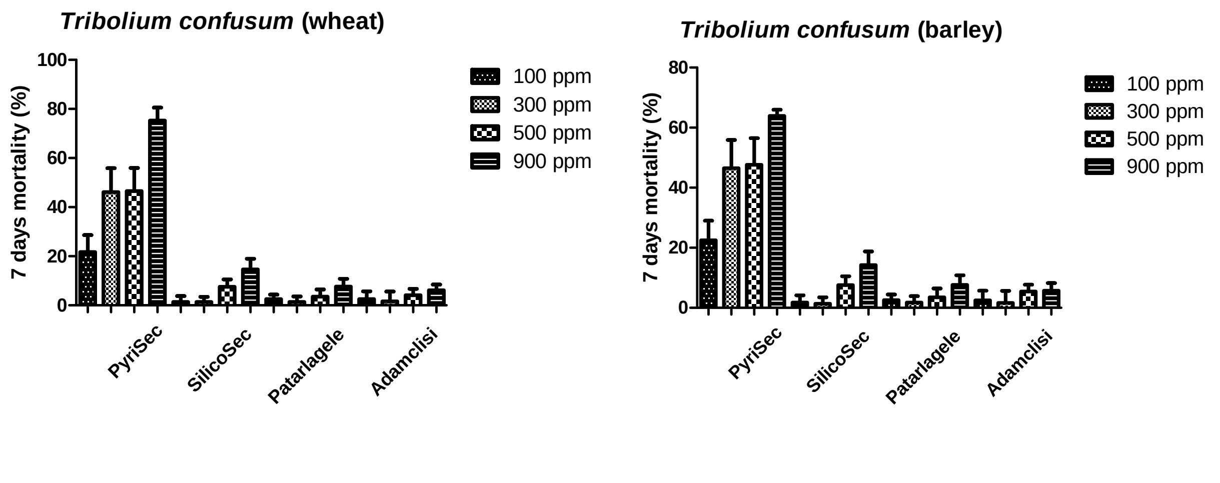

Fig.1 - Mortality on wheat and barley treated with DE's in four dose rates, at 7 days

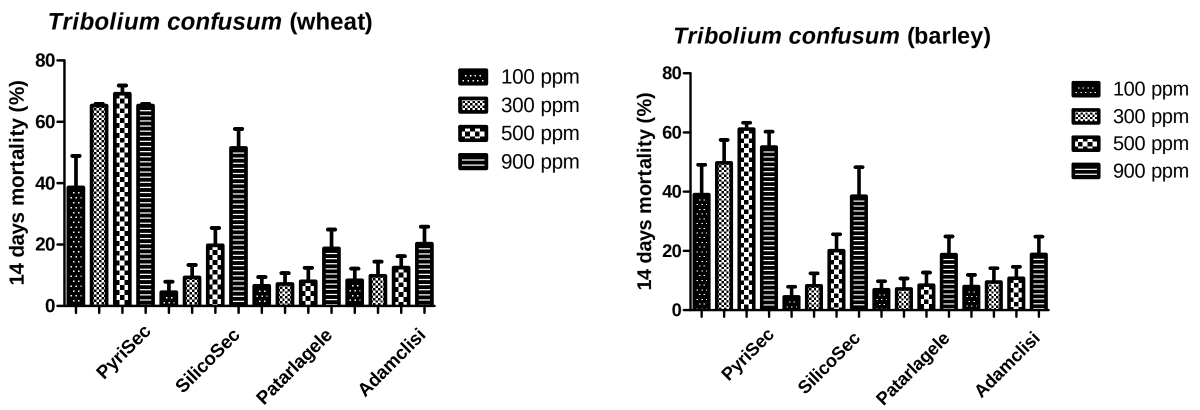

Fig. 2 - Mortality on wheat and barley treated with DE's in four dose rates, at 14 days

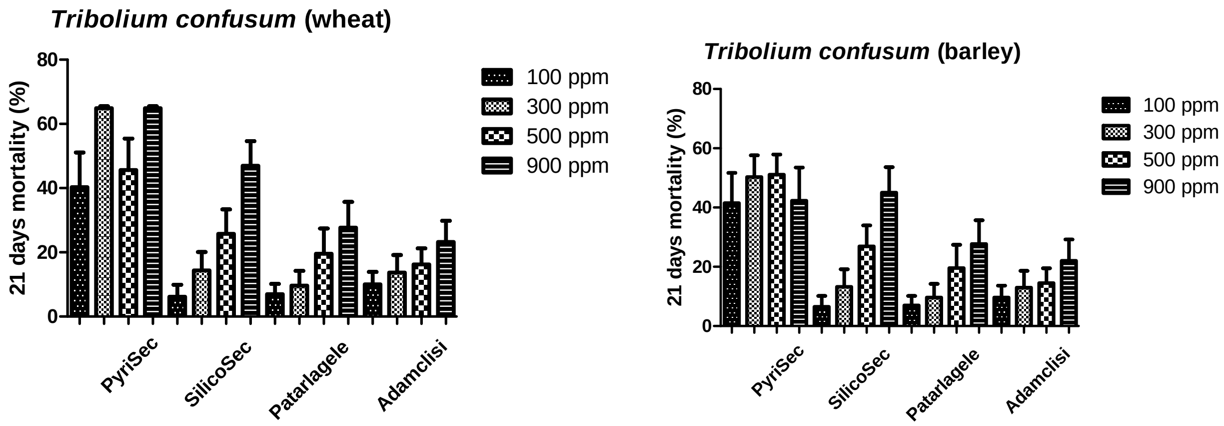

Fig. 3 - Mortality on wheat and barley treated with DE's in four dose rates, at 21 days

Figure 3 presents the final mortalities for *T. castaneum.* with the exception of PyriSec. SilicoSec reached a 60% with the dose 900 ppm followed by Romanian DE's with 40% respectively 35%.

From the DL50 data analysis, it can be concluded that DE PyriSec and Adamclisi have different adherence for wheat and barley. Meanwhile, SilicoSec's adherence has been close to that of the DE from Pătârlagele (fig.4).

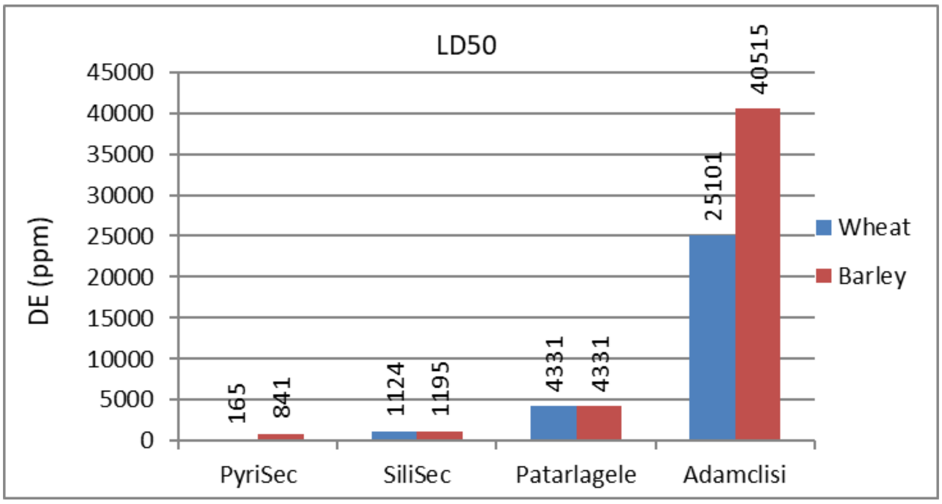

Fig. 4 - LD50 values of diatomaceus earth (DE) on treated grains (wheat. barley)

CONCLUSIONS

The most effective DE was the commercial formulation PirySec. in half of the tested grains (wheat and barley) after 7 days of exposure in dose rates above 100 ppm and at 25°C. and relative humidity level of 60±5%. The two Romanian DE's at the highest dose rate had the same performance with the commercial formulation of SilicoSec. Grain adherence is a factor that must be taken into account in future tests. DE's with high insecticidal value in relatively low doses could be further improved with the addition of other substances.

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THE ISOLATION OF ENDOPHYTIC STRAINS FROM POTATO PLANTS / *IZOLAREA TULPINILOR DE ENDOFIŢI DIN PLANTELE DE CARTOF*

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Keywords: *endophytes, potato plants, tubers, antagonists, antibiotics, plant growth promoting bacteria.*

ABSTRACT
The endophytic microorganisms are living inside different organs of the plants apparently without damaging them, forming a true endophytobiome. They are mainly bacteria and fungi. Many strains are regarded as beneficial for plants, helping them to face environmental stress, to resist to pathogens and some of them can be used in different biotechnologies. The potato is one of the most common culture in temperate area of the globe. Bacteria were isolated from potato tubers and from other parts of the plant. First results showed the presence of strains of Rhizobium, Gordonia, Paenibacillus Bacillus, Micrococcus and other genera.

REZUMAT
Microorganismele endofite trăiesc aparent fără să producă nici o daună în interiorul diferitelor organe vegetale. formând aşa numitul endofitobiom. Sunt în principal bacterii şi ciuperci. Numeroase tulpini de microorganisme sunt considerate benefice pentru plante, ajutându-le să facă faţă stresului de mediu şi presiunii patogenilor, iar unele dintre ele pot fi utilizate în diferite biotehnologii. Cartoful este una dintre cele mai comune culturi din zonele temperate ale globului. Tulpini bacteriene au fost izolate din tuberculi dar şi din alte părţi ale plantei. Primele rezultate arată prezenţa tulpinilor din genurile Rhizobium, Gordonia, Paenibacillus, Bacillus, Micrococcus şi alte genuri.

INTRODUCTION
The microorganisms find habitat not only in different places in the environment, but also inside different microorganisms –animals plants and humans. They formed the so called microbiome- we think that the plant microbiome is phyto microbiome, animal – zoomicrobiome and of course human microbiome (n.a.) Generally we speak about non harmfull fungi and bacteria and others which are only hosted inside and in some instances can become pathogenic (especially in the case of animals and humans). The relation is very complex and varies from symbiosis to commensalism, including biochemical release.

In the case, they can release some compounds useful for plants or assuring protection against phytopathogens (*Shulz et al.. 2015*) and pests (*Shi et al. 2013*) or protecting against stress (*Miliute et al. 2015*). The microorganisms inside plants form the endophyto (micro) biome (n.a.); its an entire community inside which varies from a plants species to another, from organ to organ. They practically originate from soil and adapt to inner plant environments.

The present review focus on the endophytic fungal and bacterial strains from potato and their possible use in agriculture, medicine and other fields of activity in order to set up research strategies for further investigations.

MATERIAL AND METHOD
We performed a search in the databases in internet and at the same time we introduced in this mini-review our original data obtained in our investigation and researches in laboratory by isolation from selected potato tubers.

RESULTS
As a result of the minireview we considered the scientific achievement from the last decade.with some of the personal results obtained in our laboratory. A review of biology of endophytes and their classification was proposed by *Zhang et al. 2001*. The potato is a culture in all world in the areas with apropiate conditions for this plant. It host in tubers, in stems and in leaves many fungi and bacteria- alpha, beta and gamma-

Proteobacteria. *Plantomycetales* group. *Flexibacter- Cytophaga – Bacteriodes* group (*Garbeva et al. 2001; Sessitch et al. 2004*) and *Actinomycetes* (Sessitch et al. 2002) many endophytic strains with potential applications in industry (Hashegawa et al.. 2006). A *Methylobacterium radiotolerans* strain was discovered in leaves and stem of potato plantlets (Podolich et al.. 2009).

In leaves and roots and stems were discoverede 55 bacteria genera, in root being a microbial community which was very closed to soil community (Franco et al.. 2013) and from the leaves was much more different. Genera *Teribacillus, Enterococcus, Streptomyces, Microbispora*, *Pantotea, Bacillus Pseudomnas, Lactococus, Rhodococcus Exiguobacterium* were identified. In our researches we find strains from genera *Rhizobium, Gordonia, Paenibacillus, Bacillus, Micrococcus, Rhodococcus, Mycobacter* determinated with BIOLOG device and GEN III soft ware (Fendrihan. 2014).

A lot of endophytic fungi from about 63 groups were isolated by Gotz et al. (2006) which most frequents were *Verticillium dahlia, Cylindrocarpon destructans, Colletotrichum coccodes* and *Plectosporium tabacinum*. Some of the endophytes (for example *Pseudomonas* strains and *Serratia plymoutica*) demonstrated an antagonistic activity against phytopathogens for example against *Verticillium dahliae* and *Rhizoctonia solani* (*Berg et al 2005*), like bacteria *Pseudomonas putida* (*Andreotte et al.. 2009*).

The endophytic bacteria community differ from soil bacteria community structure, being practically selected (substrate driven selection) by the conditions (*Bulgarelli et al. 2013*) and play in the same time a role of protection of the plants from phytopathogens and as plant growth promoting bacteria. They are able to protect plant from different environmental stress and their relation with the plant host is essential for plant growth and development (*Yadav. 2017*). Generally speaking is a entire relation inside the community -the endophytes are releasing compounds which maintain a balance inside and face practically to multiple antagonism very complicated relations in network(*Schulz et al. 2015*).

Possible applications. It looks like the endophytes microorgnisms can be use in differents biotechnologies for their ability to produce antibiotics, other medicines, compouds for food industry, for bioremediation (Nair et Padmavathi. 2014). A part of bacterial isolates has plant growth promoting activities (Santoyo et al. 2016) Some endophytic strains of bacteria and fungi are able to release new antibiotic (Menpara et Chandra anul). Different strains were isolated from potato tuber and stems of *Solanum tuberosum* and some of them have antagonistic activity against *Streptomyces scabiae* (*Flatley et al.. 2015*). The same is for the strains of Proteobacteria and others from potato plants that are inhibiting the attack of *Erwinia carotovora* subsp. *atroseptica* (*Reiter and al. 2002*).

Isolation cases from different agricultural plants both bacteria and fungi showed a lots of useful strains wich release antimicrobial and antifungal compounds (*Mousa et Raizada. 2013*). The strains isolated from potato roots (*Pageni et al.. 2014*) –*Burkholderia*, *Azospirillum, Ideonella, Pseudacidovorax* and *Bradyrhizobium* showed an PGP activity, releasing IAA. Some from the isolated strains were effective against phytopathogens *Pectobacterium atrosepticum*. *Fusarium sambucinum* and *Clavibacter michiganensis* subsp. se*pedonicus* in culture. The isolates from rotten potato tubers were from genera *Bacillus, Pseudomonas, Rhodococcus, Serratia, Lysinibacillus* and others.

Some of them are able to release siderophores, other antibiotic compounds (*Czajkowski et al.. 2012*) and some can be use as biocontrol agent against *Dickeya* sp. In our institute were isolated some bacterial strains as *Bacillus subtilis* 6T4 which are good to be used as biocontrol agents against main pathogens like *Fusarium solani, Rhizoctonia solani* and *Alternaria solani* and other releasing important enzymes – phosphatases, amylases, proteases and some release cellulose degrading enzymes (*Boiu- Sicuia et al.. 2017*).*Bacillus amyloliquefaciens* strains release antibiotics which can be used against human pathogens *Escherichia coli, Staphyllococcus aureus* and pathogenic yeast *Candida albicans* (Bhoonobtong et al. 2012).

Fungal strains isolated from potato as *Epicoccum nigrum* and *Trichoderma atroviride* are considered to be efective for control of *Rhizoctonia solani* (*Lahlali et al.. 2010*). Other fungal strains *Aspergillus aureofulgens* and *A. flavipes*. showed (their extracts) against *Phytophtora infestans* (*Ngatia et al. 2015*). An endophytic strain of *Aspergillus* sp. strain F1544 (*Martińez-Luis et al.. 2012*) releases bioactive agents (pseurotin A. 14 norpseurotin, pseurotin D, fumochinone B with activity against *Leishmania* and some with anticancer activity.

CONCLUSIONS

The endophytes are among the most interesting microorganisms, they are very diverse belonging to different taxonomical units, to an important number of genera of bacteria and fungi. They are found in soil environments too from where they originate, but inside plants they form a different microbiome composition selected by inner host factors. They use the plant as host forming the so called phyto microbiome (n.a.).

At the same time, they are beneficial for the host even they cannot be called real symbionts some release plant growth promoting compounds, other offer a certain degree of protection against phytopathogens and sometimes against pests. Some of them are interesting for human industry – they are able to release antibiotics and antifungal, anticancer compounds and to be used in different biotechnologies as releasing valuable enzymes. That is why the researches on this ecological category of microorganisms are very interesting from theoretical and practical points of view and must continue.

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FUNCTIONAL FOODS PRODUCED FROM STRAWBERRIES
/
ФУНКЦИОНАЛЬНЫЕ ПРОДУКТЫ. ПРОИЗВЕДЕННЫЕ ИЗ КЛУБНИКИ

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Keywords: freezing; strawberry; production; food industry; vitamins; processing.

ABSTRACT

The relevance of the research topic is related to high economic value of strawberries for the Republic of Dagestan. The total area of strawberry cultivation exceeds 700 hectares. while complex biochemical composition, fine flavor and nutritional value of this culture offer the possibility to use it for production of various multicomponent food items. This study was aimed at developing frozen derivative products packed in glass jars holding 500 g. and loose berries in polystyrene packaging holding 250-300 g. with the freezing temperature of -40°C and the storing temperature of -18°C. The central method of studies was implementation of freezing as being the most efficient method of conservation of the food products allowing to maintain the highest taste and flavor qualities of the resulting products.

As a result, considering the examined derivative products we observed high content of vitamin C in the fresh berries of the following cultivars: Gigantella (73.9 mg%). Lord (77.5 mg%) and Victoria (73.7 mg%). Subsequent storing resulted in minor losses of vitamins. After 10 months of storing, decrease in the content of vitamin C reached from 10.1% to 15.4% was observed. The samples had an extensive and diverse range of constituents providing nutritional and biological value. The rates of preservation of the biochemical composition of the strawberries during the low-temperature storing ranged from 60% to 80% in different cultivars. We observed minor losses of vitamin C in all the derivative products from 3% to 35%. as compared to the initial content.

The data provided in the study may be useful for the food industry workers, for agriculture and for general public as these products are of high nutritional quality with a broad spectrum of vitamins, macro- and microelements.

РЕЗЮМЕ

Актуальность темы исследования связана с высокой экономической ценностью клубники для Республики Дагестан. Общая площадь выращивания клубники превышает 700 гектаров. а сложный биохимический состав. тонкий вкус и питательная ценность этой культуры дают возможность использовать его для производства различных многокомпонентных продуктов питания. Это исследование было направлено на разработку замороженных продуктов. упакованных в стеклянные банки объемом 500 г. а в ящиках из полистирола - 250-300 г. с температурой замораживания -40 ° C и температурой хранения -18 ° C. Центральным методом исследований было внедрение замораживания как наиболее эффективного способа сохранения пищевых продуктов. позволяющего поддерживать наивысшие вкусовые и вкусовые качества полученных продуктов.

В результате. учитывая исследованные производные продукты. мы наблюдали высокое содержание витамина С в свежих ягодах следующих сортов: Гигантелла (73.9 мг%). лорд (77.5 мг%) и Виктория (73.7 мг%). Последующее хранение привело к незначительным потерям витаминов. Через 10 месяцев хранения содержание витамина С уменьшилось с 10.1% до 15.4%. Образцы имели обширный и разнообразный набор компонентов. обеспечивающих питательную и биологическую ценность. Показатели сохранения биохимического состава клубники при низкотемпературном хранении варьировались от 60% до 80% в разных сортах. Мы наблюдали незначительные потери витамина С во всех производных продуктах от 3% до 35% по сравнению с исходным содержанием.

Данные. представленные в исследовании. могут быть полезны для работников пищевой промышленности. для сельского хозяйства и для широкой общественности. поскольку эти продукты имеют высокое качество питания с широким спектром витаминов. макро- и микроэлементов.

INTRODUCTION

According to the Food Security Doctrine of the Russian Federation, authorized by the Executive Order of the President of the Russian Federation on January 30th, 2010, the scientific research should be directed towards development and improvement of the theoretical basis for storing and processing of raw agricultural materials in the course of manufacturing of safe food products. One of the important tasks includes the development of the next-generation food products for different demographic groups including childhood and elderly nutrition, both for medical and preventive purpose.

Proper and reasonable nutrition is one of the most important factors of the human health. Normal human life, strong performance and active recreation require food products with balanced chemical composition and their value primarily lies in their ability to provide bioactive substances [3].

The issues of well-balanced nutrition are particularly topical and important today. Functional foods decreasing the risks of manifestation of the nutrition-related disorders, preserving and improving human health through the functional nutritional ingredients are intended to be consumed by all age groups of the population [4].

Development of new well-balanced food products supplemented with a complex of vitamins, minerals and other natural antioxidants plays an important part in modern science and medicine [2].

Over the last years, much attention is given to the development of new functional foods with various widely known conservation methods – sublimation, pasteurization, dehydration. low-temperature freezing, etc. The major criteria for the assessment of any of these techniques are the preservation of the initial properties of the raw materials and the storage period during which the products can be conserved with preset technological parameters, using any particular method [6].

Long-term research performed in this area by different scientists shows that, among the known methods of prolonged storing of the functional foods quick freezing provides unlimited opportunities for common use [5.6].

The range of quick-frozen products present in the retail chain of the Republic of Dagestan today is quite wide: frozen apples, pears, ashberries, apricots, cherries, peaches, plums, cherry plums, sweet cherries, cranberries, gooseberries, buckthorn fruits, dewberries, blueberries, strawberries, grapes, currant; the vegetables including frozen green peas, green beans, cauliflowers, Brussels sprouts, tomatoes, eggplants, sweet peppers, asparagus, zucchini, pumpkins, spinach, sorrels, flavoring green herbs (dill, parsley, celery), carrots, potatoes.

However.,all the products present in the retail chain are imported, mostly from Poland.

Over the last year,. the researchers of the Dagestan State Agricultural University have been conducting studies aimed at the identification of fruits and berries with high nutritional value and have been developing ecologically-friendly technologies of storing and processing of fruits and berries.

At the Dagestan State Agricultural University, the development of the balanced food products is performed by Mukailov M.D.. Isrigova T.A.. Aliev Kh.A.. Guseinova B.M.. Ulchibekova N.A.. Sheikhmagomedova G.N. and other researchers.

Technical specifications and technological instructions have been developed and approved for certain varieties of end products.

The cultures with particularly high biological value and nutritional qualities have been selected.

Strawberries cultivated on the area of over 700 hectares are one of highly valuable and promising cultures with economic significance to the Republic of Dagestan. Complex biochemical composition, fine flavor and nutritional value of this culture offer the possibility to use it for production of various multicomponent food items. In light of this, we have developed different food products made of strawberries.

MATERIAL AND METHOD

The studies on the frozen strawberries assessing the biochemical composition, marketable condition and flavor have provided the foundations for the development of the derivative products from strawberries, involving low-temperature freezing.

In addition, the requirements for a particular type of products on the consistency in the nutritional value during the low-temperature storing were considered.

In order to provide more balanced flavor, we supplemented the strawberry derivative products with sugar and honey. The products were frozen in glass jars holding 500 g. while loose berries – in polystyrene packaging holding. 250-300 g. The freezing temperature was -40°C. the storing temperature – -18°C. We assessed 5 cultivars of strawberries cultivated in the Republic of Dagestan: Elizabeth, Gigantella, Honeoye, Lord and Victoria.

The content of soluble solids was determined with the RL3 Nr225 44/90 refractometer; total titratable acidity – by titration with 0.1N alkaline solution; the content of sugars – with the cyanide method; total content of pectins – with the carbazole method; juice loss – through the difference in the weight of the frozen and thawed samples; vitamin C (ascorbic acid) – with the iodometry; vitamin PP (niacin) – according to GOST R 50479 – 93.

RESULTS

Fruits and berries provide an inexhaustible source of vitamins. 12 out of 26 vitamins. necessary for the human body can be found in fruits and berries.

In light of this, we have studied the content of vitamins in the strawberries and the derivative products. Vitamin C has salutary effects on the cell growth and healthy development and facilitates the uptake of calcium.

Large amounts of vitamin C are utilized by the organism when it fights diseases or infections during the wound healing or the post-surgery recovery.

Vitamin C is also essential for restoration and preservation of the proper functions of cartilages, teeth, gums, and bones; it prevents the formation of hematomas and blood clots.

Among the examined products, high content of vitamin C was observed in the fresh berries of the following cultivars: Gigantella (73.9 mg%), Lord (77.5 mg%) and Victoria (73.7 mg%) (Fig. 1).

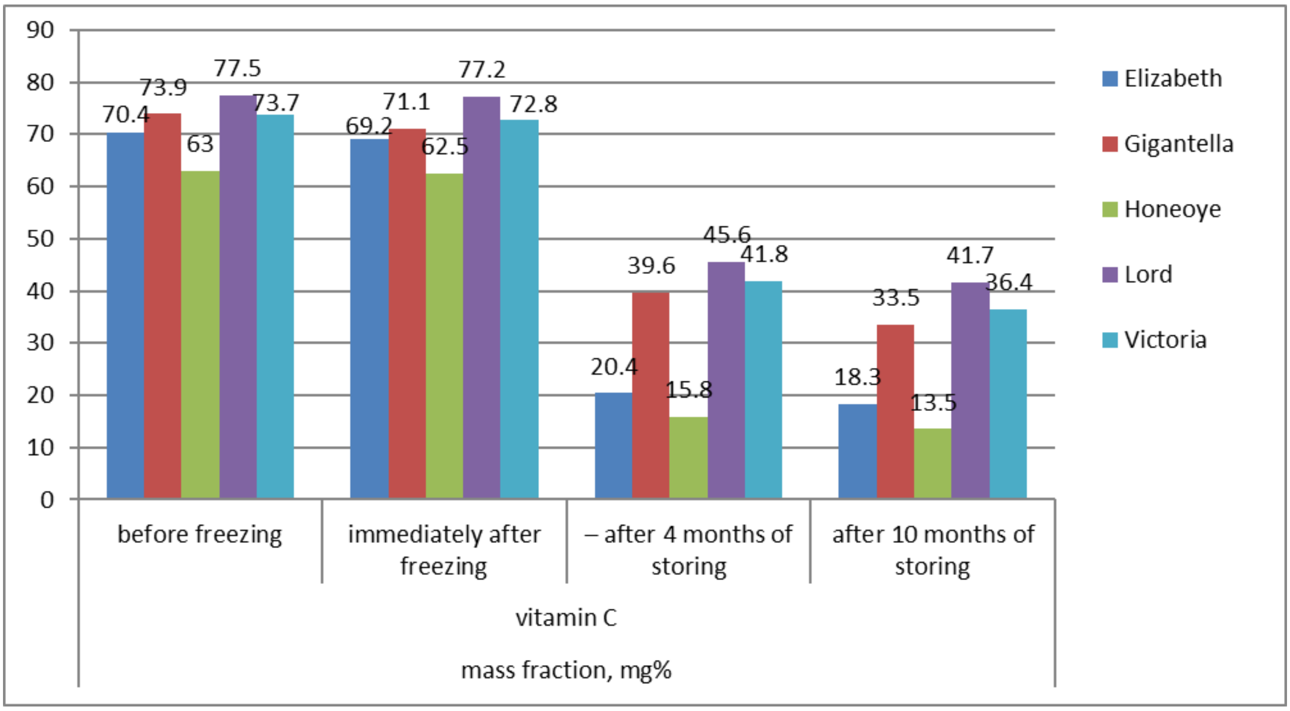

Fig. 1 - Effects of freezing and storing on the content of vitamin C in strawberries

Further storing resulted in minor loss of vitamins. The decrease in the content of vitamin C after 10 months of storing ranged from 10.1% to 15.4%.

In our experiments, the content of vitamins depended exclusively on the initial levels related to the metabolic characteristics of a particular variety during the period of vegetation.

According to some studies, the ascorbic acid conversions in frozen fruits and berries are limited to its oxidation to dehydroascorbic acid and, furthermore to 2.3-diketogulonic acid.

The former two substances are bioactive, whereas the latter one has no dietary value. The authors of these studies suggest that the rate of the vitamin loss in the stored frozen fruits and berries depends on the storing temperature and duration [4; 6].

Therefore. we can assume that vitamins and other necessary substances in strawberries are generally preserved at high levels in the course of freezing and long-term storing.

Along with vitamins, fruits and berries contain such nutrients as sugars, acids, inorganic salts. water and minor amounts of fats and proteins. The major and the most important constituents of the biochemical composition of berries are solids, acids and sugars; pectin substances also play a significant part.

In light of this, we have examined the following set of nutrients in strawberries (Table 1).

Table 1

Changes in the chemical composition of strawberries after low-temperature freezing and storing

Nutrients	Step	Cultivars				
		Elizabeth	Gigantella	Honeoye	Lord	Victoria
Total sugars, %	1	10.6	11.6	9.4	9.0	8.4
	2	10.4	11.2	9.1	8.9	8.2
	3	9.4	10.3	8.2	7.4	7.1
	4	7.8	8.6	6.9	5.8	5.9
Titratable acids, %	1	1.27	1.05	1.67	1.30	1.18
	2	1.27	1.09	1.58	1.25	1.28
	3	1.30	1.25	1.14	1.32	1.30
	4	1.38	1.31	1.10	1.35	1.34
Vitamin PP, mg%	1	0.23	0.25	0.29	0.21	0.27
	2	0.22	0.24	0.29	0.20	0.25
	3	0.12	0.14	0.20	0.11	0.18
	4	0.11	0.12	0.15	0.10	0.16
Pectin substances, %	1	2.67	1.53	2.31	1.95	2.16
	2	2.52	1.45	2.30	1.88	2.02
	3	1.98	0.92	1.47	1.38	1.63
	4	2.12	0.83	1.58	1.45	1.49

1-before freezing. 2-immediately after freezing. 3-after 4 months of storing. 4-after 10 months of storing.

According to the technological requirements for the strawberry cultivars used for conservation and freezing, the content of soluble solids in fresh berries should be at least 10%. the content of sugars – at least 7%. acids (in regards to malic acid) – 0.8-1.0%, pectin substances – no less than 0.8%. vitamin C – at least 60 mg/100 g. The examination of the biochemical composition of the fresh strawberries of the selected cultivars elucidated variations in the accumulation of the particular chemical constituents.

Biochemical analysis was performed on the fresh berries immediately after freezing, after 4 and 10 months of storing according to the conventional technologies. The results of the assessment of the biochemical composition of different strawberry cultivars suggest that the samples had an extensive and diverse range of constituents. providing nutritional and biological value. The rates of preservation of the biochemical composition of the strawberries during the low-temperature storing ranged from 60% to 80% in different cultivars.

The strawberry varieties cultivated in Dagestan are suitable for further production of high-quality foods for dietary and medical purpose. Howeve,. all-year use of these products is impeded by the seasonal pattern of strawberry harvesting. This issue can be addressed with proper storing condition, implementation of new methods and technologies, as well as temperature regimes providing consistency and the highest possible rates of preservation of the nutritional qualities of the natural raw plant materials, its bioactive substances. and the constituents responsible for the energy value.

Shock-freezing technique provides the opportunities for the development of new natural derivative products made of strawberries, featuring high biological value and complementary in the major characteristics. The development of such products meeting the requirements involves balancing both the biochemical composition and the acceptable organoleptic quality positive flavor characteristics.

The wide variety of processed foods currently produced all over the world stems from the implementation of a broad range of different raw materials from the development of various formulations, methods, storing and processing techniques. Processing of fruits and berries is closely related to the solution of the problem of the all-year provision of high-quality food products, rich in bioactive substances (BAS) for the public.

The studies on the frozen strawberries assessing the biochemical composition, marketable condition and flavor have provided the foundations for the development of the derivative products from strawberries involving low-temperature freezing: berries in sugar; berries in 20% sugar syrup; berries in sugar-free pulp; berries in pulp with 20% of sugar; berries in honey.

Production of such supplemented processed foods from raw fruits and berries is justified with the principle directions of the healthy nutrition policy in Russia [7].

The next stage of the study involved assessment of the biochemical composition of these products.

The analysis of the data on the functional foods market has revealed that the products based on raw fruits and berries providing the source of valuable macro- and micronutrients are virtually absent. At the same time, fruits and berries contain the ingredients responsible for the functional qualities of food products (vitamins, amino acids, minerals, dietary fibers) [6.12.13].

We believe that the most important characteristics of the chemical composition reflecting the value and quality of the products are the content of vitamins and acids in the frozen samples. Therefore, we measured these values in the resulting processed foods.

Freezing and one year-long low-temperature storing led to decrease in the content of vitamin C in all samples with the exception of the berries of all cultivars frozen in honey.

The content of vitamin C in the Elizabeth and Gigantella berries frozen in sugar decreased by 15.8% and 17.1%. respectively during the low-temperature storing. In the rest of cultivars, the vitamin loss ranged from 11.4% to 15.9%. The average decline in the vitamin content over the whole set of varieties equaled to 14.7%.

Supplementation with berry pulp with 20% of sugar resulted in better preservation of vitamin C than in case of berries in sugar-free pulp. The smallest decrease was observed in the Victoria cultivar – 9.9%. and the largest losses occurred in the berries of the Lord cultivar – 21.8%.

The reduction in the content of vitamin C in berries frozen in sugar-free pulp ranged from 25.9% to 35.2%. We observed a reverse pattern in berries frozen in honey. The content of vitamin C increased in all varieties. The largest gain of the vitamin C content (21.2%) after storing was observed in the Honeoye cultivar.

CONCLUSIONS

Our studies revealed minor losses of vitamin C in all the derivative products from 3% to 35%, as compared to the initial content. Such decrease is apparently caused by the fact that vitamin C is highly sensitive to the technological processing conditions and the addition of sugar.

In conclusion, we suggest that the resulting food products benefit the human health due to their nutritional value and possess great taste qualities. Substantial resources found in the Republic provide the means for production of such foods.

In this light, all-year provision of highly nutritious functional foods based on fruits and berries to people is necessary for the support of public health under the conditions of global changes.

The varieties cultivated in Dagestan are suitable for further production of high-quality foods for dietary and medical purpose.

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THE STUDY OF OPERATIONAL PARAMETERS OF A WHEELED TRACTOR WITH A GAS ENGINE IN THE TRANSPORT PROCESS
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ДОСЛІДЖЕННЯ ЕКСПЛУАТАЦІЙНИХ ПОКАЗНИКІВ КОЛІСНОГО ТРАКТОРА З ГАЗОВИМ ДВИГУНОМ У ТРАНСПОРТНОМУ ПРОЦЕСІ

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Keywords: a wheeled tractor, a gas engine, a mathematical model, a driving cycle, control parameters.

ABSTRACT
Here are the results of the theoretical studies of the indications of a wheeled tractor with a gas engine in the appropriate modes of the transport process. The rational values of the parameters of the transmission and the gas engine control during the tractor acceleration and the values of the speeds of a steady movement in operating conditions according to the criteria of the minimum specific fuel consumptions and harmful emissions were selected and justified on the basis of calculations on the mathematical model of a wheeled tractor movement on a specially formed driving cycle. It was found that the maximum engine rotation is in the range of 1400…1500 min^{-1}, the size of opening of the throttle valves is in the range of 50…60 % when the speed of opening of the throttle valves to 75 %/s is optimal. Using these recommendations it is possible to achieve fuel saving up to 10 % and significantly to reduce emissions of harmful substances together with exhaust gases.

РЕЗЮМЕ
Наведено результати теоретичних досліджень показників колісного трактора з газовим двигуном у характерних режимах транспортного процесу. На підставі розрахунків математичної моделі руху колісного трактора за спеціально сформованим їздовим циклом обрані й обґрунтовані раціональні значення параметрів керування трансмісією і газовим двигуном під час розгону трактора і швидкостей усталеного руху в експлуатаційних умовах за критеріями мінімальних питомих витрат палива і шкідливих викидів. Встановлено. що оптимальними є частота обертання колінчастого вала в діапазоні 1400…1500 хв$^{-1}$. відкриття дросельних заслінок газоповітряного змішувача 50…60 % при швидкості їх відкриття до 75 %/с. Використовуючи дані рекомендації можна досягти економії палива до 10 % і істотного зниження викидів шкідливих речовин з відпрацьованими газами.

INTRODUCTION
Everyone knows that agricultural machines are equipped with diesel engines of a good fuel efficiency and are unpretentious in operation and in maintenance. However, the increasing demands of environmental characteristics of vehicles including agricultural ones require the improvement of their structure, which will provide a significant reduction of emissions of harmful substances together with exhaust gases. This is because a lot of wheeled tractors in agricultural production are constantly used as technological transport for maintenance of livestock farms, greenhouses, warehouses, etc. Along with this they go inside and work for a long time indoors that causes harm to the health of people and of other biological objects. After a few minutes of engine running in an enclosed space the maximum allowable concentration of emissions of harmful substances exceeds the permissible limits (Zaharchuk V.I.. 2011).

The previous scientific researches (Mateichyk V.P.. 2008; Zaharchuk V.I.. 2011) showed that one of the effective ways of improving the environmental performance of tractors with diesel engines is their conversion to running on compressed natural gas (CNG), including the ability to run on biomethane which is a product of agricultural production.

Today the leading scientific research and engine-building organizations and companies are engaged in conversion and upgrading of diesel engines to their running on CNG. They are MAN, Scania, Nissan, Mercedes-Benz, CUMMINS, Iveco, Moscow automobile and road Institute, all-Russian scientific-research Institute of gas, Scientific automobile engine Institute, Kharkiv national automobile and road University, The Institute of problems in machine engineering and others (Nylund N.. 2002).

Our research has found that, according to 13 modes ETS cycle the total toxicity of exhaust gases reduced to carbon oxide CO is 1.83 times less than that of diesel (Mateichyk V.P.. 2008).

The analysis of work modes of the wheeled tractors engines in operational conditions has shown that about 40 – 45 % of all works performed by tractors are the transport works. When doing them the engines run primarily in transient modes in which the parameters of transmission and engine control have a substantial impact on fuel efficiency and on environmental performance of machines.

The analysis of the results of studies of vehicles with diesel engines converted to CNG ones has shown that no one has done the research of influence of transmission and gas engine control parameters on the operational performance of such vehicles in the transport process.

Therefore, the actual scientific-technical problem is to study the influence of parameters of control of the tractor transmission and of the gas engine converted from diesel one on the performance of the tractor running in operational modes.

The aim of this work is to study the regularity of changes in fuel consumption and harmful emissions of a wheeled tractor with the gas engine depending on the parameters of a transmission and a gas engine control during their transportation work and the argumentation of the choice of rational values of these parameters.

MATERIAL AND METHOD

The choice of rational parameters of the transmission and the gas engine control during tractor acceleration and the selection of appropriate speeds of the steady movement were carried out by simulation on a mathematical model of movement of a tractor with a trailer in the adopted "acceleration–movement with steady speed–deceleration" driving cycle. This simulation corresponds to the tractor operating conditions in the transport process and describes the modes of movement (Mateichyk V.P.. 2010).

The mathematical model is represented by a number of differential and algebraic equations describing the patterns of change in the tractor speed, fuel consumption and emissions of harmful substances in exhaust gases at each elementary field of the driving cycle. The input parameters of the mathematical model are the size of opening φ_{thr} and the speed V_{thr} of opening of throttle valves of gas and air mixer, the gear ratio U_i of the gearbox and the engine rotation frequency n_{ef} . at which the operator turns higher gear during acceleration. φ_{thr}. V_{thr}. and n_{ef} set by the operator, define the vacuum in the intake pipe. The vacuum in the intake pipe and the rotation frequency determine the engine operating modes, the hourly gas G_{gas} and air G_a consumption, the content of carbon oxides CO. hydrocarbons C_mH_n and nitrogen oxides NO_x in the exhaust gases.

The base engine parameter is a torque moment M_t. the value of which at the throttle valves position given by operator is determined by such conditions at the output: by characteristics of the road (its longitudinal slope i. the coefficient of resistance to rolling of a tractor and a trailer wheels f_0); by own weight of the tractor M_0; by the mass of the load M_l ; by the gear U_i the operator selected; and by the factor of air resistance kF. This is because these conditions determine the speed of the tractor and, correspondingly the frequency of rotation of the engine crankshaft.

In the mathematical model we simulate the movement of a wheeled tractor with a trailer on the road. In every moment of the cycle we determine its engine running modes (rotation frequency and vacuuming behind the throttle valves of gas and air mixer) on the basis of which we calculate fuel consumption, harmful emissions, traction-speed characteristics of a tractor at the elementary section of the path, generally in the mode and for the entire cycle of the tractor movement. This is according to experimentally defined characteristics considering the features of engine running in transient modes.

A refined mathematical model of movement of the gas engine tractor on driving cycle simulating the transport process allows to study the influence of transmission and a gas engine control parameters on the economic and environmental performance and to choose appropriate speed of the steady movement (Zaharchuk V.I.. 2015).

The checking of the adequacy of the mathematical model of a tractor movement was carried out by comparing the estimated speeds with the data of experimental studies obtained with the implementation of driving cycle on a tractor and with the comparisons of fuel consumptions (Mateichyk V.P.. 2012).

RESULTS

Theoretical studies (Zaharchuk O.V.. 2012) of the performance of the tractor with a gas engine were carried out according to the algorithm of determining of the rational values of the transmission and gas engine control parameters. It is shown in Fig. 1.

The algorithm allows to determine: 1) the appropriate order of gear-shifting in dependence on the operating conditions by the criterion of minimum specific fuel consumption; 2) the rational maximum engine rotation frequency at which gear-shifting goes on; 3) the rational values of the size and the speed of opening of the throttle valves during acceleration according to the criterion of minimum total emissions of harmful substances. It also allows to set proper speeds of the steady movement of the tractor, depending on the rolling resistance coefficient.

The first stage of the study was to determine an appropriate order of gear-shifting during acceleration of the tractor. Along with this the maximum values of the gas engine control parameters were accepted. At this stage, the choice of the order of gear-shifting was carried out according to the criterion of minimum specific consumption of gas g_{gas}. On the mathematical model we simulated the acceleration of the tractor with different variants of gear-shifting and chose such order which showed the least gas consumption per 1 km of accelerating.

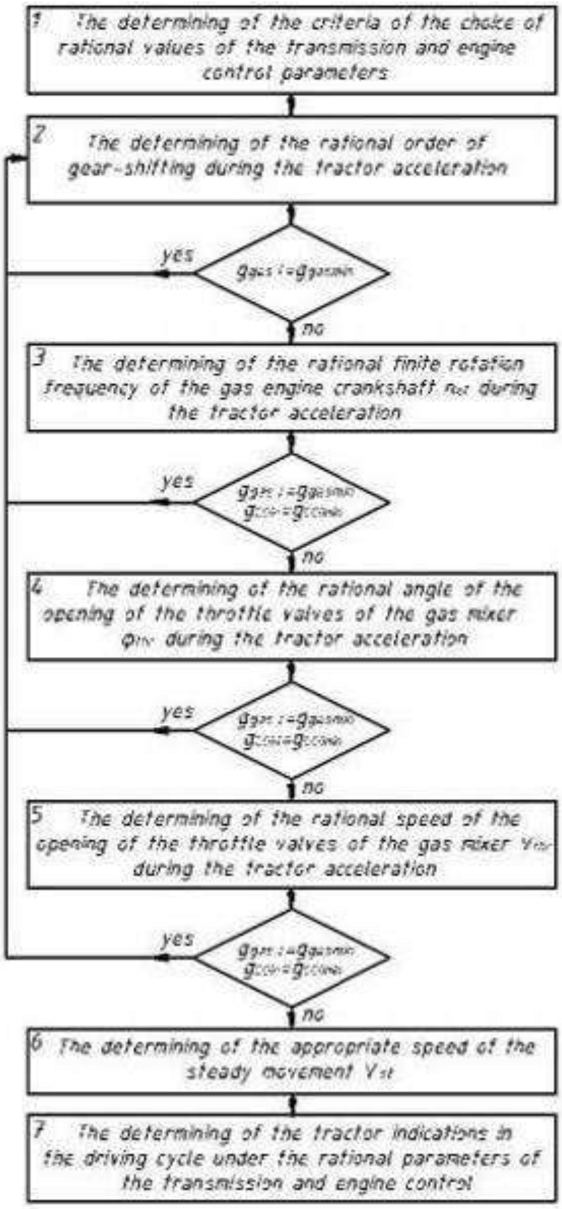

Fig. 1 - The algorithm of the determination of the expedient values of the parameters of the wheeled tractor transmission and gas engine control

The acceleration of the tractor when one chooses a proper gear-shifting was simulated with a coefficient of resistance to rolling wheels f_0 = 0.016, typical for dry asphalt-concrete and cement-concrete roads in a good condition. It was also simulated with a coefficient f_0 = 0.03. typical for dry dirt road and with the 4000 kg weight of the load.

The minimum specific fuel consumption occurs when shifting of gears is in the 6-8-9 order at f_0 = 0.016 and in the 6-7-8 order at f_0 = 0.03.

The next stage of the study was to determine rational parameters of the gas engine control. These parameters are: the rotation frequency of the engine crankshaft n_{ef} at the moment of gear-shifting, the throttle valves position φ_{thr} in each gear and the speed of opening the throttle valves of the gas and air mixer V_{thr}. taking into account the rational control parameters defined in previous stages of the research. The choice of control parameters was carried out according to the criterion of minimum specific gas consumption g_{gas} and of minimum total specific emissions of harmful substances reduced to carbon oxide $g_{\Sigma CO}$. During this choice the appropriate order of gear-shifting and the stepwise accounting of the rational values of gas engine control were taken into consideration.

With the use of the mathematical model the proper order of gear-shifting during acceleration of the gas engine tractor was determined.

Using the recommendations related to the appropriate gear-shifting order it is possible to achieve 3.9...9.8 % reduction of fuel consumption and a significant reduction of emissions of harmful substances together with exhaust gases.

The rational values of the parameters of the gas engine control during tractor acceleration were determined. In order to achieve the minimum specific emissions of harmful substances it is recommended to provide the maximum engine rotation frequency at which the gear shifting is in the range of 1400...1500 min^{-1}. and the size of opening of the throttle valves in the range of 50...60 % (Fig. 2) when the speed of opening of the throttle valves does not exceed 75 %/s.

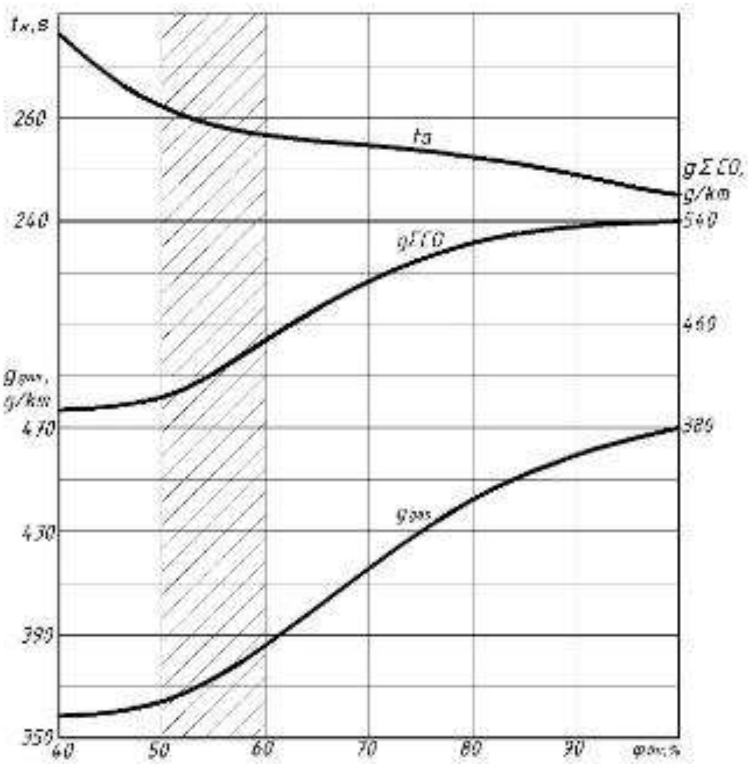

Fig. 2 - Dependences of the indications of the tractor from the angle of opening of the throttle valves

The last stage of the study was to establish the appropriate speeds of the steady movement at the corresponding segments of the driving cycle depending on the value of the coefficient of resistance to the wheels rolling taking into account the rational values of the parameters of the transmission and the gas engine control.

The proper speeds of the steady movement of the gas engine tractor in the driving cycle are installed depending on the coefficient of resistance to the wheels rolling. In particular, it is shown that achieving of minimum specific fuel consumption and minimal emissions of harmful substances on the road with the dry asphalt-concrete pavement is possible by performing driving cycle with the constant speed of 20...24 km/h and on the dry dirt road with the constant speed of 10...13 km/h (Fig. 3).

CONCLUSIONS

Using the mathematical model of the wheeled tractor movement in the transport process we determined the rational values of the parameters of the transmission and the gas engine control in the acceleration modes and the appropriate speeds of the steady movement of the tractor according to the criteria of the minimum specific fuel consumption and harmful emissions together with exhaust gases.

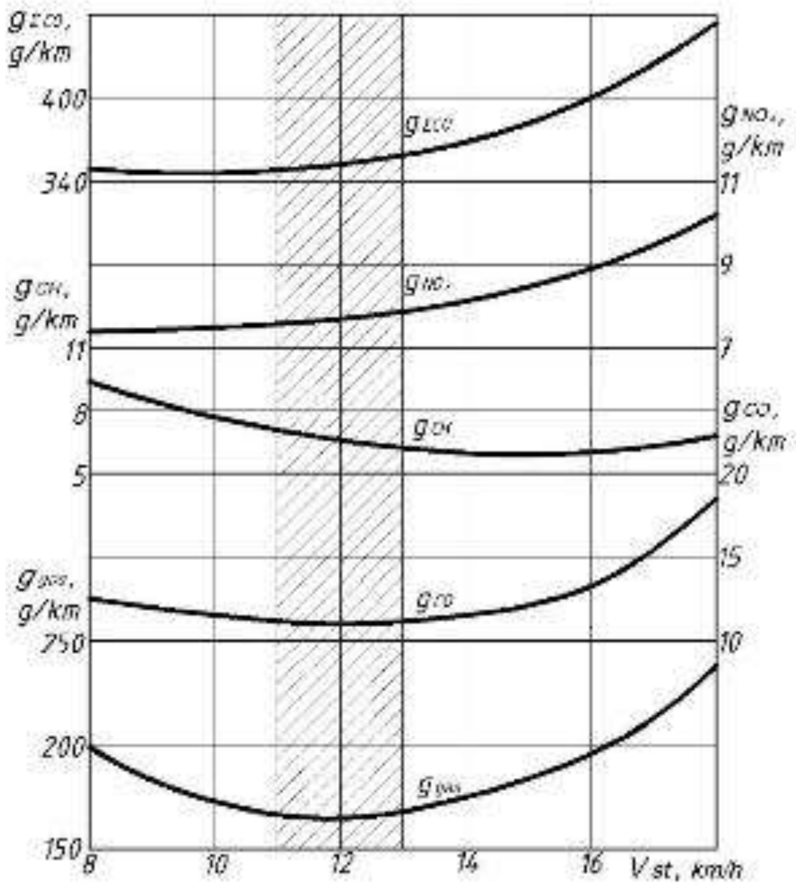

Fig. 3 - Dependences of gas consumption and harmful emissions on the speed of the tractor steady movement. when the coefficient of the resistance to rolling is f_0 = 0.03

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RATIONAL PARAMETERS OF A VIBRATION SHELL FOR CRACK FORMATION IN SOIL
/
РАЦІОНАЛЬНІ ПАРАМЕТРИ ВІБРОСНАРЯДУ ДЛЯ ФОРМУВАННЯ ЩІЛИНИ В ҐРУНТІ

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Keywords: *ground wall, vibration shell, adjusting angles.*

ABSTRACT

The paper is designed to the analysis of key geometric parameters of a working body and theoretical studies of geometrical parameters interrelations. It also presents graphic studies of optimization of working body's parameters.

РЕЗЮМЕ

Стаття присвячена аналізу основних геометричних параметрів робочого органу та проведенню теоретичних досліджень взаємозв'язку геометричних параметрів. В ній представлені графічні дослідження оптимізації параметрів робочого органу.

INTRODUCTION

Today's manufacturing demands for constructing buildings consist in the "ground wall' technology. Such buildings are used for creating antifiltration curtains, hydraulic engineering construction screens and port facilities' sluices to a depth of 20 metres and more. There are several basic demands for such type of constructions, namely their high quality, low energy and money cost of their building together with minimal technological and ecological impact on environment. All the above means that wall-forming materials used for constructing a ground wall should be utilized rationally and removal of mineral soil onto the surface should be minimal (*Zhvan V.. 2011. Ranniev A.. 2004*).

The analysis of modern technologies and tools for the ground wall construction proves that the most promising method is exploitation of blade vibration shells (Kravets S.. Romanovskii O.. 2009. Kiriyenko O.. 2015). They provide building of a minimum-sized wall to any projected depth together with forming and stuffing the cleft in soil without removal of mineral soil onto the surface.

MATERIAL AND METHOD

Specialists from National University of Water and Environmental Engineering developed a vibration shell which includes cleft-forming blades fixed on a bar. Wide implementation of the tool into production requires setting of rational parameters of the said blades to minimize energy consumption while forming the cleft.

Picture 1 demonstrates the scheme of interaction between cleft-forming blades and soil.

The study was conducted through minimization of the force of the shell's immersion into soil. The initial conditions of the experiment were set on the base of studies of V.Baladinskii. S.Kravets. O.Romanovskii. They are the following:

Vibration does not affect geometric parameters significantly;

Soil means homogeneous isotropic medium with inner and outer friction, density and moisture;

Soil destruction appears under plastic deformation together with soil pressing into cleft walls while soil particles are slipping on the blades' working faces;

The determinant power that affects rational parameters of the shell is static one.

The said blades are symmetrical.

We do not take into account soil friction on the lateral surfaces.

We project the studied powers on the OY axis:

$$dP_y = dN \sin\alpha_p \sin\gamma_{зх} + dT \cdot \cos\delta \text{. [N]} \quad (1)$$

where:

P_y - means resistance of epy shell immersion. [N];

N - means normal component of resistance. [N];

α_p - means an angle between working cutting edge of the blade and the plane XOY. [grd];

$\gamma_{зx}$ - means a slope of the cutting edge to the direction of its immersion. [grd];

T - means a tangential component of the resistance. [N];

δ - means an angle between direction of soil movement and the OY axis. [grd].

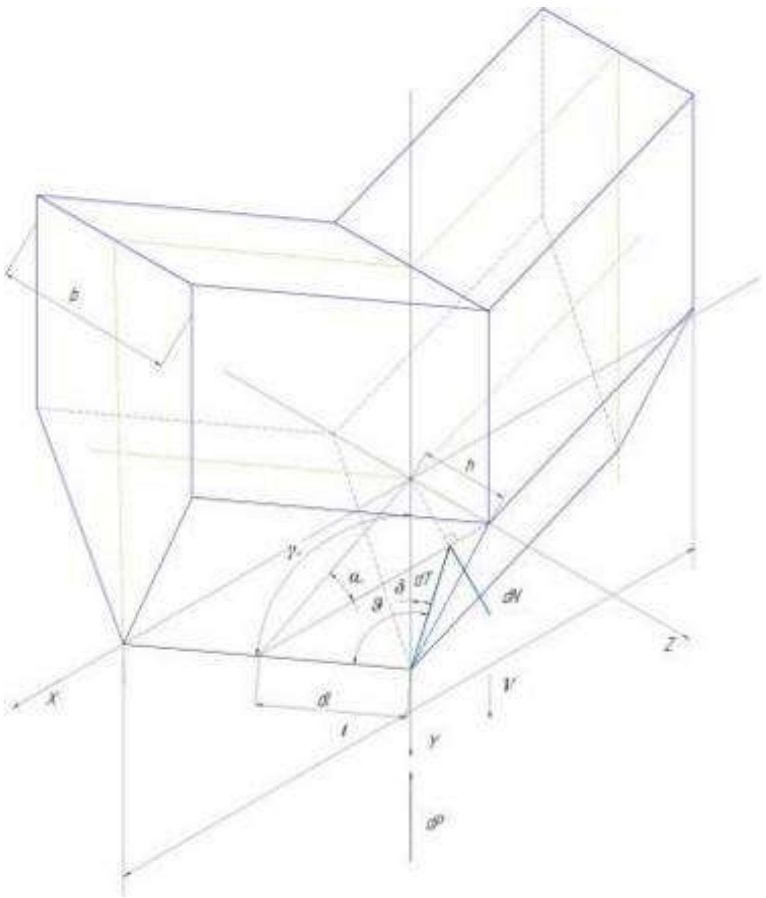

Fig.1 - The scheme of blades and soil interaction

An elementary normal pressure on the working edge can be shown through the pressure index q and differential area dF:

$$dN = q \cdot dF \text{ . [N]} \tag{2}$$

where

$$dF = \frac{h \cdot dl}{sin\alpha_p} \text{ . [m}^2\text{]} \tag{3}$$

here

$$h = \frac{b}{2} \text{ . [m]; } l = \frac{t}{sin\gamma_{зx}} \text{ . [m]; } dl = \frac{dx}{sin\gamma_{зx}} \text{ . [m]} \tag{4}$$

where

b - means thickness of a cutting blade. [m];

l - means length of a cutting edge of a knife . [m];

dl - means an elementary area of a cutting edge. [m];

t - means length of a single grab. [m].

Measuring of an elementary friction force through a normal pressure force dN and frictional coefficient $f=tg\varphi$ gives

$$dT = f \cdot dN = tg\varphi \cdot dN \text{ . [N]} \tag{5}$$

where

φ - means an angle of wall friction. [grd].

Angles δ and ν are angles between direction of soil movement onto working edge of a knife and OY axis and cutting edge. They can be determined on the base of assumption that movement of soil particles along a working edge of a knife is uninterrupted under the following circumstances (*Kravets S.. Romanovskiy O.. 2014*):

$$\nu = \gamma_{зх} \,.\ \text{[grd]} \tag{6}$$

$$\cos\delta = \sin^2\gamma_{зх}(ctg^2\gamma_{зх} + \cos\alpha_p) \,.\ \text{[grd]} \tag{7}$$

We put the expressions (2) – (7) into the formula (1), make some approximations and get the following:

$$dP_y = q_{cep}h\left(1 + \frac{tg\varphi\cdot(\cos\gamma_{зх}\cdot ctg^2\gamma_{зх} + \sin\gamma_{зх}\cdot\cos\alpha_p)}{\sin\alpha_p}\right)\cdot dl \,.\ \text{[N]} \tag{8}$$

We integrated the expression (8) from 0 to t and got the following:

$$\begin{aligned} dP_y &= \int_0^t q_{cep}h\left(1 + \frac{tg\varphi\cdot(\cos\gamma_{зх}\cdot ctg^2\gamma_{зх} + \sin\gamma_{зх}\cdot\cos\alpha_p)}{\sin\alpha_p}\right)\cdot dt = \\ &= 4q_{cep}bt\sin\gamma\left(1 + \frac{tg\varphi\cdot(\cos\gamma_{зх}\cdot ctg^2\gamma_{зх} + \sin\gamma_{зх}\cdot\cos\alpha_p)}{\sin\alpha_p}\right) \end{aligned} \tag{9}$$

We express q_{cep} through soil bearing capacity $q_{кр}$ and ratio between pressure of an environment on a knife working edges in case of bias cut K (*Romanovskiy O.. 2012*):

$$q_{cep} = q_{кр}\cdot K \,.\ \text{[Pa]} \tag{10}$$

$$K = \frac{q_{\gamma_{зх}}}{q_{\gamma_{зх}=90^\circ}} = \frac{\cos\alpha_p - \sin\alpha_p\cdot tg\varphi}{1 - \sin^2\gamma_{зх}\cdot(1-\cos\alpha_p) - \sin\gamma_{зх}\cdot\sin\alpha_p\cdot tg\varphi} \tag{11}$$

The number of working edges is four; thus, the expression (8) will be the following:

$$\begin{aligned} P_y = 4q_{cep}bt\sin\gamma\cdot &\frac{\cos\alpha_p - \sin\alpha_p\cdot tg\varphi}{1 - \sin^2\gamma_{зх}\cdot(1-\cos\alpha_p) - \sin\gamma_{зх}\cdot\sin\alpha_p\cdot tg\varphi}\times \\ &\times\left(1 + \frac{tg\varphi\cdot(\cos\gamma_{зх}\cdot ctg^2\gamma_{зх} + \sin\gamma_{зх}\cdot\cos\alpha_p)}{\sin\alpha_p}\right) \end{aligned} \,.\ \text{[N]} \tag{12}$$

According to the said angles of cutting α_p the minimal power of cutting is measured as

$$\frac{dP_y}{d\gamma_{зх}} = 0 \,. \tag{13}$$

$$\frac{dP_y}{d\gamma_{зх}} = \frac{\cos\alpha_p - \sin\alpha_p\cdot tg\varphi}{1 - \sin^2\gamma_{зх}\cdot(1-\cos\alpha_p) - \sin\gamma_{зх}\cdot\sin\alpha_p\cdot tg\varphi}\cdot\left(1 + \frac{tg\varphi\cdot(\cos\gamma_{зх}\cdot ctg^2\gamma_{зх} + \sin\gamma_{зх}\cdot\cos\alpha_p)}{\sin\alpha_p}\right) = 0 \,. \tag{14}$$

$$\begin{pmatrix} \left(\dfrac{(\cos\alpha_p - \sin\alpha_p\cdot tg\varphi)\cdot(\sin2\gamma_{зх}\cdot(1-\cos\alpha_p) + \cos\gamma_{зх}\cdot\sin\alpha_p\cdot tg\varphi)}{(1-\sin^2\gamma_{зх}\cdot(1-\cos\alpha_p) - \sin\gamma_{зх}\cdot\sin\alpha_p\cdot tg\varphi)^2}\right)\times \\ \times\left(1 + \dfrac{tg\varphi\cdot(\cos\gamma_{зх}\cdot ctg^2\gamma_{зх} + \sin\gamma_{зх}\cdot\cos\alpha_p)}{\sin\alpha_p}\right) \end{pmatrix} + \\ + \left(\left(\frac{\cos\alpha_p - \sin\alpha_p\cdot tg\varphi}{1 - \sin^2\gamma_{зх}\cdot(1-\cos\alpha_p) - \sin\gamma_{зх}\cdot\sin\alpha_p\cdot tg\varphi}\right)\cdot\left(\frac{tg\varphi\cdot\cos\gamma\cdot(\cos\alpha - 2 - ctg^2\gamma)}{\sin\alpha}\right)\right) \,. \tag{15}$$

The results of calculations done are demonstrated in the form of the following line chart (fig. 2).

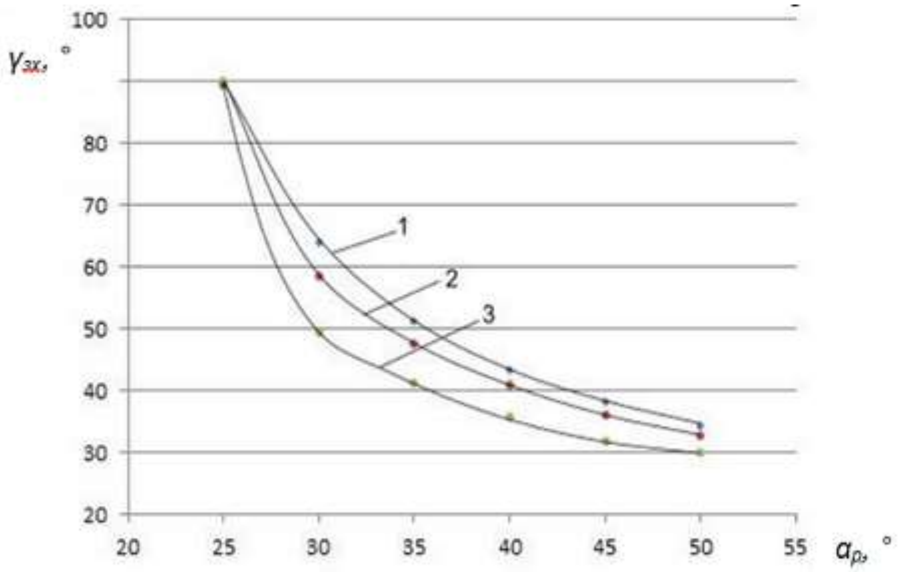

Fig.2 - Dependence of rational constituent angles of knives for soils with frictional coefficient:
1 - φ=20°; 2 - φ=30°;3 - φ=40°

CONCLUSIONS

The dependence above allows us to draw the following conclusions:

1. Rational constituent angles of knives γзх depend on angles αр, essentially while soil conditions are not so crucial.
2. Equipment designed with rational constituent angles of knives is able to significantly affect energy efficiency of a vibration shell for ground walls construction.

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RESEARCH OF WEDGE-SHAPED DESTRUCTIVE ELEMENTS PLACEMENT ICEBREAKER
/
ДОСЛІДЖЕННЯ РОЗМІЩЕННЯ КЛИНОВИДНИХ РУЙНІВНИХ ЕЛЕМЕНТІВ ЛЬОДОСКОЛЮВАЧА

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Keywords: *ice coverage, crack, destruction, placement of wedge-shaped destructive elements, technological module, system of cracks.*

ABSTRACT

Experimental researches of the rational system of wedge-shaped destructive elements placement are expounded. The change of energy capacity of the ice layer destruction process is determined and experimentally grounded and the estimation of quality of road pavement cleaning is given depending on placing of indents on the working body.

РЕЗЮМЕ

Изложены экспериментальные исследования рациональной системы размещения клиновидных деструктивных элементов. Изменение энергетической емкости процесса разрушения ледяного слоя определяется и экспериментально обосновано и дается оценка качества очистки дорожного покрытия в зависимости от размещения отступов на рабочем теле.

INTRODUCTION

For this purpose it is expedient to apply working bodies which would provide cleaning of road pavement without its damage and without contamination of the environment. Until recently, the development of their design has been mostly aimed at diminishing hauling resistance and to a lesser extent – at achieving high-quality operation indices and road pavement cleaning. According to the existing technologies the required quality of road pavement cleaning is obtained with the utilization of combination of a few types of treatment which result in additional energy consumption *(Sedov L.I.. 1973; Balovnev V.I.. 1981).*

Winter period in the road maintenance organizations is the most difficult and responsible. Road conditions at this period of year are often the cause of accidents. Phenomena that include complicate or make impossible to travel on roads include blizzards, snow and puts icing coatings. Last one causes a significant reduction in traffic speed and movement and sometimes stops altogether. Due to the deterioration of toll roads in winter Ukraine's economy has significant social and economic losses.

Existing technologies remove ice formations formed on the surface of the road surface, including the use of salt in the cities that are not effective enough, as a result corrosion of metal surfaces adversely affects the road surface, the tires of cars, falling into the ground, roadside vegetation, pollute waste water and practically it is not used in the thickness of ice formations than 30 mm and temperatures below -10 0C.

It is therefore recommended to use working bodies that would ensure clean coating without damaging and polluting. Until the development of structures in their majority, it was aimed at reducing traction resistance and less - on the achievement of quality indicators and quality cleaning coatings. For existing technologies necessary quality cleaning coating is achieved using a combination of several types of treatment which results in additional energy (*Goldstein R.V..2012*). In addition, existing ice breaking working bodies do not provide contactless detachment ice formations from the surface coating, which leads to damage.

In this regard, nowadays, the urgent task is to develop effective working bodies to remove ice formations that would consider the various conditions of formation and temperature of the natural environment to improve quality cleaning coverage with minimal power consumption, without polluting the environment without damaging the pavement.

Features and efficient operation of city streets and roads are largely dependent on the technical state of structural elements. Among them is the basic building block pavement, technical condition which affects almost all indicators of operation and functioning of city streets and roads. This is due to the dominance of technical indicators of pavement in assessing the overall operation and functioning of city streets and roads.

During the operation of city streets and roads as a result of mechanical stress, natural and other factors having various pavement defects (wear, deformation, fracture, etc.) lead to the deterioration of its technical condition. As a result, over the time it leads to deteriorating of technical condition and other structural elements and engineering equipment of city streets and roads.

In addition to technical performance status, the quality of operation of city streets and roads is also defined as operational, hygienic, aesthetic, social, economic.

The most difficult period of operation of city streets and roads is winter maintenance, which requires large material costs and labor costs.

Clean technology of urban areas involves removing snow as soon as possible. But because of the complexity of the organization, deviations from technical recommendations as well as the limited number of available machines snow removing is often done poorly and late. Thus, with increasing temperature above 0°C and subsequent sharp cold snow turns to ice formation.

Compaction of snow is accompanied by a sharp increase in its strength, durable large snow becomes compacted during the transition from state to ice formation. Thus, the strength of ice formations at shift exceeds the same indicator for compacted snow almost three times (*Veyukov E.V.. 2012*).

Ice formation significantly alters the performance characteristics of the road surface, defined by two parameters:

- Coefficient of adhesion of the car to the road surface;
- Coefficient of rolling wheels.

In reality, there is always the potential for urban roads of compacted snow and ice formations to be removed from the pavement surface as soon as possible.

Struggle with slippery winter on the roads leads in three directions:

- Prevention of slipperiness;
- Improve the adhesion of the car with icy coating;
- Remove ice formations on the road surface.

The first direction is based on carrying out preventive measures that impede forming slipperiness on the roads. This area is not very effective, as can not be predicted during the formation of ice formations and is not suitable for use on city roads.

The second trend is spilling over the surface of icy road friction materials which improve adhesion to the road. The disadvantage is the low cost and lack of effectiveness as friction materials are off the wheels of cars and wind blown off the road immediately after the spill.

The third area is the destruction of ice formations on the surface of the cover and remove it outside the sidelines. Destruction efficiency increases with increasing thickness of ice, decreasing temperature and increasing the degree of water repellency air. It is used for clearing snow and ice removal and destruction of structures (*Voskresenskiy G.G.. 2010*).

Current trends of removing ice formations of pavement have several disadvantages that lead to deterioration in the quality of pavement and limit the application range. So important is the task of developing a new technical solution to remove ice formations of pavement and sidewalks.

Summarizing the above mentioned, it resulted that the most promising in terms of material costs, environmental pollution and efficiency is a mechanical way to remove ice formations of pavement and sidewalks.

MATERIAL AND METHOD

Effecting on ice with dynamic loading of high amplitude but low frequency results in his instantaneous fragile destruction under the action of tension waves. The prerequisite of tension waves formation and their distribution in the environment under dynamic loadings that influence the destruction of material are considered in the monographs of the well-known scientists: N.A. Alekseev, D.D. Barkan, L.I. Baron, V.L. Baladinsky, S.S. Grigoryan and many others. The researches of physical and mechanical properties of ice and its destruction peculiarities have been performed by G.L.Karaban, A.N. Zelenin, V.N. Denisov, L.S. Mnukhin, V.V. Bogorodsky, V.V. Laure,. K.F. Voytkovsky, etc. In the course of research it has been elucidated that the ice formed on road pavements of streets and sidewalks has an obviously expressed chaotic texture formation and the rate of its freezing up with road pavement depends on a series of factors, primarily on the state of road pavement surface *(Baladinskiy V.L.. 1971; Cherepanov G.P.. 1974; Balovnev V.I.. 1981)*.

In this connection, it is an urgent task nowadays to develop highly efficient working bodies for ice removal which would allow to improve the quality indices of road pavement cleaning without its damage grounding on the consideration of different formation terms.

The efficiency of an icebreaker operation substantially depends on placement of indents in the technological module which form a system of destroying cracks on the ice surface. Therefore, while choosing the rational placement of contiguous destructive elements on a working body it is possible to reduce the energy capacity of destruction process, to increase the area of destruction and decrease the size of fractions of the split off ice, to provide necessary cleaning quality of road pavement.

Consequently, in order to provide high-quality operation of working equipment, it is necessary to create such a strained state in an ice array so that to promote the distribution of destructive cracks down to the surface of road pavement *(Muskhelishvilli N.I.. 1966).*

Thus, the distance between the contiguous destructive elements must provide the mutual overlapping of the fields of their strained states, that will enable the complete destruction of ice formations layer on the pavement.

As an object of the research there has been used a hydroimpulsive working body, the shocking plate of which is equipped with indents having appropriate geometrical parameters together with the brush for clearing from ice formation remains.

Workings indents are accommodated in two parallel rows, in a chess order with the mutual overlapping of the destruction area (fig. 1) perpendicular to the direction of icebreaker motion with the united front of cracks development.

The volume of formations amounted to 0.01…0.10 m^3 per one m^2 of pavement. The ambient temperature was -2…-25 ^{0}C. the density of ice formations – 0.7…0.95·10^3 kg/m^3, the presence of different inclusions aws equal to 2…7%.

It should be noted that with the implementation of the working body into the working environment with opened lateral walls, the blasted area is increased due to the appearance of cracks which go out on a lateral surface. In this case, the optimum value of shoulder of splitting off, the size of which can be obtained under the condition of energy minimum necessary for the formation of splitting off cracks serves as a determinative of the process.

Consequently, if we want to dispose an instrument nearby, earlier was created a small hole of splitting off before a subsequent blow, the latter playing the role of an additional free surface, though of limited size, however the breakage is performed jointly.

The purpose of the experiment is the verification of analytical dependences and findings for the substantiation of parameters of splitting off and placing of indents for the destruction of an ice layer. The tests have been carried out on the laboratory installation presented in figures 1 and 2.

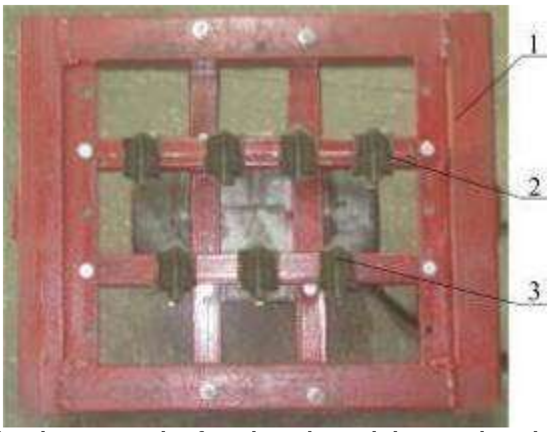


Fig 1. Laboratory installation for the research of wedge-shaped destructive elements placed on the shocking plate: 1 – a frame of working body. 2 – the indents of the first row. 3 – the indents of the second row.

RESULTS

After conducting the experimental researches on a laboratory stand, it was detected the influence character of wedge-shaped destructive elements placing order on the peculiarities of the process: of operation *A*. of energy capacity q_A of destruction process and index of cleaning quality of road pavement – the data have been obtained by which graphic dependences have been designed; the analysis allowed to define the basic particularities of wedge-shaped destructive elements interaction with the environment being destroyed.

During conducting the experiment for creating high-quality picture, photographing was erformed that has allowed to create a photogram presented in figure 3.

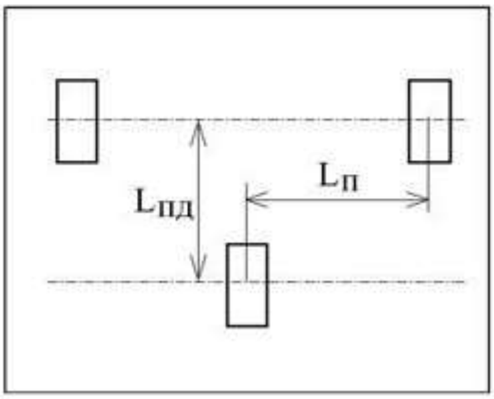
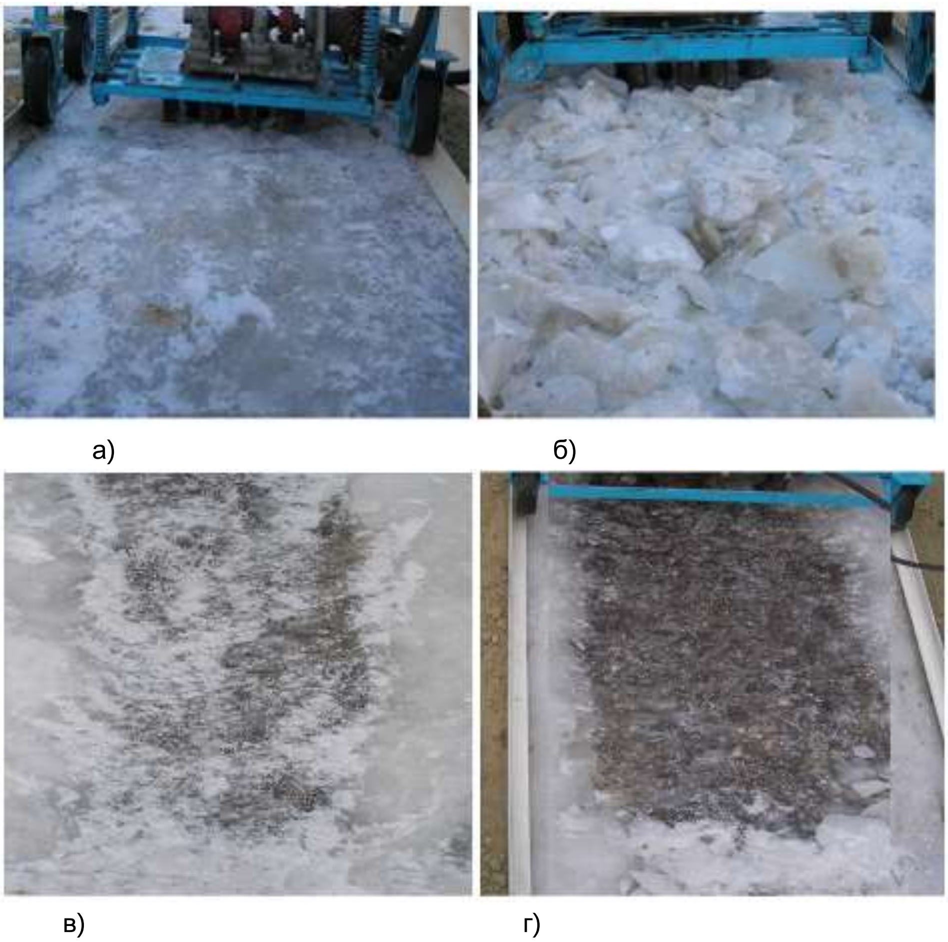


Fig 2. Chart of wedge-shaped destructive elements placing in two parallel rows in a chess order.

As a result of experimental researches the dependences for placing of wedge-shaped destructive elements on the working body have been obtained, while removing ice formations from the surface of road pavement at the angle of an indent sharpening 2α=27°.



а) б)

в) г)

Fig. 3. Photogram of ice destruction process.

As a result of PFE was obtained the regression equation and was introduced in natural scale. After its decode it results:

$$q = 65{,}36 - 18{,}67 \cdot L_П - 1{,}34 \cdot L_{ПД} - 5{,}42 \cdot H \ + 2{,}07 \cdot L_П \cdot L_{ПД} - \\ - 4{,}74 \cdot L_П \cdot H + 1{,}29 \cdot L_{ПД} \cdot H + 2{,}13 \cdot L_П^2 - 0{,}86 \cdot L_{ПД}^2 - 1{,}12 \cdot H^2 . \quad (1)$$

$$k_Я = 1{,}021 - 0{,}029 \cdot L_П + 0{,}0003 \cdot L_{ПД} - 0{,}0011 \cdot H \ + 0{,}0015 \cdot L_П \cdot L_{ПД} - \\ + 0{,}0011 \cdot L_П \cdot H + 0{,}0002 \cdot L_{ПД} \cdot H - 0{,}0012 \cdot L_П^2 + 0{,}0004 \cdot L_{ПД}^2 - 0{,}0002 \cdot H^2 . \quad (2)$$

The dependence of energy capacity process indices and quality of road pavement cleaning on the distance between the nearby wedge-shaped destructive elements at different thickness of ice layer *H* is resulted in figure 4 – 6.

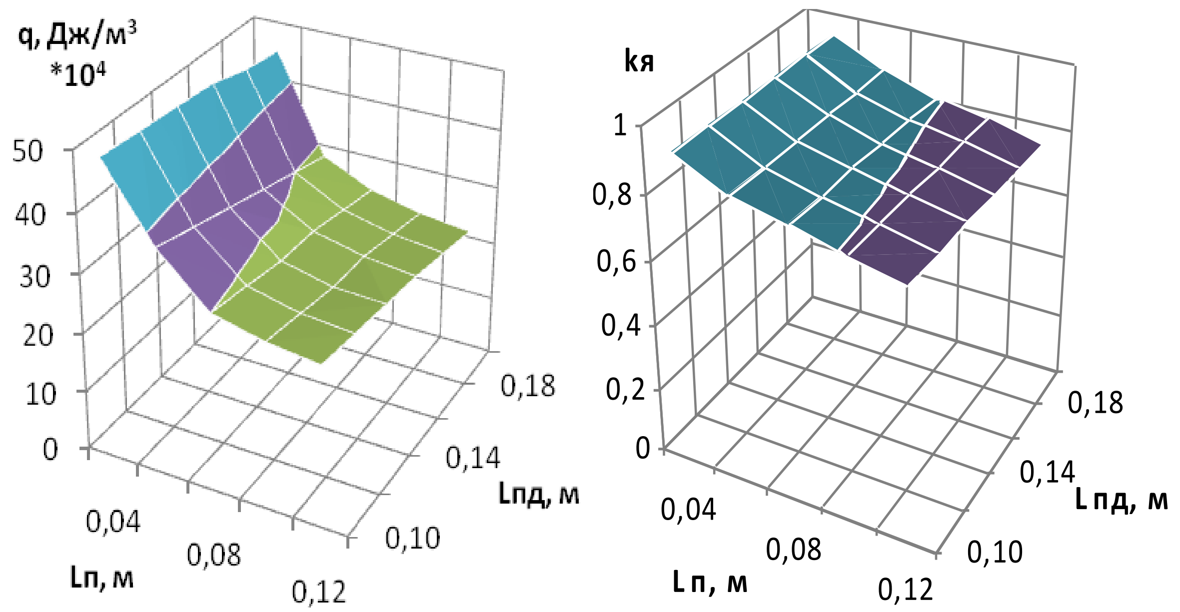


Fig. 4. Dependence of specific energy of destruction and the quality of road pavement cleaning on the distance between contiguous destructive elements at *H* = 0.06 m

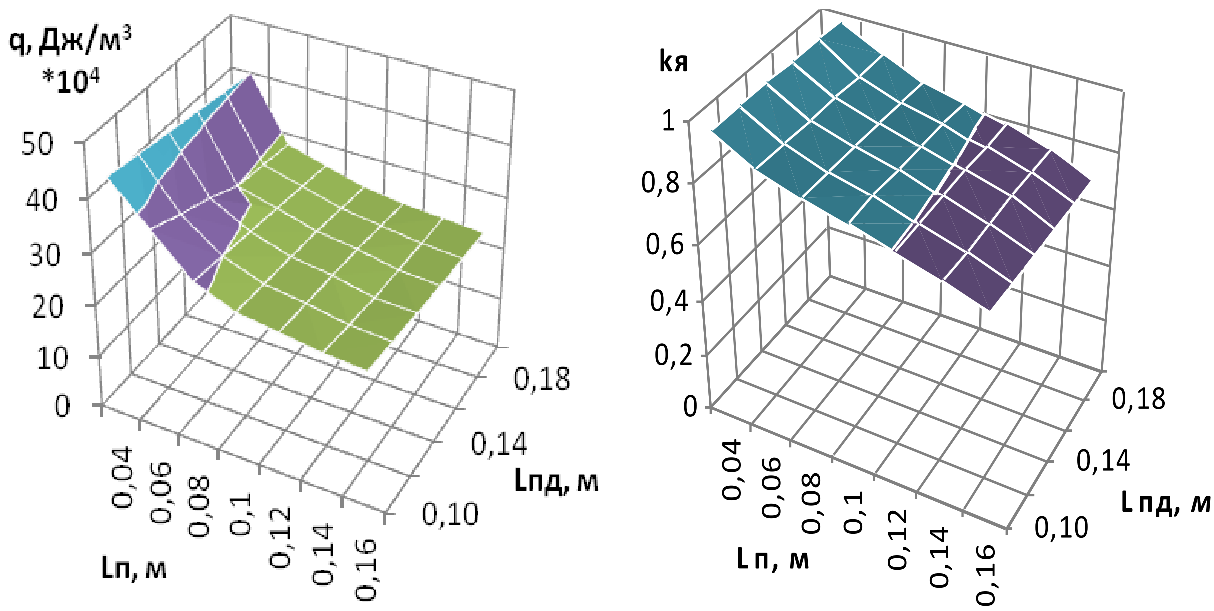


Fig. 5. Dependence of specific energy of destruction and the quality of road pavement cleaning on the distance between contiguous destructive elements at *H* = 0.08 m

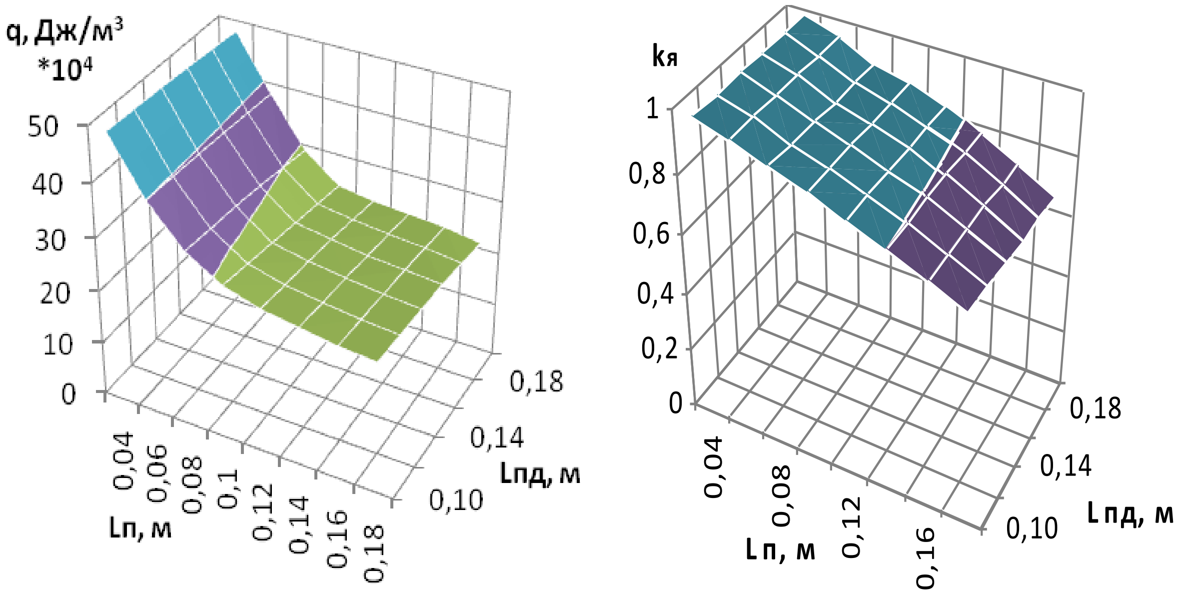


Fig. 6. Dependence of specific energy of destruction and the quality of road pavement cleaning on the distance between contiguous destructive elements at *H* = 0.10 m

CONCLUSIONS

In the course of experimental researches it has been determined (fig. 4–6) that the energy capacity of the process diminishes proportionally with the growth of the distance between destructive elements and the quality of road pavement cleaning diminishes with the increase of the distance between contiguous destructive elements (fig. 4–6). The performed experimental researches enable to select the rational parameters of wedge-shaped destructive elements placement on a working body for the removal of ice formations, which will satisfy minimum energy capacity at the set index of the quality of road pavement cleaning.

As a result of studies, there were found rational placement options of destructive elements to remove ice formations = 80-100 mm. 100-150 mm = aspect ratio = 0.7-0.8 with minimum power consumption for a given indicator as cleaning coating = 0 . 85-0.90.

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EVALUATION OF TRANSPORT SYSTEM DEVELOPMENT THROUGH MODELLING / *ОЦІНЮВАННЯ РОЗВИТКУ ТРАНСПОРТНОЇ СИСТЕМИ ЗА ДОПОМОГОЮ МОДЕЛЮВАННЯ*

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Keywords: *modelling, transport system, mode, transport.*

ABSTRACT

A proper condition for social and economic progress is the reliable operation of the transport system. Prediction of the transport system depends on properly chosen methods of transport processes modelling. This article presents various models of transport, transport and traffic, mainly focused on certain types of vehicle or certain types of operations performed in transport. Studied results were obtained as a result of the simulation. The main objectives of the transport system of Ukraine are investigated.

РЕЗЮМЕ

Необхідною умовою соціально-економічного прогресу є надійне функціонування транспортної системи. Прогнозування розвитку транспортної системи залежить від правильно вибраної методики моделювання транспортних процесів. В роботі представлені різні моделі розвитку транспортну. транспортної системи та транспортних потоків. які переважно орієнтовані на окремі види транспорту або на окремі види операцій. які виконуються на транспорті. Досліджено результати. які можна отримати в результаті моделювання. Визначено основні завдання розвитку транспортної системи України.

INTRODUCTION

Transport system can be seen as an organized association of interrelated and interacting elements, objects, space transport mode of transport to carry out transport operations.

Nowadays, transport system of Ukraine is not fully prepared to provide transportation in required quantities. Due to lack of regulatory framework and low investment potential of the transport system increased wear of means, deteriorating their structure, is not ensured proper traffic safety, increasing the negative impact of transport on the environment and human health. The rapid development of the domestic market of Ukraine requires efficient and economical transportation system. It means not only a modern transport infrastructure with high throughput and transportation capacity and reliable modern rolling stock that meets international standards but also new and better methods of assessing the economic and technical efficiency of transport of Ukraine *(Mukminova T.A.. 2007).*

In practice, the planning of transportation systems is represented by common normative statistical extrapolation, system-structural associative and methods of economic and mathematical modelling. Problems regarding planning process included a number of domestic and foreign authors *(Tsyrel S.V.. 2007).*

Model is an image representation of an object, system, process in the same form as another in real life. There are physical and mathematical modelling systems.

When modelling is the process of investigation of the real system that includes building a model of research and transfer of the results for the studied system. In mathematical model of a real system it refers to the set of relations that define the characteristics of the system depending on its parameters, environmental conditions, initial conditions and time.

The main stages of modelling are:

1) Analysis of the economic system, its identification and determination of sufficient structures for modelling.

2) Synthesis and build of a model because of its mathematical characteristics and specifications.

3) Verification of the model and specification parameters.

4) Clarification of all system parameters and the parameters of the model with the necessary corrections, adjustments *(Mamonov K.A.. 2009).*

Research of mathematical model makes it possible to obtain real economic characteristics of the object or system. Type of mathematical model depends on the nature of the system and of the objectives of the study. In general, the mathematical model of the set contains a description of possible states and last law of transition from one state to another (operation of law).

Are there widespread the development and use of mathematical modelling techniques in the analysis and management of socio-economic processes?

The main problem in modelling traffic flows is the lack of limitations in processing power and high sensitivity of real transport system to input data (characteristics of sources and sinks of cars) and the inability to collect enough information about the full input.

MATERIAL AND METHOD

In a market economy, the development of the transport system is very important too. Traditional approaches to managing the development of transport systems mainly focused on certain types of vehicle or for certain types of operations performed in transport. In existing techniques the transport operation in the development of an integrated transport system, is not considered.

Many scientific researchers investigated sectoral subsystems of transport system of the country or region. The authors Nagornyi. Ye. V.. Sheptura. O. M.. & Potapenko. A. V. The model transport systems "LAS" and software to this model. make it possible to set patterns of development and forecasting performance of trucking companies Ukraine. With this model can make predictions passenger volumes. the average monthly wage of workers trucking companies. the size of rolling stock. harmful emissions and the required number of engineering staff *(Nagornyi Ye. V.. Sheptura O. M.. & Potapenko A. V.. 2011)*.

Panasenko N.L. presented an algorithm of complex integrated assessment of transport systems in Ukraine. The first step in the algorithm evaluation of the transport system is the identification and selection of sub indicators of sufficient completeness reflecting properties of these subsystems. In the second stage for a comprehensive integrated assessment of each transport all selected statistical indicators characterizing its development. should lead to dimensionless parameters *ij z* a set of values on the interval [0. 1]. which is calculated by the formula

$$z_{ij} = \frac{x_{ij} - x_{ij}^{\min}}{x_{ij}^{\max} - x_{ij}^{\min}} \tag{1}$$

where x_{ij} – the initial value of i-th index for the j-th mode of transport;

$x_{ij}^{\min}$ and $x_{ij}^{\max}$ – respectively is the smallest and the largest value of initial index. x_{ij} initial rate for the period of time.

In the third phase for each indicator. weights are defined w_{ij}. These factors are selected proportional component of the vector squared covariance matrix normalized indicators z_{ij}. corresponding to the maximum eigenvalue λ_1 this matrix [1. 4]. A comprehensive integrated assessment of individual modes of transport is determined by the formula:

$$W_j = \sum_{з=1}^{n} W_{ij} \cdot Z_{ij} \tag{2}$$

where w_{ij} - a weighting factor of indicator z_{ij} in evaluating the level of development the j-th mode of transport;

z_{ij} - normalized index corresponding to the initial index xij.

According to the results obtained can analyze the trend of the transport system *(Panasenko N.L.. 2014).*

Shumeyko O.A. considered using the method of sequential analysis of variants (PAHs) for the numerical solution of complex optimization problems of transport system. Of particular difficulty in the practical application of the method of PAHs to meet the challenges of optimizing the railway system is to create a table of possible transitions.

There are some problems of optimization of technical and technological state of the transport system in which the final state in the process is fixed optimization. This approach allows finding all the best solutions at the same time. as a result of which the system moves from the initial state in each of the final states to ensure the compliance of technical and economic requirements of the end of the period studied. However, since the chosen might get a tree structure. which values of b t on these branches will meet semi-optimal solution. The whole procedure must be repeated for all sets of values that give a task that falls apart.

CAV method used for solving the problem of optimizing the technical and technological development of transport systems can be used for a wide range of multivariate problems to analyze many factors influence the choice of the optimal trajectory study of the system.

This allows for example to analyze the sensitivity criterion of efficiency investments and investigate the impact of various factors on this indicator *(Shumeyko O. A.. 2008).*

Transport model is divided into mathematical and simulation. The first known laws operate traffic. in the form of formulas. systems of equations and more. Second. mimic the movement of individual vehicles. driver behavior. work lights and more. In practice increasingly used a mixture of mathematical and simulation models.

For example. transport systems modeling at the macro (country. city. neighborhood) operate demographic data. the concepts of "Earl Road". "attraction zone". "transport supply and demand." They laid the percentage of the population use cars. the capacity of the streets. the number of parking spaces at the mall. Macro model uses basically. mathematical modeling and tries to answer the question: "Why and where all go?". "Is it enough bandwidth streets that all serve?". "What would happen if this street block?". Etc..

Micro model of operating a particular site with "real world" – controlled intersection. transportation. network street car. This micro model "knows" about the number of lanes. the presence of the ups / downs. characteristics of engines (how quickly they can move). rules of the road and stop. To micro model started working at full capacity. her entry should submit information on macro model. quantity and composition of vehicles at certain times (how many cars and how many trucks. how many buses. trams. etc.). the behavior of drivers (or often rearranged as often follow the signs and displays. or observe the rules of parking). If the data are correct macro. micro allows to accurately simulate real traffic.

The main purpose of transport models are conducting experiments. You can check how certain changes in the movement of impact on traffic. You can set up traffic lights. to decide on the extension of the street to ban or permit turns on the organization of one-way traffic. The model will help develop a plan of temporary traffic at the time of major events – competitions. street parades and more. At the city level transport modeling will decide on the consequences for transport conditions of construction of another shopping center or a new neighborhood. In other words. the transport model – an indispensable tool for the improvement of the city without serious consequences. The more the model. the more diverse information it stores. Maintain up to date model display means it is changing the real world – floor traffic. road repairs. the appearance of new roads. traffic lights. traffic lanes. residential areas. schools. offices and retail space. Support models to date – a time-consuming and responsible process that imposes high demands on the staff. the organization's internal processes. quality and stability information channels.

The use of surveillance cameras over the work of commercial vehicles in ITS (intelligent transport systems) can detect its gravitational zone. demand. supply. These data create a transport simulation of rolling stock commercial city level. Experience in implementing this simulation indicates a significant reduction in travel time and attract additional rolling stock. reduce the environmental impact on the environment *(Rudzinska O.V.. toothless Y.V.. Shumlyakivskyy V.P.. 2016).*

As the Rudenko D.V.. the essence of economic and mathematical modeling of transport systems is to find adequate reflection process using mathematical description. For this you can use different groups of economic and mathematical models.

Building a model of logistic system will help determine the parameters of the system in which the maximum of the expected financial results (OS).

The author notes that it is appropriate to evaluate the results of the logistic system by the criterion of the expected loss. In general. the record of this criterion has the form:

$$OS\ system = D\ \ system - Z\ \ system - N\ system. \tag{3}$$

where: D system – the cost of shipping logistics system. UAH; Z system – system costs. UAH; N system - the loss of the logistics system. UAH.

With the fixed volume of sales in the market and the selling price fixed in accordance with the formula 3 OS system may increase by reducing the costs and losses of the system. The magnitude of expenditure systems affect transport costs. The costs of transport. however. depend on the delivery of goods transport technologies that use in the logistics system. The use of transport technologies is closely related to the work of the agents of the logistics system as well as using different channels of distribution of goods.

To evaluate the basic version of functioning logistics system in terms of transport technologies deliver the goods proposed to use the indicator attractiveness transport goods distribution channels:

$$K_T^{KR} = \frac{Z_p^{tr}}{Z_b^{tr}}. \tag{4}$$

where: Z_p^{tr} – transport costs in the proposed version's distribution of goods in the logistics system. UAH; Z_b^{tr} – transport costs by the base (or current) version of the distribution of goods in the logistics system. UAH.

To assess the feasibility of vehicle logistics system is proposed to use ratio relative efficiency of vehicles:

$$K_{TZ}^{LS} = \frac{OFR_{sis(q)}^{p}}{OFR_{sis(q)}^{b}}. \tag{5}$$

where: $OFR_{sis(q)}^{p}$ – expected financial performance logistics system for the proposed brand vehicle. UAH; $OFR_{sis(q)}^{b}$ – expected financial performance logistics system for the base (or existing) brand vehicle. UAH.

The current state of market relations requires a combination of all market consumer products for the successful operation in this market. Logistic system formed must respond quickly to changes in demand for goods. Because of the large variety of possible formation of logistics systems there is the need to study and get information about the features of their development *(Rudenko D.V., Lagodyuk O.D.. 2013).*

Kudrytska N.V. believes that the study of the transport system of Ukraine should be performed through the development and implementation of cognitive model that enables it to survive in the competitive context of globalization. Cognitive model gives an idea of how should operate and develop the transport system, ideas and mechanisms should be formulated and employed in management.

Cognitive modelling methodology is a set of methods for analysis and subjective perceptions of an expert (a person who makes decisions) regarding the functioning of semi structured systems and methods for developing strategies for managing such systems.

The cognitive approach for decision support is focused on how to activate the expert intellectual capacity and help him fix his vision of problem situation in a formal model. As the latter applies cognitive map that represents the fundamental laws and regularities in the form of a signed oriented graph in which the apex of the graph – the factors (attributes, characteristics) and the weighted arch between them – the causal linear or nonlinear relationship.

It is important for cognitive models is the requirement of stability in relation to single pulse exposure. These properties of processes and phenomena provided by the presence of both negative and positive. stimulating growth. feedback. and debugging options feedbacks. guaranteeing performance conditions described above. With the positive cognitive-communication factor causes an increase leads to an increase factor and effect. the negative – Increasing the value factor. causes leading to the reduction factor and effect.

Cognitive graph is subjective simplified model of the system and provides material for further research – cognitive modeling. which aims at generating and verifying hypotheses about the functional structure of the situation there. to obtain structures able to find out the situation through behavior study and explanation qualitative forecasts of its development (direct problem solution "What if?"). get tips and advice on management situation (the inverse problem solution "What you want?") *(Kudrytska N.V.. 2015)*.

The figure represented fuzzy cognitive map of the transport system of Ukraine with the main factors of its development. which is devoted to research achievements of the author (*Kudrytska N.V.. 2015*). However. the difficulty is determining the degree of influence and relationship between these factors. To solve this problem. appropriate use of cognitive modeling.

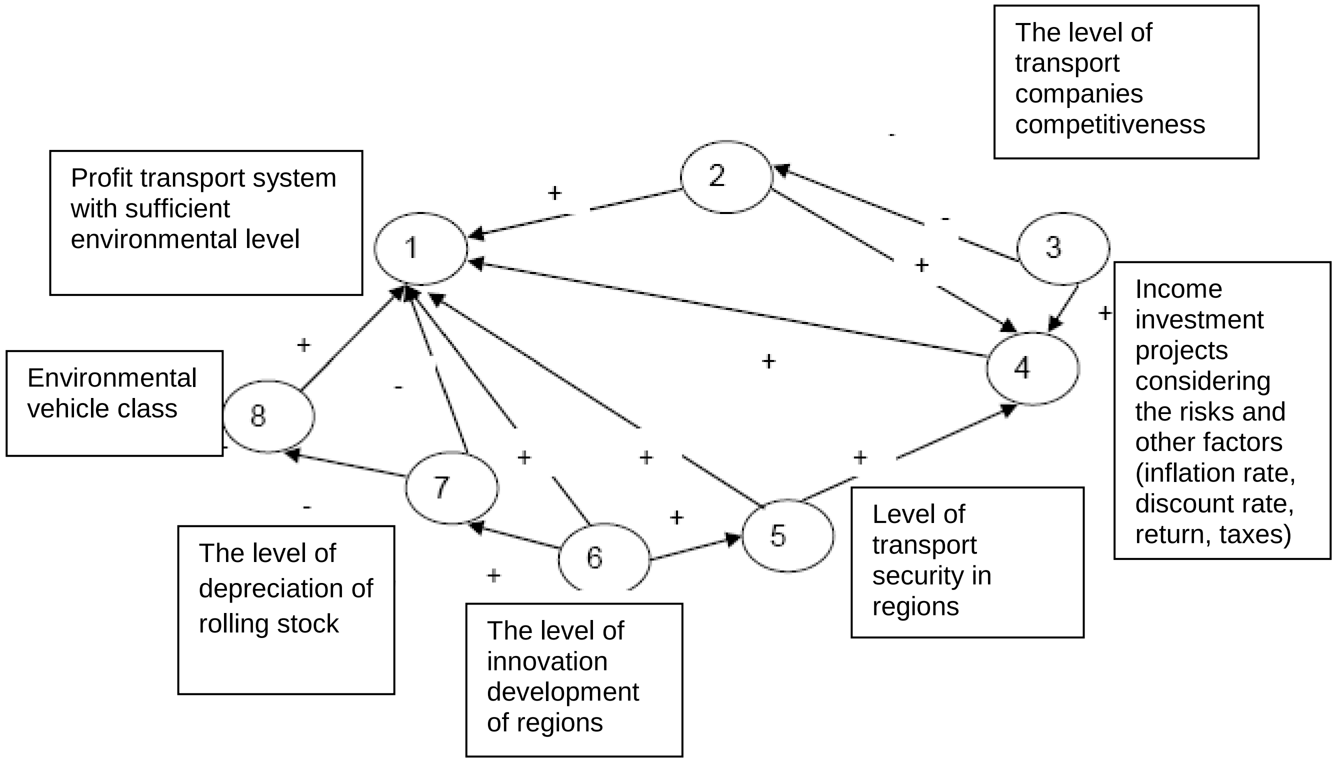

Fig. 1 - Fuzzy cognitive map of the transport system of Ukraine

The author presents the following economic and mathematical models of dynamic development of transport system of Ukraine:

1. Models ranking regional transport security by:

a) hierarchical cluster analysis

The components of the integral index of transport provision Regions cargo transportation: - existing population. thsd.; land area. thous. km2; - Transport of goods by road. mln. Tons; - Length of public roads. thous. Km - the average transport distance of the 1st ton Trucking km - total mileage of trucks. thous. Km; - Density of public roads paved (km per 1 thousand. Km2 area) .In the simulation result by 3 clusters:

1) a high level of Dnipropetrovsk. Donetsk. Kyiv. Lviv. Kharkiv region;

2) Medium: Vinnitsa. Zaporozhye. Lugansk. Odessa. Poltava and Cherkasy;

3) low: Crimea. Volyn. Zhytomyr. Ivano-Frankivsk. Kirovohrad. Mykolaiv. Rivne. Sumy. Ternopil. Kherson. Khmelnytsky. Chernivtsi. Chernihiv.

b) the desirability function Harington.

The overall indicator transport security:

$$D = \sqrt[n]{\prod_{i=1}^{n} d_i} . \qquad (6)$$

where: d_i - partial function. n – number of indicators. d_i =exp (□-exp (□y_i)) . where: y_i - the indicator in a standardized form.

2. The model determining the cost of transport of goods by risk The study of economic risks on transport showed that the acceptable level of risk will be 0.338. while the calculation of tariffs for cargo transportation by road cost is: S2= S1+0.338 S1.

3. Probabilistic model updating vehicles using the theory of Markov processes

Number of vehicles vehicles is updated so that the total number N for the future years remains unchanged: $D_n = D_o P$.

where: D_n - population distribution by age of vehicles in the n-th time; D_0 - initial allocation size vehicle v age at the initial time $D_0 = (v_0.\ v_1. \ldots.\ v_{T-2})$; P - matrix of transition probabilities.

4. The model linear programming problem of finding the optimal distribution capacities of enterprises for the production of biofuels.

Limitations:

1) Every vendor must give consumers biofuels any more than it has: $a_i \geq \sum_{j=1}^{n} x_{ij}$ (*i* =1.2.….*m*);

2) every consumer should receive as much biofuel as is necessary $b_j \geq \sum_{i=1}^{m} x_{ij}\lambda_{ij}$ (*j*=1.2.….*n*);

3) supply and conversion factors should not be negative: $x_{ij} \geq 0$. $\lambda_{ij} \geq 0$;

4) supply option should be the most beneficial to ensure that a minimum total costs: $F = \sum_{з-1}^{nm} \sum_{j=1}^{n} x_{ij} \cdot c_{ij} = \min$; де a_i – provider resources; b_j – consumer needs; c_{ij} – the cost of supply a unit of production from the i-th supplier to the consumer j-th;x_{ij} – size of the supply of the i-th supplier to the j-th consumer; λij - conversion factor that binds ai and bj. *(Kudrytska N.V.. 2015)*.

As noted by Dmitry Bespalov in modeling traffic historically developed two basic approaches – deterministic and probabilistic (stochastic).

The basis of deterministic models is the functional relationship between different parameters. such as speed and distance between cars in the stream. In stochastic models of traffic flow is considered as a probabilistic process.

All models of traffic can be divided into three classes: the model analogs. models passage of the leader and probabilistic models.

In the models-analogues movement of the vehicle is similar to physical flow (hydro- and gas dynamic model). This class of models is called macroscopic.

In the models passage of the leader significant assumptions about the connection between the movement and the main driven car. As the theory in models of of the group take into account the reaction time of drivers studied traffic on the many roads band enough. studied the stability of motion. This class is called the microscopic models.

In probabilistic models of traffic flow is considered as a result of the interaction of vehicles on the elements of the transport network. Due to the strong character limit network traffic the mass character of in the transport stream consisting distinct regularities forming of queues intervals downloads bands on the road. etc. These regularities are essentially stochastic.

Recently. studies traffic flow began to apply interdisciplinary mathematical ideas. methods and algorithms for nonlinear dynamics. Their expediency proved presence in the transport stream of persistent and unstable modes of motion. loss of stability when changing traffic conditions. nonlinear feedback). the need for a large number of variables to adequately description of the system *(Dmitry Bespalov. 2014).*

Modeling and traffic flow research provides an in forecast data of loading transport network. Unloading the problem areas of the road will reduce the overall cost of moving road users.

RESULTS

Improving the effectiveness of transport systems foresees the decision of set of interrelated tasks. many of which can be carried to a higher level of tasks because they are beyond the scope a narrowly transport problems. Process optimization of transport systems consists in finding optimal proportions between the quantitative meanings and tendencies of changes of financial. of technological and organizational factors associated with the operation of transport systems. For realization of these calculations necessary to have a formalized description of patterns of functioning transport systems in which quantitative values of possible changes in the factors which are accounted would be linked with the economic indicators or indicators of the quality of the transport systems of mathematical relationships. For example. it may be the ratio of the balance type in which the quantitative values recorded factors associated functional dependencies; ratio describing the dynamics of the factors in economic indicators over time or when changing numerical values of factors and so on.

Preparation of such relationships. forming together a mathematical model of the object of research is a challenge. First of all. it is difficult to choose the very structure of dependencies. such as the above factors. the technological and technical parameters of transport systems. Then. under the chosen structure should take into account that transport systems operate in an uncertain external and internal environment associated with a large number of interacting parallel functioning of objects and human factor. For example. transportation planning. you can not accurately predict the actual weather conditions. the possibility of sudden congestion on the route. the number of vehicles of other carriers arriving simultaneously at points of loading and unloading. etc.

Optimal planning of transportation systems. essentially overcomes many of these difficulties. based on a system of interconnected mathematical models within which it is possible to take into account features such transport systems as lack of clarity of the information available. the contradictions in the interests of partners. a multi-character assessment of the mode of operation and t. e. based on these models it is possible to formalize optimization problem and use appropriate mathematical apparatus. Experts identify several classes of optimization of transport systems: the problem of routing traffic and vehicle traffic. the task of loading vehicles. the problem of the timetable. task scheduling of labor and technical resources. tasks planning of transport enterprises. problems of perspective development of transport. the problem of industrial and transport planning (*Lotysh V.. 2015).*

More valuable results can be obtained by combining ideas from different fields. For example. hybrid models are able to combine the advantages of different types of models. It would be interesting to combine. for example. Mesoscopical model with microscopic or macroscopic models. In addition. new branch hybrid models can unite mixed class and multi-class models. And finally. now generalized models include many models. but not all. Further generalization can be developed and used to compare existing effective and new models (*Femke van Wageningen-Kessels. Hans van Lint. Kees Vuik. Serge Hoogendoorn. 2014*).

So. for the assessment of transport system is not enough study of its individual subsystems. an integrated approach that reflects the relationship of these subsystems. In this approach. it is important to complete the assessment by which to examine the trend in performance over time. and research results of the analysis. accounting. forecasting. control and regulation of the transport system.

CONCLUSIONS

The system of regulation should be aimed at improving the legislative framework and organizational restructuring. accelerate the development of transport infrastructure. the creation of a national network of international transport corridors. integration of transport systems in Europe and Asia. the Baltic and Black Sea regions in line with international standards. The main factors that hinder the development of transportation services in foreign economic activities in Ukraine are: disorder in system of state regulation regarding border control and collection of fees; the high cost of services provided by customs brokers. service control and transport terminals; numerous bureaucratic obstacles in the design of international transport; low speed delivery of passengers and cargo; and the lack of comprehensive information services to the implementation of international transport; insufficiency. and in certain areas of the complex and lack of regulations governing the international transport and service. the inadequacy of the road network to international standards.

The main objectives of the transport system is the development of infrastructure projects on routes. terminals. ports. airports. bridges. railway stations. supply schemes use mutually vehicles and equipment for shipbuilding industries. automotive and aircraft industry. manufacturers of loading. packing and containerization. accelerate the development of a national strategy clustering of relevant programs. organization of functioning and development of international transport corridors and their involvement in the international transportation network. increase the investment attractiveness of transport by ensuring a competitive environment in the transport sector.

The modeling of the transport system is an integral part of its future development. To address the objectives necessary comprehensive approach in selecting optimization models. since the transport system depends on many factors.

The transport system composition includes all modes of transport and ways of communication. the proportion of each type differs in regions of Ukraine. Therefore. the modeling of the transport system must:

- determine the main indicators of its work through a comprehensive evaluation of integrated transport system development;
- assess a transport provision of regions when using the integral index of transport provision regions and a cluster analysis;
- investigate traffic flows in just a simulation what will help to get the forecast data on loading transport network and determine its throughput;
- solve the problem of optimization of transport system development by a sequential analysis of options method that will allow analyzing the sensitivity criterion of investment efficiency;
- to evaluate the results of the logistic system by the expected financial results criterion.

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GENERAL MECHANIZATION OF SHELLED HAZELNUT PROCESSING PLANTS / *KABUKLU FINDIK İŞLEME TESİSLERİNİN GENEL MEKANİZASYONU*

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Keywords: *hazelnut, mechanization.*

ABSTRACT

Anatolia is the most important centre of hazelnut in the world. The wild species that generate the source of culture varieties have spread from Anatolia. Hazelnut production in Turkey is generally carried out in the Black Sea Region. Turkey provides about 70 % of world production with hazelnut production of 550,000 tons / year according to the average of the last ten years. The fact that the shells of the nuts are broken efficiently without harming the fruit is very important in terms of protecting the economic value of these fruits. In this article, it has been tried to give the sequence of the hazelnut crushing mechanism which has an important place in this economic value.

ÖZET

Anadolu. dünyada fındığın en önemli gen merkezi durumundadır. Kültür çeşitlerinin kaynağı olan yabani türler Anadolu'dan yayılmıştır. Türkiye'de fındık üretimi genel olarak Karadeniz Bölgesi'nde gerçekleştirilmektedir. Türkiye. son on yılın ortalamasına göre dünya fındık üretiminin yaklaşık % 70'ini (550.000 ton/yıl) sağlamaktadır. Fındık kabuğunun içindeki meyvenin zarar görmeden etkili bir şekilde kırılması. bu meyvelerin ekonomik değerinin korunması açısından çok önemlidir. Bu makalede. bu ekonomik değeri sağlamada önemli bir yeri olan fındık kırma mekanizasyonuna ait işlem basamakları verilmeye çalışılmıştır.

INTRODUCTION

Hazelnut production in Turkey is generally carried out in the Black Sea Region. Turkey, while varying according to years provides about 70% of world hazelnut production (550,000 tons/year) according to the average of last ten years. Turkey is followed by Italy, Azerbaijan, USA, Georgia and Spain, respectively (Table 1).

Table 1

World hazelnut production (shelled) [ton]

Countries	2009	2010	2011	2012	2013	2014*	Rate (%)
Turkey	500,000	600,000	430,000	660,000	549,000	412,000	68
Italy	85,000	87,200	140,000	84,000	100,000	80,000	13
Azerbaijan	30,000	25,000	55,000	40,000	35,000	25,000	5
Georgia	27,000	40,000	30,000	28,000	40,000	35,000	4
USA	42,600	24,500	35,000	32,000	40,200	36,300	4.5
Spain	18,000	20,000	22,000	16,000	18,000	19,500	2.5
Others	20,000	27,000	27,000	25,000	25,000	25,000	3
Total	**722,600**	**823,700**	**739,000**	**885,000**	**807,200**	**632,800**	**100**

Hazelnut production is being fulfilled in 33 different provinces of Turkey. In 2014 year, 32 % of hazelnut planting areas are in Ordu, 17% in Giresun, 13 % in Samsun, 10% in Sakarya, 9 % in Trabzon and 9% in Düzce *(GTB Hazelnut Report.. 2015).*

When the general situation of the nuts in the world is examined, it is observed that wild varieties of hazelnut which is the most common breeding after almonds, are found in every region in the northern half and temperate climatic zone. Cultivars are mostly grown in Turkey, Italy, USA, China, Azerbaijan, Georgia. When the last 5 years' data are analysed, it is seen that the total hazelnut areas in the world have changed between 800 - 905 thousand hectares (Table 2).

Table 2

Hazelnut areas in the world [ha]

Countries	2009	2010	2011	2012	2013	2014*	Rate (%)
Turkey	642,866	667,865	696,964	701,407	762,144	701,141	77
Italy	70,256	70,492	70,492	57,992	70,492	71,200	8
Azerbaijan	22,193	23,242	23,242	23,968	23,242	23,000	3
Georgia	12,000	15,500	15,500	12,400	15,500	18,000	2
USA	11,614	11,938	11,938	11,890	11,462	12,500	1
Spain	14,536	13,803	14,067	14,000	15,000	15,000	2
Others	33,000	34,900	35,100	57,186	40,000	63,350	7
Total	**806,465**	**837,740**	**867,303**	**878,843**	**877,840**	**904,191**	**100**

Approximately 80% of this amount is in Turkey, 8% in Italy, 3% in Azerbaijan and 2% in Georgia (TMMOB. 2016).

In addition to data on production quantities and areas, other important aspect of hazelnut is that of breaking of nuts such as hazelnut which are produced intensively in the world and especially in our country and that are broken efficiently without damaging the fruit in order to protect the economical value of these products. One of the main factors affecting the quality of hazelnuts is processing conditions *(Özdemir and Akıncı .. 2004)*, because, as a result of the shell crushing process the damaged fruits lose their value. This situation is even more important in terms of products such as hazelnuts which have an important place in the Turkish economy *(Saraç I.. 2013)*.

The hazelnut harvest in Turkey is usually carried out by hand and the harvested hazelnuts are brought to the factory immediately after they have been dried in large areas or immediately after sowing.

There were two specific objectives of this article. The first was to explain briefly hazelnut production of Turkey. The second was to give the sequence of the hazelnut cracking mechanism which has an important place in this economic value.

GENERAL PROPERTIES OF HAZELNUT CRUSHING PLANT

Firstly, in order to better define the hazelnut cracking and processing activities and to determine the specific properties of the produced hazelnut varieties, studies were made on the standardization of hazelnuts according to certain criteria *(Baş H. 1993)*. In this scope, descriptive hazelnut standards such as internal hazelnut, foreign matter, bitter nuts, brittle and wrinkled rotten nuts in Turkey are defined according to TS 3074. TS 3075 (TSE. 2016). While hazelnuts are divided into groups according to hazelnut trade and shapes (internal plump and pointed kernel and other), they are also divided into classes according to their characteristics such as extra, class 1 and second class. According to the size of the nuts, it is observed they are divided into dimensions. Especially in longitudinal, the difference between the largest and smallest diameters cannot exceed 2 mm. Depending on the smallest diameter in the method of separating the lengths for extra and class 1, any kind of sorting can be done by 2 mm difference *(Baş H. 1993)* (Figure 1).

Fig. 1 - Sorting hazelnuts with sieves

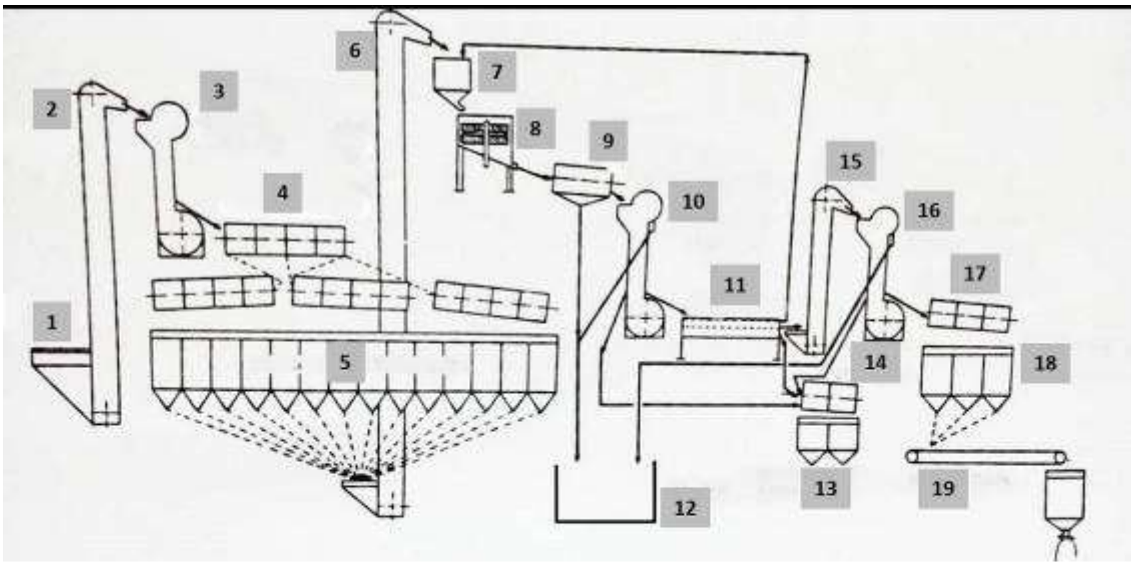
Determination of the differences between hazelnut varieties and physical properties such as hazelnut size, shape, porosity, volume, density, limit speed and breaking force is necessary for the development of hazelnut processing machines. The functionality of most machines depends on their fruit size and shape. For example, sphericity is an important feature in that hazelnuts influence the easy of workability by the food industry. Due to this reason. varieties which are closer to fruit-shaped sphere than others can be grown. Studies have shown that mechanical properties play an important role in many technological processes and determination of fruit quality *(Aktaş et al. 2007).* Numerous works have been dedicated to physical and mechanical parameters regarding different varieties of nuts. Braga *et al*. studied the mechanical behavior of macadamia nut under compression. Delprete and Sesana worked on mechanical characterization of kernel and shell of hazelnuts to improve the discrimination between conform and non-conform hazelnuts. Similarly, Güner *et al.* studied the mechanical behavior of hazelnut under compression loading.

HAZELNUT CRUSHING SYSTEM

In Turkey, hazelnut gardens have a structure that does not meet the standards due to variety and many types. This situation causes problems such as having many kinds of hazelnut which are not suitable for hazelnut standards and foreign market demands, which can easily be damaged on the market. Therefore, tolerances related to the quality of hazelnut, especially in exports are exceeded and as a result prices can fall. Crush breaking efficiency is not at the desired level during the crushing operations in many types of plants which are not in compliance with the standards. It is clear that the lack of standardization in hazelnuts will hamper the development of the mechanization level and reducing the cost of production in the future, as well as the current situation *(Demir and Beyhan.. 2000)*. It is observed that the most suitable crushing system for hazelnut is the mill system of Turkish hazelnut.

Mill system

The fact that the system is cheaper and easier to establish than other systems increases the prevalence in Turkey. Hazelnut crushing factories in Turkey are working with mill system *(Pınar and Beyhan.. 1986*). (Figure 2).



1. Shelled hazelnut storage	*7. Silo*	*13. Wrinkled hazelnut storage*
2. Elevator	*8. Crusher (stone)*	*14.Oblong sieve*
3. Pneumatic separation	*9. Dust sieve*	*15. Elevator*
4. Classification sieve	*10. Pneumatic separation*	*16. Pneumatic separation*
5. Shelled hazelnut storage under sieve	*11. Swinging sieve*	*17. Nut sieve (kernel sieve)*
6. Elevator	*12. Dam of shell*	*18.Nut storage (kernel storage)*
		19. Conveyor

Fig. 2 - Flow chart at hazelnut crushing plant

RESULTS

Calibration of hazelnut

Shelled hazelnuts are poured on the ground floor or in the basement of the factory. Here the hazelnuts are delivered to the numbered sieves with the help of elevators. In the first stage, the hazelnut is cleaned by passing through a dust trap. Cleared nuts pass through cylinders with a diameter of approximately 1.5 m. which are bedded on both sides with holes 10 mm to 15 mm in diameter (Figure 3).

Fig. 3 – General view of sieves

Then. shell nuts below 15 mm are brought to a second classification with the help of elevators. Hazelnuts are passed through 10.11.12.13 and 14 mm hole classification sieves respectively starting from the entrance part. At the bottom of each section there are small holdings where nuts passing through the sieve can be collected. In this classification system used for shell nuts calibration, it is important the functions of dimensioning such as the number of sieve revolutions, the size of the sieve, the slope angle of sieve and the distance between the holes. *(Baş H. 1993)*.

Crushing of Hazelnuts

Hazelnuts collected in numbered warehouses are sent to mills with transmission channels. The mill consists of two stones, the lower stone and the upper stone. The diameters of both stones are between 750-850 mm on average. They have the same taper to work with each other (Figure 4). The system has a fixed stone on top and a rotating stone on the bottom. The bottom stone rotates with an average of 120 rpm. The shelled nuts are broken at the outermost part of the stone in a part about 60 mm wide. The conic section of the inner zone that can reach this region, is greater. The taper width is very small. Crushed hazelnuts come out with the effect of centrifugal force of stone together with inner and shells. Then, the broken nuts are conveyed to the separate compartments as the inner and the shell in the closed channels with the ventilation system.

Fig. 4 – General view of the lower stone and the upper stone

Sizing of the inner nuts

The inner hazelnut calibration is the same as the method for calibrating the shelled hazelnuts. The only difference here is that the sieve holes are in the diameter between the upper and lower diameters of the inner nuts. The differences between the inside of the hazelnut, the cylindrical sieve and the regions on it are divided into diameter groups as well. Classification of hazelnuts has become an indispensable stage in hazelnut trade.

Selection of inner hazelnut

Lastly, unbroken or cracked hazelnuts are re-sieved for the last time. The inner hazelnuts are moved on bands rotating at a heavier speed, which are designed to be 450-550 mm wide and different lengths according to the structure of the factory before packaging. At this time, wrinkled, broken, bruised.,rotten, crusty and other foreign materials are selected by the workers standing on both sides of the band (Figure 5). With the developing technology in recent years, this operation has been done with some sort of laser separation machines in some enterprises (Figure 6), saving considerable amount of labour cost.

Fig. 5 – Selecting foreign materials via hand and laser system

Especially in the integrated facilities. hazelnuts collected in the internal hazelnut storage are filled with nuts which can vary between 40 and 80 kg and are made ready for transportation.

Fig. 6 – Hazelnut storage

CONCLUSION

Although there are no major mechanization problems in hazelnut operations in Turkey, especially the level of damaged rate is still not at the desired level.

Classification of hazelnut is much more important than crushing. Classification of the nuts according to their diameter values will ensure that the crushing range. For this reason, in recent years new factories in Turkey have been classifying different diameters with 0.5 mm sensitivity instead of 1 mm diameter for better classification.

In addition, the start-up of the use of laser sorting machines resulted in a significant reduction in labor costs. In addition, it is possible to do business on this site much faster and with fewer incentives.

Also. It can be said that researches on hazelnut crushing facilities will be useful in order to reduce the amount of damaged hazelnut.

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COMPARATIVE ANALYSIS OF SOME TIRE DEFORMATION MODELS USED FOR THE PREDICTION OF TRACTION CHARACTERISTICS / *ANALIZA COMPARATIVĂ A UNOR MODELE DE DEFORMARE A PNEULUI ÎN SCOPUL OBŢINERII CARACTERISTICILOR DE TRACŢIUNE*

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Keywords: *tire traction, super-ellipse, traction force.*

ABSTRACT

In the present paper is presented an interaction tire-soil model, taking into account of the deformation of the tire section under load. The tire section is considered to be elliptical; under load the minor axis decreases, while the major axis increases. The equations of the traction model were incorporated in a computer program; the length, width and area of the contact patch, the traction force and traction efficiency are calculated for each value of the wheel slip.

Field tests were performed in order to validate the model; the experimental data were collected during plowing tests. In order to evaluate the precision of the model the predicted data were compared with the test data by the means of a goodness-of-fit analysis.

REZUMAT

Lucrarea prezintă un model pentru interacţiunea pneu-sol, model in care se ţine cont de deformarea secţiunii pneului.Astfel, se consideră că pneul are în secţiune formă eliptică; sub acţiunea sarcinii verticale secţiunea se deformează, păstrându-şi forma eliptică (axa mică se scurtează. iar axa mare se alungeşte). Ecuaţiile pentru modelarea tracţiunii roţii cu pneu au fost introduse într-un program de calculator, care determină pentru fiecare valoare a patinării roţii lungimea şi lăţimea petei de contact, forţa de tracţiune şi randamentul de tracţiune.

S-au efectuat teste în camp pentru validarea modelului,datele fiind colectate la efectuarea arăturii. S-a efectuat o analiză a corelaţiei datelor experimentale cu cele oferite de model pentru a valida modelul dezvoltat.

INTRODUCTION

The tire-soil interaction models can be based on empirical, semi-empirical and analytical methods (*Tiwari et al.. 2010*).

Empirical methods are mainly based on soil properties (cone index, plate sinkage, shear strength) using similitude and dimensional analysis. At the end of the Second World War, this approach evolved as a means of measuring trafficability of soil at the US Army Corps of Engineers Waterways Experiment Station (*Tiwari et al.. 2010*). The empirical models were developed using traction data recorded from operating vehicles; for some of them, cone index measured with a standard cone penetrometer was the only soil property taken into account. Wismer and Luth (*1972*) developed a widely used model for bias tyres, based on a soil-tyre numeric, which under-predicted the traction force when applied to radial tyres. The Brixius (*1987*) equations, as a refinement of the Wismer and Luth equations expressed the gross traction ratio (GTR) as a function of slip and wheel mobility number, using a curve fitting technique in order to evaluate the coefficients for the traction equation (*Lee et al..2016*).

The semi-emipirical models represent a physical-based approach which considers the mechanics of the wheel-soil interaction and is suitable for practical applications (*Battiato and Diserens. 2017*). In the semi-empirical models, the shear deformation of soil is considered; the models are based on soil parameters obtained by the means of a bevameter technique (penetration and shear tests), assuming that the vertical deformation of soil is similar to the deformation under a sinking plate, while the shear deformation of soil under a traction device is similar to the shear action of a torsion device (*Tiwari et al.. 2010*). The parameters involved in the equations are determined experimentally. For agricultural soils, the Janoshi and Hanamoto (*1961*) equation is one of the most frequently used.

The analytical models are formulated using elasticity and plasticity approaches. Elasticity models are based on the classical mechanical contact theory in order to predict deformations and stresses (using, for example, the Boussinesq's approach). while plasticity based models take into account material (soil) failure theories. Despite the rather sophisticated theoretical base of these models, there are authors (*Upadhya et al. 1990; Xia. 2011*) who concluded that analytical models never adequately describe the interaction between tyre and soil due to the large number of soil parameters that should be taken into account and to their variability

The tire-soil interaction models are used in order to predict the wheel traction force and traction efficiency. Besides these, they also take into account the shape and area of contact patch between tire and soil, which is also used for the calculation of the surface pressure and is also considered by the models for stress propagation in soil and for the prediction of the compaction risk (*Diserens et al.. 2011*).

In a previous paper (*Roşca et al.. 2014*) a semi-empirical model for predicting the traction force and traction efficiency was presented; the model was applied on a 2WD agricultural tractor, assuming that the shape of the tire-ground contact area is a super ellipse. The model assumed that the super ellipse equation describes the shape of the tire-ground contact surface and was considered to be a reasonable compromise between the more simple empirical models, for which the range of applicability is limited to the cases having similar conditions to the ones from which the models were derived and the analytical models which require in-situ evaluation of a large number of soil properties. Experimental results from plowing tests were used in order to validate and verify the applicability of the model, using a goodness-of-fit analysis. For the case of the traction force, the value of the Pearson r^2 correlation coefficient achieved values between 0.921 and 0.925. thus confirming the validity of the model; for the case of traction efficiency lower values of the Pearson coefficient were obtained due to the lower values predicted by the model at wheel slips bellow 15%.

One of the key elements of the above mentioned model was the tire change in volume due to deflection under load which was calculated considering that the tire radius increases as the tire flattens in the contact area; the tire width was considered constant.

In order to improve the theoretical results regarding the wheel traction efficiency in the present paper the deformation of the tire section was also taken into account. The tire section was considered to be elliptical; under the vertical load the minor axis decreased, while the major axis (tire width) increased.

MATERIAL AND METHOD

The tire-soil interaction model is based on the model developed earlier (*Roşca R. et. al.. 2014*) and its schematics is shown in fig. 1: under the vertical load (G), the wheel sinks into the soil reaching the depth (z_c) and the load induces tyre deflection (z_p); as a result, the radius of the contact patch becomes r_d ($r_d > r_0$) and the length of the contact patch is:

$$l_c = 2 \cdot r_d \cdot \sin\beta = 2 \cdot r_0 \cdot \sin\alpha \,. \tag{1}$$

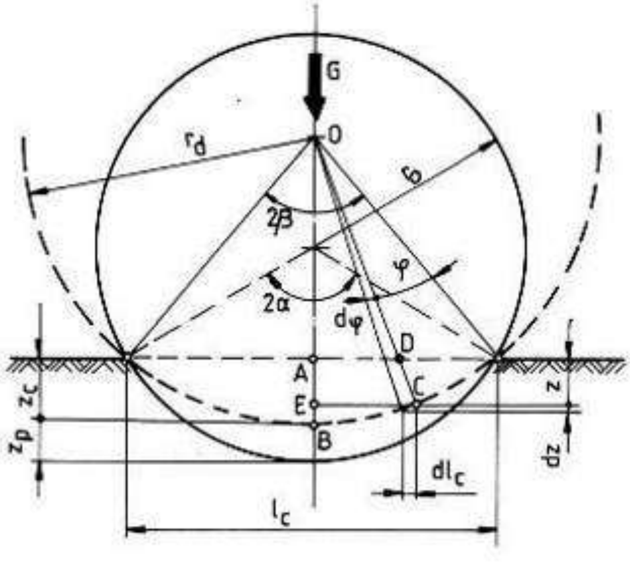


Fig. 1 – Schematics of the wheel-soil interaction model

The shape of the contact patch is assumed to be a super ellipse (*Keller. 2005*):

$$\left(\frac{2\cdot x}{l_c}\right)^k+\left(\frac{2\cdot y}{l_w}\right)^k=1\cdot \tag{2}$$

where k is the super ellipse exponent, the minor axis of the super ellipse is assumed to be equal to the tyre width b (Keller. 2005) l_c is the major axis of the super ellipse (length of the contact area) and l_w is the minor axis of the super ellipse (width of the contact area).

The tire-soil pressure was defined using the pressure-sinkage relationship:

$$p=k\cdot z^n. \tag{3}$$

where p is the normal pressure [kPa]. z is the deformation [m] and k [kPa/m^n] and n are constants.

Based on the tire-soil pressure and assuming that the tire is perfectly elastic (*Ghiulai and Vasiliu. 1975*) finally leads to:

$$G=\int_0^{2\beta} p\cdot b(\varphi)\cdot r_d\cdot cos(\beta-\varphi)\cdot d\varphi=q_p\cdot \Delta V_p\cdot \tag{4}$$

where φ is the current angle, defining the position along the contact surface, p is the normal pressure. q_p is the tyre volume stiffness and ΔV_p is the tyre change in volume due to deflection.

In the initial paper (*Roşca et. al.. 2014*) the tire change in volume due to deflection ΔV_p was evaluated considering that the tire radius increases from r_0 to r_d as the tire flattens in the contact area, while the tire width was considered constant (fig. 2).

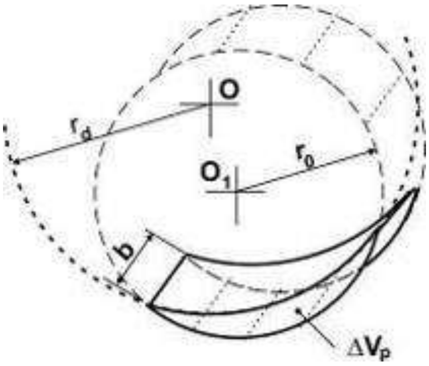


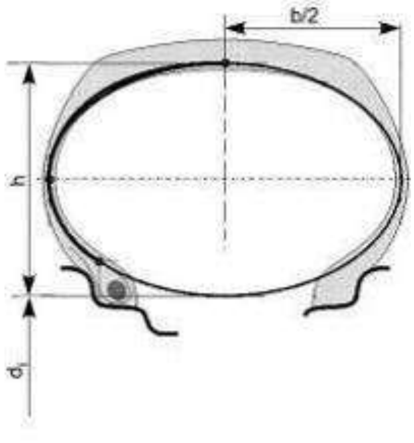
Fig. 2 - Initial tire deformation model

ΔV_p - tyre change in volume due to deflection;
b - tire width;
r_0 – radius of the undeflected tire;
r_d – radius of the contact patch under vertical load.

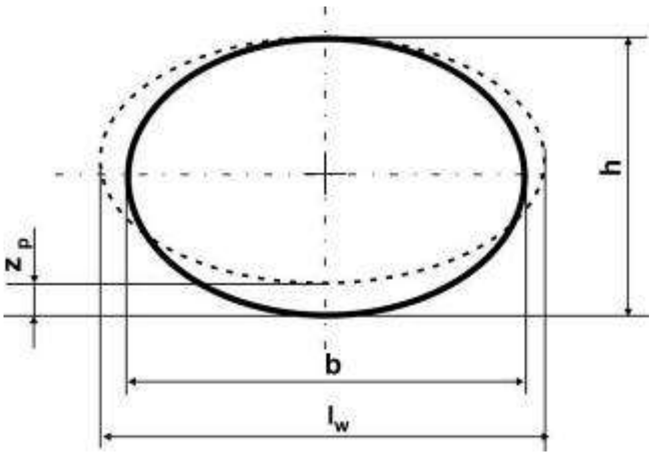
Finally, after several transformations of equation (4), the following equation is obtained:

$$k\cdot\int_0^{2\beta} b(\varphi)\cdot r_d^{n+1}\cdot[cos(\beta-\varphi)-cos\,\beta]^n\cdot cos(\beta-\varphi)\cdot d\varphi+\frac{4}{3}\cdot b\cdot q_p\cdot\beta^3\cdot r_d^2=\frac{4}{3}\cdot b\cdot q_p\cdot\alpha^3\cdot r_0^2. \tag{5}$$

In the present study the deformation of the tire cross-section is considered; the shape of the tire cross-section is approximated by an ellipse (*Koutný. 2007*), as shown in fig. 3a. Under the effect of vertical load (G. fig. 1), the cross-section is deformed, but the elliptical shape is preserved (fig. 3b): the minor semi-axis decreases and becomes h-z_p. while the major axis increases from b (tire width in the unloaded condition) to l_w.



a)



b)

Fig. 3 – Model for tire section deformation

a) tire section prameters; b) tire section deformation under load;
d_i – rim diameter; h – tire section height; b-tire width (undeformed); l_w – tire width (under load); z_p - tire deflection under vertical load

The major axis of the ellipse is calculated assuming that its perimeter remains constant:

$$2\pi \cdot \sqrt{\frac{(b/2)^2 + (h/2)^2}{2}} = 2\pi \cdot \sqrt{\frac{(l_w/2)^2 + [(h - z_p)/2]^2}{2}} . \tag{6}$$

which results in:

$$l_w = \sqrt{b^2 + 2 \cdot h \cdot z_p - z_p^2} . \tag{7}$$

The tire volume change ΔV_p is calculated as the cross-section area multiplied by the length of the contact patch, resulting in:

$$\Delta V_p = 2 \cdot \alpha \cdot r_o \cdot \pi \cdot \frac{b}{2} \cdot \frac{h}{2} - 2 \cdot \beta \cdot r_d \cdot \pi \cdot \frac{l_w}{2} \cdot \frac{h - z_p}{2} = 0{,}5 \cdot \pi \cdot [\alpha \cdot r_o \cdot b \cdot h - \beta \cdot r_d \cdot l_w \cdot (h - z_p)]. \tag{8}$$

After several transformation 4quation (4) becomes:

$$k \cdot \int_0^{2\beta} b(\varphi) \cdot r_d^{n+1} \cdot [\cos(\beta - \varphi) - \cos\beta]^n \cdot \cos(\beta - \varphi) \cdot d\varphi = \\ = q_p \cdot 0{,}5 \cdot \pi \cdot [\alpha \cdot r_0 \cdot b \cdot h - \beta \cdot r_d \cdot l_w \cdot (h - z_p)] \tag{9}$$

The following equations are also obtained from fig. 1:

$$z_c = r_0 - z_p - r_0 \cdot \cos\alpha . \tag{10}$$

$$z_p = r_0 \cdot (1 - \cos\alpha) - r_d \cdot (1 - \cos\beta). \tag{11}$$

where z_p is tyre deflection under vertical load.

A computer program is used in order to solve the systems of equations (1). (5). (10). (11) and (1). (9). (10). (11). respectively. The program displays the following values (fig. 4):

- length of the contact patch, l_c;
- width of the contact patch, l_w;
- area of the contact patch,
- calculated value of tire deformation under load, z_p;
- tire sinkage, z_p;
- dynamic radius of the wheel, r_d;
- angle of the contact patch, β;
- maximum shear stress, τ_{max};
- normal pressure, p.

The values of slip, traction force and traction efficiency are saved in a file.

Fig. 4 – Output screen of the computer program

In order to evaluate the maximum traction force it is assumed that it is limited only by the soil shear strength; the Mohr-Coulomb equation is used to calculate the soil maximum shear stress:

$$\tau_{max} = c + p \cdot tg\gamma \,. \tag{12}$$

where c is soil cohesion [kPa], p is the vertical pressure [kPa] and γ is the internal friction angle.

Soil shear tension was calculated using the Janosi and Hanamoto (1961) equation:

$$\tau = \tau_{max} \cdot \left(1 - e^{-\frac{J}{K}} \right). \tag{13}$$

where K is the soil shear deformation modulus and J is the shear displacement.

The maximum traction force was calculated as the product of shear stress and shear area; according to ASAE S296, the net traction force is $F_N = F_t - R_r$. with the wheel rolling resistance R_r being calculated with the relation (*Elwaleed et al.. 2006*):

$$R_r = G \cdot \left(\frac{1}{B_n} + 0.04 + \frac{0.5 \cdot s}{\sqrt{B_n}} \right) \quad [kN] \cdot \tag{14}$$

The wheel numeric B_n is (*ASAE D497.7, 1999*):

$$B_n = \frac{CI \cdot b \cdot d}{G} \cdot \left(\frac{1 + 5 \cdot \frac{z_p}{h}}{1 + 3 \cdot \frac{b}{d}} \right). \tag{15}$$

where CI is the soil cone index [kPa]. $d = 2 \cdot r_0$ [m] and h is the tyre section height [m].

The same standard defines the traction efficiency as:

$$\eta_{tr} = (1 - s) \cdot (1 - R_r / F_t). \tag{16}$$

The model was applied to the driving wheel of an U-650 agricultural tractor; the main characteristics of the wheel are presented in table 1.

Table 1

Main characteristics of the driving wheel

Item	Value
Load on the driving tire. G [kN]	11.75
Type of tire	14.00-38
Rim diameter. d_i [m]	0.965
Section height. h [m]	0.307
Exterior diameter of tire. $d_i + 2 \cdot h$ [m]	1.58
Tire width. b [m]	0.300
Tire inflation pressure [kPa]	100

The experimental data were collected during the field tests performed with the U650+P2V plowing unit; during these tests drive wheel slip did not exceed 30% because of the restraints imposed by the plowing process. Different traction forces and drive wheel slips were achieved by changing the operating width and depth of the plough. The traction force for each experimental point was calculated as the average value of nine measurements; the standard error and 95% confidence interval were then evaluated. The experimental results taken into account for the goodness-of-fit analysis are shown in table 2.

Table 2

Experimental data for traction force

Wheel slip [%]	Average traction force [kN]	Standard error	95% data confidence interval
6	1.8033	0.095	0.2179
9	2.3744	0.116	0.2684
14	3.1033	0.082	0.1891
17	3.3067	0.121	0.2797
18	3.6855	0.116	0.2680
20	4.3122	0.175	0.4029
25	4.6777	0.087	0.2003
26	4.7567	0.114	0.2636
29	5.8800	0.141	0.3249

The tests were performed on wheat stubble sandy loam soil after cereal harvesting; soil characteristics in the test field are presented in table 3.

In order to evaluate the goodness-of-fit between model and experimental data the following criteria were considered (*Schunn and Wallach. 2005*):

- percentage of points within 95% confidence interval of data (Pw95CI) – represents the percentage of model predictions that lie within the 95% confidence interval of each corresponding experimental data point;

Table 3

Characteristics of the test soil

Item		**Value**
Soil deformation modulus. K [m]		0.05
Coefficients for the pressure-sinkage equation	k	55
	n	1.3
Soil cohesion. c [kPa]		25
Angle of internal friction. γ [^{0}]		32
Cone penetrometer index. C [kPa]		970

- mean absolute deviation (MAD) – represents the mean of the absolute value of the deviation between each model point and the corresponding experimental point:

$$MAD = \frac{\sum_{i=1}^{n} |m_i - d_i|}{n} . \qquad (17)$$

where m_i is the model mean for point I, d_i is the experimental data mean for point I and n is the total number of points being compared;

- root mean squared deviation (RMSD):

$$RMSD = \sqrt{\frac{\sum_{i=1}^{n} (m_i - d_i)^2}{n}} ; \qquad (18)$$

- mean scaled absolute deviation (MSAD):

$$MSAD = \sum_{i=1}^{n} \frac{|m_i - d_i| \cdot \sqrt{n_i}}{n \cdot s_i} . \qquad (19)$$

Where: n_i is the number of values contributing to each experimental data mean d_i (n_i = 9)'

s_i is the standard deviation for each data mean. A MSAD value of 1.5 means that, on average the model is 1.5 standard errors off from the experimental data.

- Pearson correlation coefficient r^2.

RESULTS

For the both tire section deformation models the calculations were performed using the same value for the super ellipse coefficient (k=3.5). Table 4 presents some comparative results given by the tire – soil computer simulation; the assumption that the tire cross-section has an elliptical shape and is deformed due to the vertical load of the tire had the following consequences:

- while the length of the contact patch decreased slightly (from 0.533 m to 0.531 m). the width of the contact patch, l_w. increased from 0.3 m to 0.319 m. resulting in a larger area of the contact surface (0.154 m^2);
- the tire radius r_d decreased from 1.4 m to 1.371 m; as the length of the contact patch did not change significantly, the centre angle β increased from 10.916^0 to 11.19^0;
- the maximum shear stress decreased from 53.3 kPa to 52.01 kPa due to the increase of the contact surface area.

Table 4

Model results

Item	Initial tire deformation model (b const.)	Modified tire deformation model (b elipse)
Length of the contact patch. l_c [m]	0.533	0.531
Width of the contact patch. l_w [m]	0.300	0.319
Tire deflection. z_p [m]	0.02	0.02
Sinkage depth. z_c [m[	0.027	0.027
Area of the contact surface. A_t [m^2]	0.145	0.154
Tire radius. r_d [m]	1.400	1.371
Centre angle of the contact patch. β [^{0}]	10.916	11.19
Maximum shear stress. τ_{max} [kPa]	53.3	52.01

Figures 5 and 6 present the predicted and experimental results concerning the traction force and traction efficiency. The charts clearly show that the model predicted higher values of the traction force and traction efficiency when the deformation of the tire cross section was considered, due to the increased value of the contact surface area.

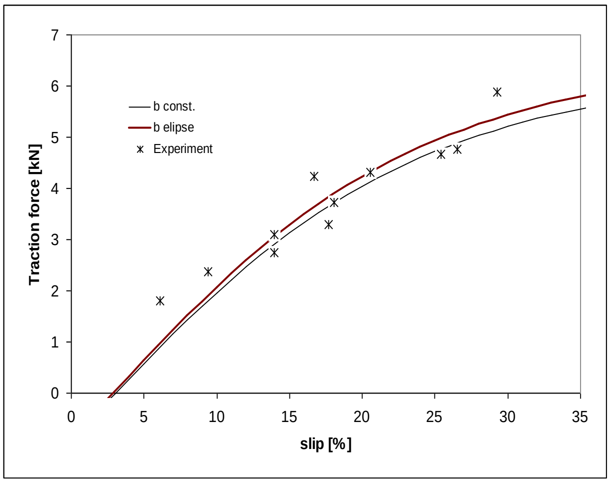


Fig. 5 – Results concerning the traction force

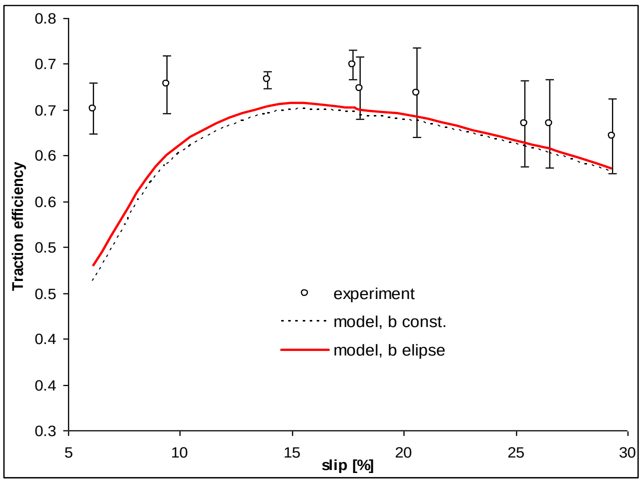


Fig. 6 – Results concerning the traction efficiency

The results of the goodness-of-fit analysis are shown in table 5. Compared to the previous model. the most significant differences were recorded for the traction efficiency: the Pearson correlation coefficient r^2 increased from 0.186 to 0.216, the mean absolute deviation (MAD) decreased form 0.058 to 0.051. root mean squared deviation (RMSD) decreased form 0.0752 to 0.0686 and the mean scaled absolute deviation (MSAD) decreased from 5.225 to 4.557.

When referring to the values of the traction force, all the goodness-of-fit parameters recorded better values for the modified traction model, excepting the percentage of points within 95% confidence interval of data (Pw95CI). which has slightly decreased (from 66.7% to 55.6 %).

Table 5

Goodness-of-fit comparative analysis

Item	Traction force		Traction efficiency	
	Constant cross-section	Deformable cross-section	Constant cross-section	Deformable cross-section
r^2	0.923	0.924	0.186	0.216
PW95CI	66.7	55.6	55.6	55.6
MAD	0.354	0.356	0.058	0.051
RMSD	0.480	0.438	0.0762	0.0686
MSAD	3.122	3.065	5.225	4.577

CONCLUSIONS

A modified semi-empirical model for the prediction of traction performance of a tractor driving wheel is presented in this study. The model assumed that the super ellipse equation describes the shape of the tire-ground contact surface.

The model is a reasonable compromise between the more simple empirical models for which the range of applicability is limited to the cases having similar conditions to the ones from which the models were derived and the analytical models which require in-situ evaluation of a large number of soil properties.

Experimental results from plowing tests were used in order to validate and verify the applicability of the model by the means of a goodness-of-fit analysis. The analysis showed that the modified traction model provided more accurate results regarding the traction force and traction efficiency then the initial one.

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RESEARCH ON THE CALORIFIC VALUE OF THE HARDWOOD SPECIES / *CERCETĂRI PRIVIND PUTEREA CALORICĂ A SPECIILOR DE FOIOASE*

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Key words: *biomass, hardwood, calorimetric bomb, calorific value.*

ABSTRACT

Romania is a country with a great potential in the field of biomass energy. At the level of 2016, an area of 229973 km^2 was used for agricultural and forestry purpose of which the forest area was 4.7%. The lands covered by the forest are widely exploited and the waste resulting from the processing of cut wood is often left to degrade producing water pollution.

REZUMAT

România este o ţară care are un potenţial mare în domeniul obţinerii energiei din biomasă.La nivelul anului 2016 se foloseau în scopuri agricole şi forestiere o suprafaţă de 229973 km^2. din care suprafaţa forestieră era de 4.7%. Terenurile ocupate de pădure sunt pe larg exploatate. iar deşeurile rezultate din prelucrarea lemnului tăiat este de multe ori lăsat să se degradeze producând poluarea apei.

INTRODUCTION

In the year 2000, the estimated contribution of the biomass to the European Union's energy supply was of 1900 PJ. This contribution was of approximately two thirds of the entire energy production achieved by renewable resources in the European Union.

For bioenergy, the following tendencies have been observed:

- Heat: In the year 1990, the production of thermal energy from biomass was of approximately 1500 PJ;
- Electricity: the production of electric energy from biomass was of 54 PJ in the year 1990 and increased to 166 PJ in 1999 (an increase of 9% per year);
- Fuel: the present contribution of biofuels is of approximately 25 PJ, almost negligible in the overall production of bio-energy.

Despite the modest role of bio-fuel in terms of energy, the production and use of biomass increased rapidly in the last 10 years. The production of bio-diesel increased from 80 Ktons in 1993 to 780 Ktones in 2001. The production of ethanol in the European Union increased from 48 to 216 ktones in the same period. France, Spain and Sweden are the three main players on the European energy market (*Berkesy. 2011*).

Up to the present, six member states of the European Union wish to enforce tax programs to support the use of bio-fuel (Austria, Belgium, Germany, Spain, Italy and Sweden). In these charts biofuels are exempt from taxes, as compared to fossil fuels used for transportation.

Renewable energy resources represent one of the replacement variants for fossil fuels in Romania and worldwide with high development perspectives in the future.

In Romania, it is estimated an energy consumption of 34.9 Mtoe (million tones oil equivalent) until 2020. Biomass covers more than 60% of the entire renewable energy sources, respectively 190-200 PJ/year. (Gherghicescu,1997).

Presently, a great part of the energy necessary for humankind is produced from fossil fuels. Fuel can be found under three forms, respectively fossil fuel, nuclear fuel and renewable fuel.

Researchers from all countries applied a multitude of projects in order to reduce carbon dioxide emissions (*Astburg. 2000*) .

In approximately 50 years, according to European Union statistics, all fossil fuels in the world will be exhausted. It is predicted that the entire world will suffer from a huge energy deficit which must be covered by production of alternative energy (*Eisentraut. 2012*).

The biggest risk of fossil fuel use is represented by the toxic emission discharged in the atmosphere.

The production and consumption of fuel materials ensured the quality of living necessary for humankind. The biomass reserves differ throughout the territory of the European Union, as well as worldwide. The forest spreading area varies from 27. 6 million hectare in Sweden to 117 hectares in Cyprus. Worldwide, the forest fund occupies approximately 4 billion hectares, the biggest quantity being distributed on the territory of the Russian Federation- 809 million hectares, Brazil 478 million hectares, Canada 310 million hectares, U.S.A. 303 million hectares, China 197 million hectares.

Biomass is a renewable energy source by its renewal year after year; it is widely spread worldwide and possesses great costs as compared to fossil fuel.

Biomass resources of which fuel material is produced. It may include wood, wood waste, agricultural cereals and waste resulted from their production, municipal waste, animal dejections (*Beldean. 2004*).

Biomass under vegetal form is a complex compound and differs from a species to another. It contains all form of vegetal matter, growing on the surface of the earth, in the water or above the water, as well as substances produced by biological development (*Lunguleasa 2007.2008*).

Research performed in the field of energy proves that electrical energy and heat can be produced from biomass by conversion processes. In 2009, biomass ensured approximately 10% (50 EJ) ($1EJ=10^{18}$ J) of the entire primary energy produced worldwide.

Biomass takes part in the carbon cycle in nature by use of carbon dioxide. Carbon dioxide participates to the photosynthesis processes during the growth, but it is the component determining a more complete burning during wood combustion (*Aghamohammadi. 2011*).

Presently, biomass contributes by approximately 12% to the production of primary energy in worldwide and in the developing countries this occupies 40-50% of the necessary energy.

Romania holds a surface of 6300 thousand hectares representing 27% of the existing territory.

Biomass resources presently represent the raw material resulted from wood processing, agricultural, municipal waste and animal dejections (Cleveland. 2009).

Biomass differs from the other renewable sources by the fact that it represents a rich raw material which can be transformed by various conversion processes in liquid, gaseous and solid fuel. Biomass is divided in 4 categories described in the Regulation SR EN 14961-1:

- Forestry production: wood, waste resulted from wood cutting, sawdust, shrubs;
- Waste resulted from agricultural production, cereal waste.
- Energetic cereals: crops from short term processing, starch crops (corn, wheat, barley), sugar crops (sugarcane, sugar beet), fodder crops (grass, alfalfa), oleaginous crops (sunflower, soy, safflower)

MATERIAL AND METHOD

The determination of the calorific value for wood is similar to that of coal (as solid fuel) and with little differences as compared to liquid fuel (benzene) or gaseous one (natural gas, biogas).

The equipment used for the determination of the calorific value of the wood biomass was the calorimeter with explosive burning type XRY-1C. manufactured by Shanghai Changji Geological Instrument Co. din China (Fig1).

Before performing the proper said attempt, the calorimetric bomb is calibrated with benzoic acid with a known calorific value (usually 26 463 kJ/kg (1kJ/kg=1J/g) with slight differences of maximum ±3% as compared to this value) in order to assess the *k* calorific coefficient of the calorific equipment.

$$PCS_s = k \cdot \left(\frac{(t_f - t_i)}{m_l}\right) - q_s - q_b \, [\text{kJ/kg}]; \tag{1}$$

where:

k – calorific coefficient determined by calibration with benzoic acid, expressed in kJ/grad;

t_f – final temperature, in degrees;

t_i – initial temperature, in degrees;

m_l – wood mass, in kg.

q_s – heat consumed for the burning of the nickeline wire in kJ;

q_b – heat obtained by burning of the cotton thread, in kJ.

The assessment procedure of the calorific value of the wood mass refers first to all to the preparation of the raw material and the equipment, then to the proper said assessment and finally to the obtainment of the final result. The preparation of the wood mass for testing consists of sampling a small part of a approximately 0.6 – 0.8 grams of the entire material weighted with a precision of 0.0002 g. The sample must be clean originating from freshly cut wood because old wood does not have all volatile and flammable substances, fact that might influence its calorific value. This sample is placed in a porcelain crucible and placed in a laboratory autoclave to allow drying at a temperature of 103±2 ^{o}C.

The obtainment of the anhydric state of the wooden mass is checked by successive weighting until the difference between the two successive weightings becomes smaller than the double of weighting precision or covers for a piece of such size of at least 2 hours of keeping the piece in the autoclave.

After drying, the samples are kept in exsiccator to cool down and maintain the humidity content until its placement into the calorimetric bomb.

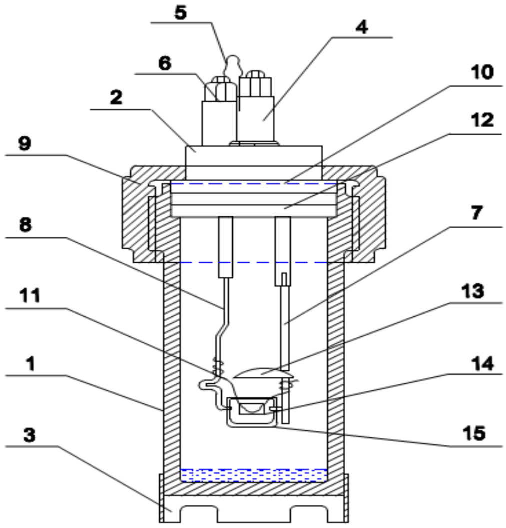

Fig. 1 - Equipment for the assessment of the calorific value of the wood biomass with calorimetric bomb with own soft

In industrial practice there are manufacturing by remains from all wood species that can be processed. Therefore, in the research process the indigenous broadleaf category was used: acer pseudoplatanus and salix alba.

The inferior calorific value of wood is determined on basis of higher calorific value: by means of the ratio:

$$PCI_i = PCS_s - 6 \cdot (U + 9 \cdot h) \text{ [kJ/kg]} \quad (2)$$

where:

PC_s- superior calorific value (kJ/Kg);

U- dampness of the wood sample (Kg/Kg);

h- hydrogen content of the wood sample (3.6%).

The preparation of the equipment for the trial refers to the checking of the water quantity from the calorimeter or hod **Cu** (so as not to exceed by 1-2 mm the lid of the calorimetric bomb). the water **Ap** agitator **A** from the hod, the computer software **C**. the exterior thermometer of the calorimeter **T** and the gas pressure in the oxygen tank **Bo**. The test sample **1** is connected to the cotton thread **2** and placed in the calorimeter crucible. **3**. The nickeline spiral thread is tied **4.** to the cotton thread after which the protection lid is properly placed. **5.** The crucible is connected to the calorimetric bomb's lid **6**. by means of two electrodes **7**. and **8**. which continue with the connective electric wires of the calorimetric bomb **9**. and **10.** By screwing in the lid of the calorimetric bomb, the bomb is connected **11.** by screw **12**. to the oxygen tank, entering 30 atmospheres. The bomb is placed in the equipment calorimeter **Cu**., it is connected by means of the two electric wires. The calorimeter's lid is closed and the thermostat **T** is placed inside to determine the temperature (Fig.1).

Next, the computer software is accessed filling in the type of test (assessment or calibration), sample name, sample mass of the nickeline and cotton thread, as well as further necessary information. After this, the operation for the assessment of the calorific value begins by selection and activation of the "START" button from the computer program displayed on the computer display (Fig.2). This is the start moment of the calorific value assessment.

The final result of wood biomass burning is expressed by calorific value, notion by which is understood the quantity of heat obtained by burning of the mass unit. For combustible materials with high hydrogen and water content such as the wood biomass, two calorific values can be distinguished, namely the superior calorific (PCS) and inferior calorific value (PCI). PCS is determined directly by means of the calorimetric bomb where the water vapors are formed by burning of the hydrogen contained in the wood, as well as the ones formed by decomposition of the water are condensed in the bomb. discharging approximately 2 510.4 kJ (600 kcal) for every kilo of condensed water vapors (the so-called condensation heat). PCS cannot be used, practically due to the fact that the water vapors are discharged outside by a funnel and only the PCI can be used effectively.

RESULTS

The test contains three distinct stages (Fig.2), namely:

- the fore period ("fore"). its purpose being the determination of the temperature variations in the calorimetric pot due to heat exchange with the exterior before the burning. During this period, usually lasting 5 minutes, the temperature is displayed and read every minute using the precision thermocouple meter. The last temperature from the fore period represents in fact the first temperature from the main period. The values of the recorded temperature in this period are usually seven. After recording the sixth value, the burning of the material takes place (Fig. 2) and it is displayed on the menu bar ("Burning time").
- The main period ("main") starts by ignition of the sample having as consequence the temperature rise in the calorimetric pot due to burning of the wood particle and heat discharge. In order to determine the final temperature, the temperature values are displayed every minute. The final temperature is given by the maximum value of the temperature, because after its decrease, the calorimetric pot is not receiving heat from the bomb. The values recorded during this period vary depending on the burning time of the combustible material in the calorimetric bomb. The number of values may vary in the range of 19-42 temperature values recorded during this period.
- The after period ("after") has the purpose of determining the average temperature variation in the calorimetric pot due to heat exchange with the exterior after the burning. Just like in the fore period, the temperature is displayed every half minute for a period of 4-5 minutes, being recorded an average of 8-10 temperature variation values.

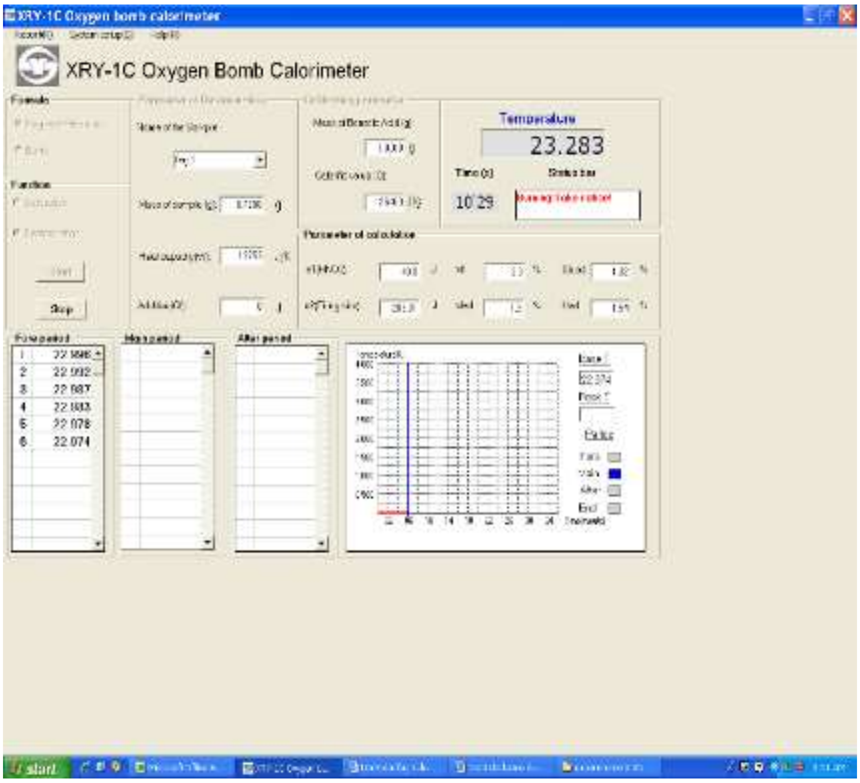

Fig.2 - Description of the process for determining the calorific value

For acer pseudoplatanus for 0% humidity was obtained the superior calorific value 18802 kJ/kg. and inferior calorific value 18336 kJ/kg; for 10% humidity was obtained the superior calorific value 16805 kJ/kg and inferior calorific value 16618 kJ/kg; for 20% humidity was obtained the superior calorific value15041 kJ/kg and inferior calorific value 14668 kJ/kg; for 50% humidity was obtained the superior calorific value 9749 kJ/kg and inferior calorific value 9166 kJ/kg.

In fig. 3 , is presented the variation calorific value function moisture content for Acer pseudoplatanus.

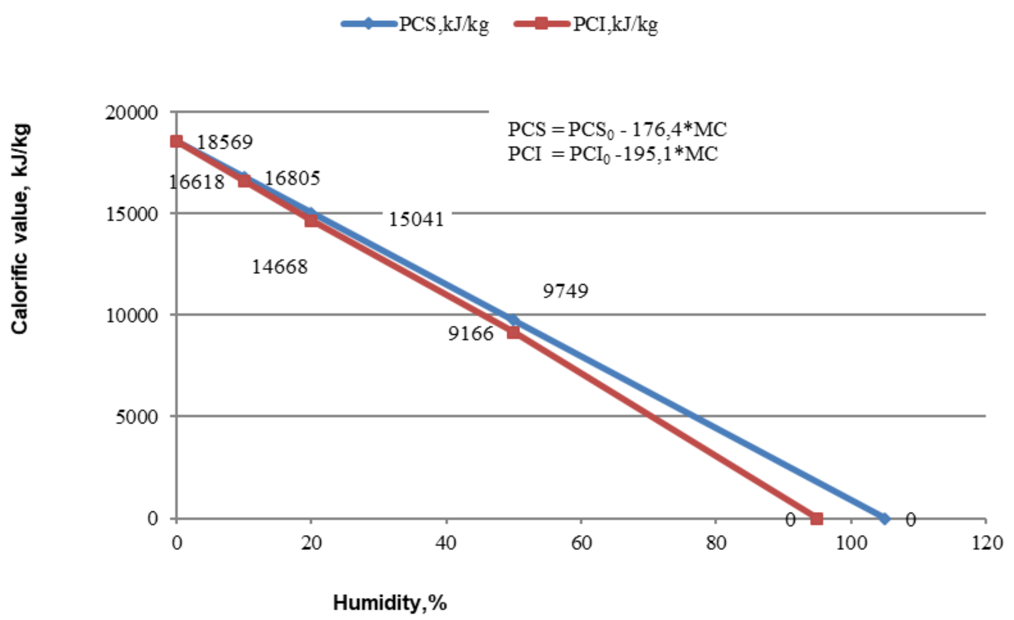

Fig. 3 - The graphic calorific value for Acer pseudoplatanus

For salix alba for 0% humidity was obtained the superior calorific value 20830 kJ/kg. and inferior calorific value 20224 kJ/kg; for 10% humidity was obtained the superior calorific value 17846 kJ/kg and inferior calorific value 17259 kJ/kg; for 20% humidity was obtained the superior calorific value14862 kJ/kg and inferior calorific value 14294 kJ/kg; for 50% humidity was obtained the superior calorific value 6364 kJ/kg and inferior calorific value 4944 kJ/kg.

In fig. 4 is presented the variation of calorific value function moisture content for Salix alba.

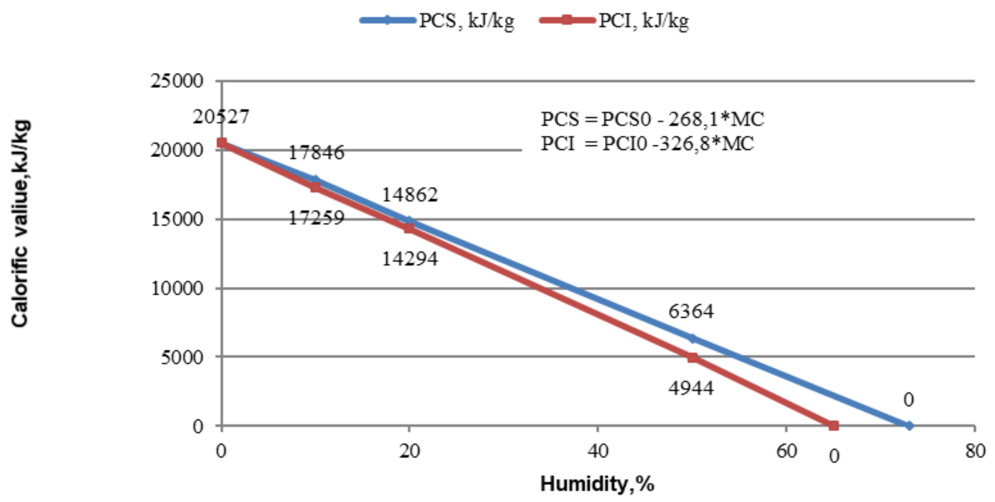

Fig. 4 - The graphic of calorific value for Salix alba

CONCLUSIONS

- The wood biomass burning is a non-ecological process, but indispensable to human activity due to the thermal energy it produces;
- Wood biomass is twice renewable, first by being part of the vegetal world obtained by photosynthesis and secondly by trees recycling the carbon in the nature;
- For acer pseudoplatanus for 0% humidity the superior calorific value is 18802 kJ/kg and for 50% humidity the superior calorific value is 9749 kJ/kg; for salix alba for 0% humidity the superior calorific value is 20224 kJ/kg; for 50% humidity the superior calorific value is 6364 kJ/kg;
- The research shows that as the humidity of the wood is lower the superior calorific value is higher.

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ROLE OF SOME TREATMENTS IN IMPROVING STORABILITY OF TOMATOES (*LYCOPERSICON ESCULENTUM* MILL.) HYBRID NEWTON
/
دور بعض المعاملات في تحسين القابلية الخزنية لثمار الطماطة هجين نيوتن

Prof. Ph.D. Dhia Ahmed Taain, Prof. Ph.D. A. M. ABD. Researcher. Noor Abdel-Zahra JABER
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Keywords: *tomato, licorice, garlic, calcium chloride, total soluble solids.*

ABSTRACT
The experiment was conducted in one of the greenhouses of the Agricultural Research Station, College of Agriculture, University of Basrah during the growing season of 2015-2016 in order to improve the storage behavior of Newton tomato fruits hybrid . Water extract of licorice at three concentrations (zero. 2. 4 g L^{-1}) was prepared and the plants were sprayed in the early morning three times starting from 5/11/2015 with a time interval of two weeks from the date of planting for the first spray and the operation was repeated after 10 days. Fruits were harvested at mature green stage in the early morning and brought to the laboratory of storage technology, then cleaned and soaked in water extract of garlic with concentration of 4%. Calcium, chloride solution with concentration of 4% in addition to control treatment for a period of 10 minutes. A portion of harvested fruits that was sprayed with the water extract of licorice at the concentrations of (zero. 2. 4 g .L^{-1}) was left without soaking. All the fruits were packed in perforated polyethylene bags (16 holes with a diameter of 5 mm per bag and weighed 2 kg per bag). Then the samples were stored at the temperature of 13°C for four weeks. Results indicated that the decay percentage, the percentage of weight loss and the percentage of total soluble solids increased while the amount of vitamin C decreased with an increment of storage periods. The lowest percentages of the decay and weight loss and the highest percentage of total soluble solids were in fruits treated with licorice extract as compared with untreated fruits. Fruits treated with 4% garlic extract recorded the lowest percentage of decay and lowest percentage weight loss, while fruits soaked in 4% calcium chloride solution gave the highest percentage of total soluble solids.

ABSTRACT
أجريت التجربة في إحدى البيوت البلاستيكية التابعة لمحطة البحوث الزراعية بكلية الزراعة جامعة البصرة خلال موسم النمو 2015-2016 من أجل تحسين السلوك التخزيني لثمار الطماطة هجين نيوتن تم تحضير المستخلص المائي لعرق السوس بثلاثة تراكيز هي (صفر، 2، 4 غم .لتر-1) وتم رش النباتات في الصباح الباكر ثلاث مرات ابتداء من 2015/11/5 مع فاصل زمني لمدة أسبوعين من موعد زراعة الشتلات في البيت البلاستيكي وأعيدت عملية الرش بعد 10 أيام. تم جني الثمار في مرحلة خضراء ناضجة في الصباح الباكر وجلبت الى مختبر تكنولوجيا التخزين ثم تم تنظيفها وتغطيسها في المستخلص المائي للثوم تركيز 4٪ وكذلك في محلول كلوريد الكالسيوم تركيز 4٪ بالاضافة الى معاملة السيطرة لمدة 10 دقائق. تم ترك جزء من الثمار التي تم جنيها والتي رشت بالمستخلص المائي لعرق السوس بالتراكيز (صفر، 2، 4 غم .لتر-1) دون تغطيس. عبئت الثمار في أكياس البولي ايثلين مثقبة (16 ثقب لكل كيس قطر الثقب 5 ملم ويتسع الكيس الى 2 كغم ثمار). خزنت الثمار عند درجة حرارة 13 م° لمدة أربعة أسابيع. أشارت النتائج إلى أن نسبة التلف والنسبة المئوية لفقدان الوزن ونسبة المواد الصلبة الذائبة ازدادت في حين أن كمية فيتامين ج انخفضت مع زيادة فترات التخزين. وكانت أقل نسبة مئوية للتلف وفقدان الوزن وأعلى نسبة للمواد الصلبة الذائبة الكلية هي في الثمار المعاملة بمستخلص عرق السوس مقارنة بالثمار غير المعاملة. سجلت الثمار المعاملة ب 4٪ من مستخلص الثوم أدنى نسبة من التلف وأقل نسبة للفقد بالوزن، بينما أعطت الثمار االمعاملة ب 4٪ محلول كلوريد الكالسيوم أعلى نسبةللمواد الصلبة الذائبة الكلية.

INTRODUCTION
Tomato (*Lycopersicon esculentum* Mill.)" belongs to family Solanaceae and is considered as one of the favorite vegetable crops in Iraq and other countries due to the highest nutritive value of fruits such as vitamins (as each 100 g containing 900 IU of vitamin A, 0.06 mg vitamin B 1, 0.04 mg vitamin B2, 0 0.7 mg vitamin B3 and 10-26 mg of vitamin C) also contains lycopene pigment, protein, carbohydrates, calcium. phosphorus. potassium and iron in addition to 22 calories (Watt & Merrill 1963).

The fact that tomato fruits are consumed throughout the year, it became necessary to think of ways to be supplied in the market such as growing in the protected environment, storing the fruits at a storage temperature of 13 °C (*Dagawi. 1996*).

The new orientation in agriculture is to move away from the use of chemical fertilizers, chemical growth regulators and pesticides of different kinds and composition, because of their toxic effects on human and animal organisms . Therefore, researchers in agriculture have tended to find safer materials such as plant and herb extracts (*Taain. 2014*).

The water extract of licorice (*Glycyrrhiza glabra* L.) used in the present work is composed of the roots and dried rhizomes of the plant and is similar to that of the *gibberellin* in stimulating the flowering as a result of containing the mevalonic acid compound ; also improves the vegetative growth as a result of stimulating the enzymes needed to convert the complex compounds into simple compounds and to use them in processing the energy necessary for the plant growth (*Almarsumi 1999*) . Garlic extract (*Allium sativum* L.) contains a high percentage of amino acids containing sulfur such as cystein and methionin. Alliin is responsible for the release of active compounds in garlic. Alliin is converted to Allicin by the enzyme Alliinase, then transformed into other compounds such as Diallyl disulphide (Krest & Keusgen 1999), while calcium used to increase membrane stability and cell wall strength.Thus, the main benefits of calcium in the postharvest physiology of fruits are the organization of fruit ripening process by reducing the respiration rate and ethylene production and increase of the shelf life of fruits; in addition, controlling the physiological diorders during storage is also a great benefit.(Taain. 2005; 2011,2014).

In a study conducted by Taain *et al*. (2007) on the storage of tomato fruits cv. Super Maramond packed with polyethylene bags for 21 days at 5°C, the results showed that decay percentage increased with the continuation of the storage periods. The fruits also showed a gradual increment in total soluble solids with decreasing in weight loss, vitamin C and the content of organic acids.

The present study was conducted to improve storability of tomato fruits cv. Newton by pre-treating them with the water extract of licorice, in addition to the post-harvest treatment of the garlic water extract and calcium chloride.

MATERIAL AND METHOD

The experiment was conducted during the 2015-2016 season in one of the greenhouses of the Agricultural Research Station / Faculty of Agriculture / Basrah University / Karma Ali site. in order to study the effect of pre-harvest spraying water extract of licorice with three concentrations (0. 2. 4) g .L^{-1}. and postharvest soaking in the garlic water extract at the concentration of 4% and the solution of calcium chloride at the concentration of 4% in storage ability of tomato hybrid *Lycopersicon esculentum* Mill. (Newton) grown in plastic greenhouses.

The seedlings were planted in the plastic house on 20/10/2015 and all the processes using in the production of this crop were conducted. Water extract of licorice at three concentrations (0. 2. 4 g L^{-1}) was prepared and the plants were sprayed in the early morning three times starting from 5/11 /2015. with a time interval of two weeks from the date of planting for the first spray and the operation returned after 10 days.

Fruits were harvested at mature green stage in the early morning and brought to the laboratory of storage technology. then cleaned and soaked in the following solutions for a period of ten minutes and left to dry at room temperature:

1. Water extract of garlic with concentration of 4%;
2. Calcium chloride solution with concentration of 4%;
3. Distilled water only (control);
4. A portion of harvested fruits was sprayed with the water extract of licorice at the concentrations of 0. 2. 4 g L^{-1} that was left without soaking.

All the fruits were packed in perforated polyethylene bags (16 holes with a diameter of 5 mm per bag and weighed 2 kg per bag) and then stored at the temperature of (13°C) for four weeks.

The decay and weight loss were calculated as percentages. Vitamin C (mg / 100 g) is determined according to A.O.A.C. (1992). Total soluble solids are determined by using hand refractometer and the results were corrected to 20 ºC

Experiment was carried out as factorial experiment consisting of three factors: spraying with the water extract of licorice, post-harvest treatment and storage period using Complete Rondomize Design (CRD) with 3 replicates. The results were statistically analyzed using the statistical program Genstat. The mean differences were compared by using the least significant difference (L.S.D) test at the probability level of 0.05(Al-*Rawi & Khalf Allah 1980*).

RESULTS

Vitamin C (mg 100 g^{-1}). The results of the Table 1 showed the effect of spraying treatments of Licorice extract and postharvest treatments with garlic extract and calcium chloride and their interaction in the amount of vitamin C for tomato fruits stored at 13°C. The results indicate that the amount of vitamin C decreased with the continuation of storage period reached to 16.99 mg 100 g^{-1} after four weeks of storage. As for the effect of spraying treatments with Licorice extract, the highest value of vitamin C was in fruits sprayed with 4g L^{-1} Licorice extract, which amounted to 19.35 mg 100 g^{-1} with no significant difference with 2 g L^{-1} Licorice extract and significant for control. As for the postharvest treatment, the highest value of vitamin C (20.58mg 100 g^{-1}) was in fruits soaked in 4% garlic extract with no significant differences with 4% calcium chloride and a significant one from the comparison treatment (soaking in distilled water only) that gave the lowest value of vitamin C amounted to (15.48mg 100 g^{-1}).

In regard to Binary interactions, there were significant differences between factorial treatments; the highest value of vitamin C was in the fruits sprayed with 4 g. L^{-1} Licorice extract and soaked in 4% calcium chloride solution (22.03mg 100 g^{-1}) with no significant differences with fruits sprayed with 4 g L^{-1} and soaked in 4% garlic extract and fruits sprayed with 2 g L^{-1} and soaked in 4% garlic extract. The lowest amount of vitamin C was in fruits sprayed with 4 g L^{-1} Licorice extract and soaked in distilled water only, which reached to 14.01mg 100 g^{-1}. The table 2 also showed the significance of the interaction between the spray treatments with the Licorice extract and the storage period. The highest vitamin C value was in the fruits of the 0 g L^{-1} Licorice extract spray after a week of storage which was 20.83mg 100 g^{-1} with no significant differences with fruits sprayed with 2 g L^{-1} and 4 g L^{-1} Licorice extract after one and two weeks of storage, with significant difference with the rest of the treatments. The lowest value of vitamin C was in fruits of 4 g L^{-1} Licorice extract spray after four weeks of storage, which was 16.12 mg 100 g^{-1}.

The highest value of vitamin C was in the fruits of 4% garlic extract soaking after a week of storage, which was 22.17mg 100 g^{-1} with no significant differences with 4% calcium chloride after a week of storage and 4% garlic extract after 2 weeks of storage. The lowest value of vitamin C was in comparison treatment (soaking in distilled water only) after four weeks of storage, which amounted to 14.15mg 100 g^{-1}.

In regard to triple interaction, the highest value of vitamin C was in fruits sprayed with 4 g L^{-1} Licorice extract and soaked in 4% calcium chloride after a week of storage, which amounted to 23.98 mg 100 g^{-1} with no significant differences with fruits sprayed with 4 g L^{-1} Licorice extract and soaked in 4% garlic extract after a week of storage and the treatment of 2 g L^{-1} Licorice extract , 4% garlic extract soaking afterone and two weeks of storage and the treatment of 0 g L^{-1} Licorice extract spray ,4% garlic extract soaking after one and two weeks of storage and with fruits sprayed with 4 g L^{-1} Licorice extract and soaked in 4% calcium chloride or, in 4% garlic extract after three and four weeks of storage.

The reason for decreasing the vitamin C with the continuation of storage period may be due to the continuation of vital processes and increased the activity of ascorbase and oxidase with the continuation of storage period and exposure to light which caused the oxidation of vitamin C to dehydroascorbic acid. This is in agreement with Taain (2011) for jujube fruits cv. Tufahi.

Table 1

Effect of spraying with licorice extract, postharvest treatments and storage period on vit. C (mg 100 g^{-1}) of tomato fruits stored at 13 ° C

licorice extract g L^{-1}	Postharvest treatments(%)	Storage period (week)				licorice extract × postharvest treatments
		1	2	3	4	
0	control O	17.88	17.88	17.18	15.84	17.19
	garlic extract 4	20.70	19.69	18.94	17.72	19.26
	calcium chloride 4	18.99	18.93	18.54	17.30	18.44
2	control O	16.33	15.82	15.17	13.66	15.24
	garlic extract 4	22.44	20.81	19.81	18.84	20.47

	calcium chloride 4	18.49	17.91	16.93	15.86	17.29
4	control O	15.15	14.52	13.69	12.96	14.01
	garlic extract 4	23.37	22.10	22.10	20.43	22.00
	calcium chloride 4	23.98	22.52	21.31	20.32	22.03
						Means of licorice extract
licorice × storage period	0	20.83	19.62	19.04	17.90	18.29
	2	19.19	18.83	18.22	16.95	17.66
	4	19.08	18.18	17.30	16.12	19.35
						Means of postharvest treatments
Postharvest treatments× storage period	Control 0	16.45	15.98	15.35	14.15	15.48
	garlic extract 4	22.17	20.87	20.28	19.00	20.58
	calcium chloride 4	20.49	19.79	18.93	17.83	19.26
Means of storage period		19.70	18.88	18.19	16.99	
			RLSD 0.05			
licorice extract 1.570	Postharvest Treatments 1.570	Storage period 1.812	licorice× postharvest treatments 3.139	licorice× storage period 2.719	Postharvest treatments× storage period 3.139	licorice× postharvest treatments× storage period 5.437

Percentage of total soluble solids (T.S.S). Results presented in Table 2 showed the effect of spray treatment with Licorice extract, garlic extract, calcium chloride and storage period on total soluble solids of tomato fruits stored at 13°C. Data showed that the percentage of total soluble solids increased up to **9.9**% after four weeks of storage. The increment in the percentage of total soluble solids may be due to the reduction of moisture content of fruits with the continuation of storage period, as the storage period progresses, the lower moisture content of the fruit increases the concentration of the cell juice of the fruit and thus increases the percentage of soluble solids (*Buroton .1982*).

The highest percentage of TSS was in fruits sprayed with 4 g L^{-1} Licorice extract which was%8.8 with no significant differences with the treatment of 2 g L^{-1} Licorice extract. In regard to postharvest treatment, the highest percentage of TSS was in fruits soaked in 4% garlic extract %9.3 with no significant differences with the treatment of 4% calcium chloride solution.

In regard to Binary interactions, there were significant differences between factorial treatments, the highest percentage of TSS being in the fruits sprayed with 4 g. L^{-1} Licorice extract and soaked in 4% garlic extract (10.3%) with significant differences from the rest treatments, while the lowest percentage of TSS was in the fruits sprayed with 0 g. L^{-1} Licorice extract and soaked in distilled water only. The highest percentage of TSS was recorded in fruits of 2 g L-1 Licorice extract spray after four weeks of storage 10.6% with no significant differences from 4 g. L-1 after four weeks. The highest percentage of total soluble solids was in the fruits of the treatment with calcium chloride solution 4%, which reached 10.7% after four weeks of storage with no significant differences with 4% garlic extract soaking after three and four weeks of storage.

In regard to triple interaction, the highest percentage of TSS was in fruits sprayed with 4 g L-1 Licorice extract and soaked in 4% calcium chloride after four weeks of storage, which amounted to 11.6% with no significant differences with fruits sprayed with 4 g L-1 Licorice extract and soaked in 4% garlic extract after four weeks of storage and with fruits sprayed with 2 g. L-1 Licorice extract and soaked in 4% calcium chloride or 4% garlic extract after four weeks of storage.

Table 2

Effect of spraying with licorice extract . postharvest treatments and storage period on TSS (%) of tomato fruits stored at 13 ° C

licorice extract g L-1	Postharvest treatments(%)	Storage period (week)				licorice extract × postharvest treatments
		1	2	3	4	
0	control O	4.9	5.4	7.3	8.2	6.4
	garlic extract 4	6.3	7.6	8.7	9.0	7.9
	calcium chloride 4	6.7	7.6	8.7	9.1	8.0
2	control O	5.9	7.3	7.4	9.3	7.4
	garlic extract 4	8.3	9.8	9.7	11.1	9.7
	calcium chloride 4	8.0	9.4	10.2	11.4	9.7
4	control O	5.6	7.2	8.0	8.1	7.2
	garlic extract 4	8.8	10.0	11.0	11.5	10.3
	calcium chloride 4	7.3	8.5	9.0	11.6	9.1
						Means of licorice extract
licorice× storage period	0	5.9	6.9	8.2	8.8	7.4
	2	7.4	8.8	9.1	10.6	8.9
	4	7.2	8.5	9.3	10.4	8.8
						Means of postharvest treatments
Postharvest treatments× storage period	Control 0	5.4	6.6	7.6	8.5	7.0
	garlic extract 4	7.8	9.1	9.8	10.5	9.3
	calcium chloride 4	7.3	8.5	9.3	10.7	9.0

Means of storage period		6.8	8.0	8.8	9.9	
RLSD 0.05						
licorice extract	**Postharvest Treatments**	**Storage period**	**licorice× postharvest treatments**	**licorice× storage period**	**Postharvest treatments× storage period**	**licorice× postharvest treatments× storage period**
0.1925	0.1925	0.2223	0.3334	0.3850	0.3850	0.6668

Decay percentage. The results presented in Table 3 showed the effect of spraying licorice extract treating with garlic extract and calcium chloride and the duration of storage in the decay percentage of tomato fruits cv. Newton stored at 13°C. The results indicated that the decay percentage increased with an increment of storage periods till reached (15.14%) after four weeks of storage. As for the effect of spray treatments with Licorice extract, results showed that the lowest percentage of the decay (7.25%) was in fruits treated with Licorice extract of 4 g L^{-1} with no significant difference with 2 g L^{-1} Licorice extract. The effect of post-harvest treatments on the percentage of decay was significant with the fruits treated with 4% garlic extract in recording the lowest percentage of decay which was 6.64 %, while the control fruits gave the highest percentage of decay (22.36%). Fruits soaked in 4% calcium chloride solution significantly differed on the control treatment.

The results also showed a significant interaction between spraying with Licorice extract and post-harvest treatments. The lowest percentage of decay was in the fruits sprayed with 4 g L^{-1} Licorice extract and soaked in 4% garlic extract, which was 4.93% with no significant difference with the fruits sprayed with 4 g L^{-1} Licorice extract and soaked in 4% calcium chloride and with fruits sprayed with 2 g L^{-1} Licorice extract and soaked in 4% garlic extract or 4% calcium chloride and significant with the rest of the factorial treatments.

The table 1 also showed the significant interaction between the spraying with Licorice extract and the storage period. The lowest percentage of decay was in the fruits sprayed with 4 g L^{-1} licorice extract after a week of storage which was 2.63%. with no significant difference with fruits sprayed with 2 g L^{-1} Licorice extract after a week of storage and fruits sprayed with 4 g L^{-1} Licorice extract after two weeks of storage.

The interaction between the post-harvest and storage period was significant. The fruits that soaked in 4% garlic extract after one week of storage gave the lowest percentage of decay which was 2.39 % with no significant difference with those soaked in 4% calcium chloride solution after one week of storage and those soaked in4% garlic extract after two weeks of storage, while the highest percentage of decay 18.36% was in untreated fruits after four weeks of storage.

The results indicated a significant interaction between spraying with *G. glabra* extract and post-harvest treatments with garlic extract and calcium chloride and the duration of storage. Fruits sprayed with 4 g L^{-1} *G. glabra* extract, soaked in 4% garlic extract recorded the lowest percentage of decay (0.5 %) after one week of storage, while the highest percentage of decay 21.75% was in fruits sprayed with 0 g L^{-1} *G. glabra* extract, soaked in distilled water after four weeks of storage.

The fruits are exposed during the process of packing and storage to the damage, which takes several forms according to its causes. It may be the result of mechanical disorders brought to the fruits during packing and storage, such as bruises caused by the pressure of the fruits of each other inside the package. The damage is caused as a result of the progress of fruits ripening and also due to injuries with pathogens such as bacteria, fungi and yeast (*Taain 2005. 2011*).

As previously mentioned, spraying with *G. glabra* extract and soaking with garlic extract and calcium chloride reduced the damage rate of tomatoes.

The effect of plant extracts in reducing the incidence of microbial infections may be due to their effect in inhibiting the growth, activity and reproduction of fungi, especially volatile oils and alkaloids that prevent the spread of pathogens and inhibit their growth (Williams & Hoagland. 1986). In addition, the volatile oils and their compounds have the potential to inhibit the growth of bacteria and fungi (Ricardo *et al.* .2003).

The effect of calcium chloride treatment in reducing decay percentage due to the vital role of calcium in plant tissues, is the increase of membrane stability and cell wall strength (Poovaiah *et al.* .1988). As was pointed out by Taain (2011), postharvest treatment of jujube fruits with calcium chloride and calcium nitrate decreased the decay of fruits particularly caused by fungi, decreased weight loss, total soluble solids and total sugars at the end of storage at 0º C and 5ºC.

Table 3

Effect of spraying with licorice extract , postharvest treatments and storage period on decay (%) of tomato fruits stored at 13 ° C

licorice extract g L-1	Postharvest treatments(%)	Storage period (week)				licorice extract × postharvest treatments
		1	2	3	4	
0	control O	9.00	12.00	15.00	21.75	14.43
	garlic extract 4	4.25	6.11	9.00	14.00	8.34
	calcium chloride 4	4.25	7.75	11.00	17.75	10.18
2	control O	4.00	9.50	12.50	17.00	10.75
	garlic extract 4	2.44	4.75	7.25	12.25	6.67
	calcium chloride 4	3.55	5.25	9.75	15.25	8.45
4	control O	4.25	6.25	10.75	16.33	9.39
	garlic extract 4	0.50	3.25	7.25	8.75	4.93
	calcium chloride 4	3.16	5.25	8.16	13.25	7.45
						Means of licorice extract
licorice× storage period	0	5.83	8.62	11.66	17.83	10.98
	2	3.33	6.5	9.83	14.83	8.62
	4	2.63	4.91	8.72	12.77	7.25
						Means of postharvest treatments
Postharvest treatments× storage period	Control 0	5.75	9.25	12.75	18.36	22.36
	garlic extract 4	2.39	4.7	7.83	11.66	6.64
	calcium chloride 4	3.65	6.08	9.63	15.41	8.69
Means of storage period		3.93	6.67	10.07	15.14	
RLSD 0.05						
licorice extract 1.389	Postharvest Treatments 1.876	Storage period 1.593	licorice× postharvest treatments 2.389	licorice× storage period 2.759	Postharvest treatments× storage period 2.759	licorice× postharvest treatments× storage period 4.778

Weight loss percentage. Data presented in table (4) showed the effect of spraying licorice extract, treating with garlic extract and calcium chloride and storage period 0n the percentage of weight loss of tomato fruits cv. Newton stored at 13°C. The results indicate that the percentage of weight loss increased by increasing the storage period until reached (1.429%) after four weeks of storage. As for the effect of spraying treatments with licorice extract, the least loss in weight was in fruits treated with 4 g L^{-1} licorice extract which reached (0.702 %) with no significant difference with 2 g L^{-1} Licorice extract and significant for control, which recorded the highest percentage (1.027%). The effect of post-harvest treatments on the percentage of weight loss was significant. Fruits treated with 4% garlic extract recorded the lowest percentage weight loss (0.638%) with significant difference from the rest treatments.

The results of the same table showed a significant difference between the spray treatments with Licorice extract and post-harvest treatments. The lowest percentage of weight loss was in fruits sprayed with Licorice extract 4 g. L^{-1} and treated with 4% garlic extract, which was (0.577%) with no significant difference with fruits sprayed with 2 g L^{-1} Licorice extract and soaked with 4% calcium chloride solution. The highest percentage of weight loss was in the fruits that sprayed with Licorice extract 0 g L^{-1} and soaked in distilled water which was (1.310 %) with no significant difference with fruits sprayed with 2 g L^{-1} Licorice extract and soaked in distilled water.

Regarding to the correlations between the spray treatments and storage period and the correlations between postharvest treatments and storage period, the highest weight loss percentages (1.598%. 1.784 %) were in untreated fruits after four weeks of storage respectively.

The interaction between spraying with Licorice extract and post-harvest treatments with garlic extract and calcium chloride and storage period was significant. The lowest percentage of weight loss was in the fruit sprayed with 2 g L^{-1} Licorice extract and soaked in garlic extract 4% after a week of storage, which amounted to (0.5%) with no significant difference with fruits sprayed with 4 g L^{-1} Licorice extract and soaked in 4% garlic extract, after one week of storage and the treatment of 4 g L^{-1} Licorice extract spray, 4% calcium chloride soaking after one week of storage , the treatment of 4 g L^{-1} Licorice extract spray distilled water soaking after one week of storage , the treatment of 0 g L^{-1} Licorice extract spray, 4% garlic extract soaking after one week of storage, the treatment of 2 g L^{-1} Licorice extract spray, 4% garlic extract soaking after two weeks of storage, the treatment of 4 g L^{-1} Licorice extract spray, 4% calcium chloride soaking after two weeks of storage

As previously mentioned, spraying with Licorice extract and soaking with garlic extract and calcium chloride reduced the weight loss percentage of tomatoes. The effect of plant extracts on the reduction of weight loss may be due to the fact that plant extracts have formed a layer of insulation covering stomata and acted as anti-transpirations because they contain substances of a similar effect to wax or vegetable oils (Rizk et al.. 1985).

It is noted that the fruits soaked with calcium chloride solution decreased the percentage of loss in weight because of calcium that increases cell wall strength and reduces the decomposition of pectin and wax layer surrounding the fruit epidermis, which leads to reduce the evaporation of water content of fruits (Taain.2005;2011).

As for the effect of the storage period, the results indicated an increase in the percentage of weight loss by increasing storage period. This is due to the reduction of weight of the fruits as the storage period progresses, resulting in loss of the water content of the fruits while the storage period continues, as well as, the consumption of the food stored in the fruit as a result of breathing. These findings are in the accordance with those previously reported by Taain et al. (2007) for Super Maramond tomato cultivar.

Table 4

Effect of spraying with licorice extract, postharvest treatments and storage period on weight loss (%) of tomato fruits stored at 13 ° C

licorice extract g L^{-1}	Postharvest treatments(%)	Storage period (week)				licorice extract × postharvest treatments
		1	2	3	4	
0	control O	0.515	071.3	1.425	1.930	**1.310**
	garlic extract 4	0.425	0.585	0.822	1.355	**0.796**
	calcium chloride 4	0.630	0.674	1.092	1.510	**0.976**

2	**control O**	0.642	0.677	1.580	1.747	**1.161**
	garlic extract 4	0.212	0.240	0.645	1.075	**0.543**
	calcium chloride 4	0.405	0.455	0.850	1.133	**0.710**
4	**control O**	0.225	0.607	0.803	1.675	**0.827**
	garlic extract 4	0.282	0.292	0.525	1.210	**0.577**
	calcium chloride 4	0.303	0.450	0.837	1.228	**0.704**
						Means of licorice extract
licorice× storage period	**0**	0.538	0.861	1.113	**1.598**	1.027
	2	0.419	0.457	1.025	1.318	0.796
	4	0.270	0.449	0.721	1.371	0.702
						Means of postharvest treatments
Postharvest treatments× storage period	**Control 0**	0.460	0.851	1.269	1.784	1.091
	garlic extract 4	0.315	0.363	0.664	1.213	0.638
	calcium chloride 4	0.460	0.511	0.926	1.290	0.796
Means of storage period		0.415	0.575	0.953	1.429	
RLSD 0.05						
licorice extract 0.1191	**Postharvest Treatments** 0.1191	**Storage period** 0.1375	**licorice× postharvest treatments** 0.2062	**licorice× storage period** 0.2381	**Postharvest treatments× storage period** 0.2381	**licorice× postharvest treatments× storage period** 0.2425

CONCLUSIONS

In conclusion, the results obtained in the present work clearly indicated the role of pre and postharvest application of G. glabra extract at the concentrations of 4 g L^{-1} and 2 g L^{-1}. 4% garlic extract and 4% calcium chloride solution in improving storage ability of tomato fruits cv. Nuton stored at 13°C for four weeks. Obtained results indicated that the decay percentage, the percentage of weight loss and the percentage of total soluble solids increased while the amount of vitamin C decreased with an increment of storage periods. The lowest percentages of the decay and weight loss and the highest percentage of total soluble solids were in fruits treated with licorice extract as compared with untreated fruits. Fruits treated with 4% garlic extract recorded the lowest percentage of decay and lowest percentage weight loss, while fruits soaked in 4% calcium chloride solution gave the highest percentage of total soluble solids.

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THE STUDY OF THE ARRANGEMENT OF WORKING ELEMENTS FOR HOMOGENEOUS FROZEN ENVIRONMENTS FRACTURE
/
ДОСЛІДЖЕННЯ РОЗМІЩЕННЯ РОБОЧИХ ЕЛЕМЕНТІВ ДЛЯ РУЙНУВАННЯ ОДНОРІДНИХ МЕРЗЛИХ СЕРЕДОВИЩ

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Keywords: *agriculture, homogeneous frozen environment, crack, destruction, placement of wedge-shaped destructive elements, technological module, system of cracks.*

ABSTRACT

Experimental researches of the rational system of wedge-shaped destructive elements placement are expounded. The change of energy capacity of the ice layer destruction process is determined and experimentally grounded and the estimation of quality of road surface cleaning is given depending on placing of indents on the working body.

РЕЗЮМЕ

Изложены экспериментальные исследования рациональной системы размещения клиновидных деструктивных элементов. Определение энергетической емкости процесса разрушения ледяного слоя определяется и экспериментально обосновано и дается оценка качества очистки поверхности дороги в зависимости от размещения отступов на рабочем корпусе.

INTRODUCTION

The development of agriculture in the country provides field work in the winter, which allows harvesting. Therefore, it is necessary to have the prper technology to ensure the capacity of equipment to maintain all roads in a clean state for travel.

The existing technologies of removing ice formations which appeared on the surface of road pavement, in particular the application of salts in agriculture are not effective enough because they cause corrosion of metallic surfaces, negatively influence road pavement, tires of cars, getting into soil or onto the wayside vegetation.

For this purpose, it is expedient to apply working equipment which would provide cleaning of road pavement without its damage and without contamination of the environment. Until recently, the development of their design has been mostly aimed at diminishing hauling resistance and to a lesser extent – at achieving high-quality operation indices and road pavement cleaning. According to the existing technologies, the required quality of road pavement cleaning is obtained with the utilization of combination of a few types of treatment which result in additional energy consumption *(Sedov L.I.. 1973; Balovnev V.I.. 1981).*

MATERIAL AND METHOD

Despite the rapid growth of various methods for the development of homogeneous frozen media nowadays, the mechanical method of their destruction is considered to be the most effective which is performed by means of static and dynamic means of mechanization. A comparative analysis of methods for the development of homogeneous frozen media shows that more than 75% of work volume is performed by this method. As well as the resistance of homogeneous frozen media to fracture during the cleavage changes is very significant at small time intervals.

Analysis of the application of dynamic fracture shows its frequent use for homogeneous frozen media. The choice of the method of destruction is determined by the energy intensity of the process for the development of homogeneous frozen media.

Researches have shown that the energy intensity of the development of homogeneous frozen media by machines depends not only on the physical and mechanical properties, but also on the design of the working parts used to perform the work. The dominant amount of the total resistance to development is accounted by the frontal surfaces of the cutting working bodies of machines that include the tips of the teeth. Therefore, in order to reduce the strength of resistances to the development of homogeneous frozen media, it is very important to choose the optimal configuration of the working elements and the parameters of their cutting edges. The extensive use of machines necessitates the manufacture of tooth tips of various configurations. At the same time practical experience in the development of homogeneous frozen media is mainly taken into account.

The development of homogeneous frozen media essentially depends not only on the initial parameters of the working parts, but also on their changes in the development process. Investigations show that the efficiency of development falls sharply because of blunting of working parts as a result of abrasive wear. In some cases, the operating parts are wearing out to the limit values for 2-4 shifts of operation.

Reducing the wear rate of the working bodies will significantly improve the productivity of machines and the efficiency of their work. Improved efficiency as an integral indicator of the process of development of homogeneous frozen environments by the working bodies of machines is characterized not only by their high wearing resistance, but also by the energy efficiency of the development of homogeneous frozen media.

Therefore, there is a need to work out a methodology for determining the optimal geometric parameters and configuration of the working parts of machines, in particular their working surfaces that are directly involved in the destruction of homogeneous frozen media. This methodology should take into consideration the spatial and dynamic nature of the process of developing homogeneous frozen media, their physical and mechanical properties and development modes.

Among the works on the study of the destruction of homogeneous frozen media, can be defined the works of the following scientists: V. P. Goriachkin, N. G. Dombrovskyi, A. D. Dalin, A. N. Zelenin, I. Ya. Aizenshtok, V. D. Abezhauz, G. I. Veselov, Yu.A. Vetrov, D. I. Fedorov, K. A. Artemeva, V. I. Balovnev, I.P. Kerov, I.A. Nedorezov, E.I. Berestov, A.S. Slusareva, V.L. Baladinskyi, A.M. E. Dinglinger, I. Ratier, V. Zene, M. Nichols *(Zav'yalov A.M.. 2012)*..

The use of known theories for research purposes is associated with the difficulties that arise when obtaining the necessary physico and mechanical indicators, a wide range of changes in conditions, the complexity of the existing dependencies for determining the values of the resistance forces. In majority of works. it is necessary to take into account the geometric parameters, the configuration of the working elements in calculating the values of the resistance forces for the development of homogeneous frozen media.

Effecting on ice with dynamic loading of high amplitude but low frequency results in his instantaneous fragile destruction under the action of tension waves. The prerequisite of tension waves formation and their distribution in the environment under dynamic loadings, the influence on the destruction of material are considered in the monographs of the well-known scientists: N.A. Alekseev, D.D. Barkan, L.I. Baron, V.L. Baladinsky, S.S. Grigoryan and many others. The researches of physical and mechanical properties of ice and its destruction peculiarities have been performed by G.L.Karaban, A.N. Zelenin, V.N. Denisov, L.S. Mnukhin, V.V. Bogorodsky, V.V. Laurel, K.F. Voytkovsky. etc. In the course of research it has been elucidated that the ice formed on road pavements of streets and sidewalks has an obviously expressed chaotic texture formation and the rate of its freezing up with road pavement depends on a series of factors. primarily on the state of road pavement surface *(Baladinskiy V.L.. 1971; Cherepanov G.P.. 1974; Balovnev V.I.. 1981)*.

In this connection it is an urgent task nowadays to develop highly efficient working bodies for ice removal, which would allow to improve the quality indices of road pavement cleaning without its damage grounding on the consideration of different formation terms.

The efficiency of an icebreaker operation substantially depends on placement of indents in the technological module, which form a system of destroying cracks on the ice surface. Therefore, while choosing the rational placement of contiguous destructive elements on a working body, it is possible to reduce the energy capacity of destruction process, to increase the area of destruction and decrease the size of fractions of the split off ice to provide necessary cleaning quality of road pavement.

Consequently, in order to provide high-quality operation of working equipment, it is necessary to create such a strained state in an ice array, so that to promote the distribution of destructive cracks down to the surface of road pavement *(Muskhelishvilli N.I.. 1966).*

Thus, the distance between the contiguous destructive elements must provide the mutual overlapping of the fields of their strained states, that will enable to ensure the complete destruction of ice formations layer on the pavement.

As an object of the research there has been used a hydroimpulsive working body, the shocking plate of which is equipped with indents having appropriate geometrical parameters together with the brush for clearing from ice formation remains.

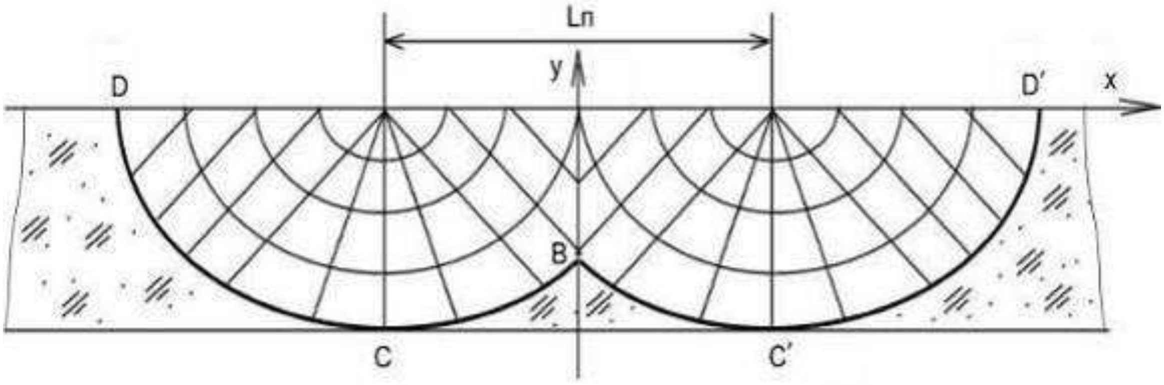


Fig 1 - Schemes of overlapping zones of stress state

Workings indents are accommodated in two parallel rows, in a chess order with the mutual overlapping of the destruction area (fig. 2) perpendicular to the direction of icebreaker motion with the united front of cracks development.

It should be noted that with the implementation of the working body into the working environment with opened lateral walls, the blasted area is increased due to the appearance of cracks which go out on a lateral surface. In this case, the optimum value of shoulder of splitting off the size of which can be obtained under the condition of minimum energy necessary for the formation of splitting off cracks, serves as a determinative of the process.

Consequently, if to dispose an instrument nearby earlier created small hole of splitting off before a subsequent blow, the latter playing the role of an additional free surface, though of limited size; however the breakage is performed jointly.

The purpose of the experiment is the verification of analytical dependences and findings for the substantiation of parameters of splitting off and placing of indents for the destruction of an ice layer. The tests have been carried out on the laboratory installation presented in figures 2 and 3.

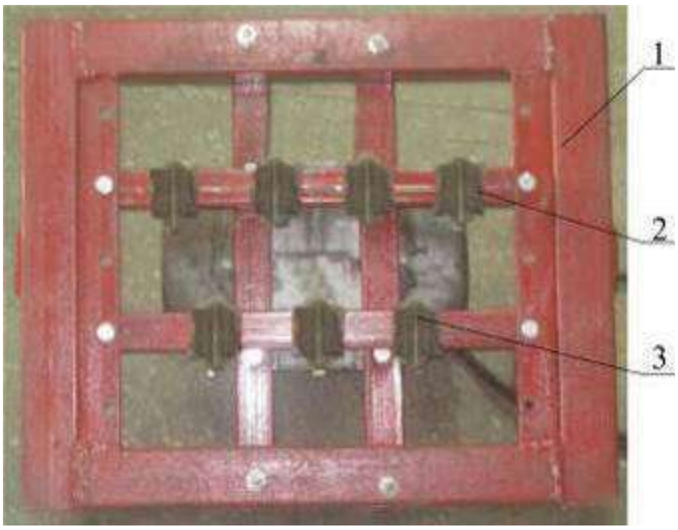


Fig 2 - Laboratory installation for the research of wedge-shaped destructive elements placed on the shocking plate: 1 – a frame of working body. 2 – the indents of the first row. 3 – the indents of the second row.

After conducting the experimental researches on a laboratory stand, it was performed the detecting of the influence of wedge-shaped destructive elements placing order on the peculiarities of the process: of operation *A*. of energy capacity q_A of destruction process and index of cleaning quality of road pavement – the data have been obtained by which graphic dependences have been designed; this analysis allowed to define the basic particularities of wedge-shaped destructive elements interaction with the environment.

During conducting the experiment for creating high-quality picture, photographing was being performed. that has allowed to create a photogram presented in figure 4.

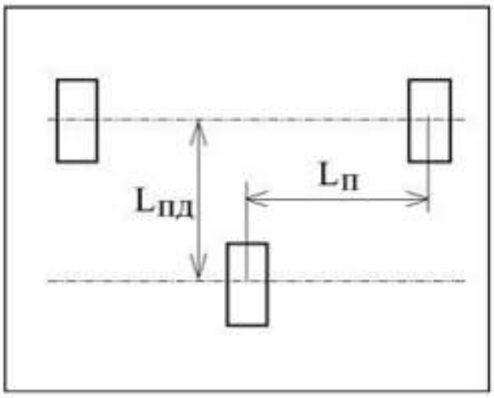


Fig 3 - Chart of wedge-shaped destructive elements placed in two parallel rows in a chess order.

As a result of experimental researches the dependences for placing of wedge-shaped destructive elements on the working body have been obtained, while removing ice formations from the surface of road pavement at the angle of an indent sharpening 2α=27°.

а)

б)

в)

г)

Fig. 4 - Photogram of ice destruction process.

As a result of PFE was obtained a regression equation. It was introduced the regression equation in natural scale after which its decoding was got:

$$\begin{aligned} q = 65{,}36 - 18{,}67 \cdot L_П - 1{,}34 \cdot L_{ПД} - 5{,}42 \cdot H \ + 2{,}07 \cdot L_П \cdot L_{ПД} - \\ - 4{,}74 \cdot L_П \cdot H + 1{,}29 \cdot L_{ПД} \cdot H + 2{,}13 \cdot L_П^2 - 0{,}86 \cdot L_{ПД}^2 - 1{,}12 \cdot H^2 \end{aligned} . \quad (1)$$

$$k_Я = 1{,}021 - 0{,}029 \cdot L_П + 0{,}0003 \cdot L_{ПД} - 0{,}0011 \cdot H \; + 0{,}0015 \cdot L_П \cdot L_{ПД} - \\ + 0{,}0011 \cdot L_П \cdot H + 0{,}0002 \cdot L_{ПД} \cdot H - 0{,}0012 \cdot L_П^2 + 0{,}0004 \cdot L_{ПД}^2 - 0{,}0002 \cdot H^2 \quad (2)$$

The dependence of energy capacity process indices and quality of road pavement cleaning on the distance between the nearby wedge-shaped destructive elements at different thickness of ice layer *H* is resulted in figure 5 – 7.

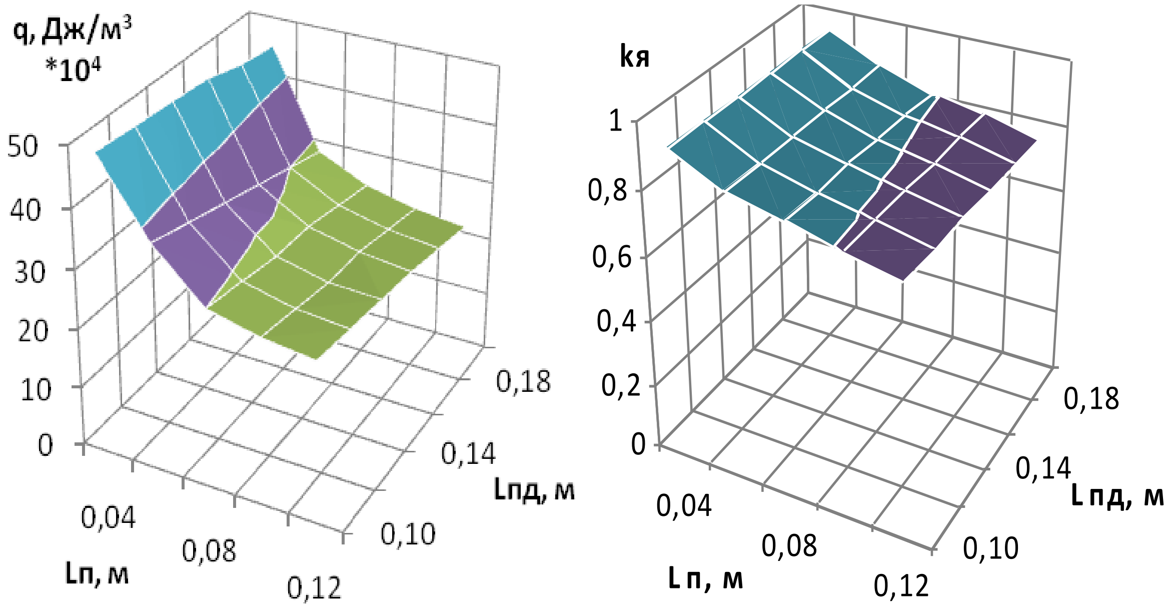


Fig. 5 - Dependence of specific energy of destruction and the quality of road pavement cleaning on the distance between contiguous destructive elements at *H* = 0.06 m

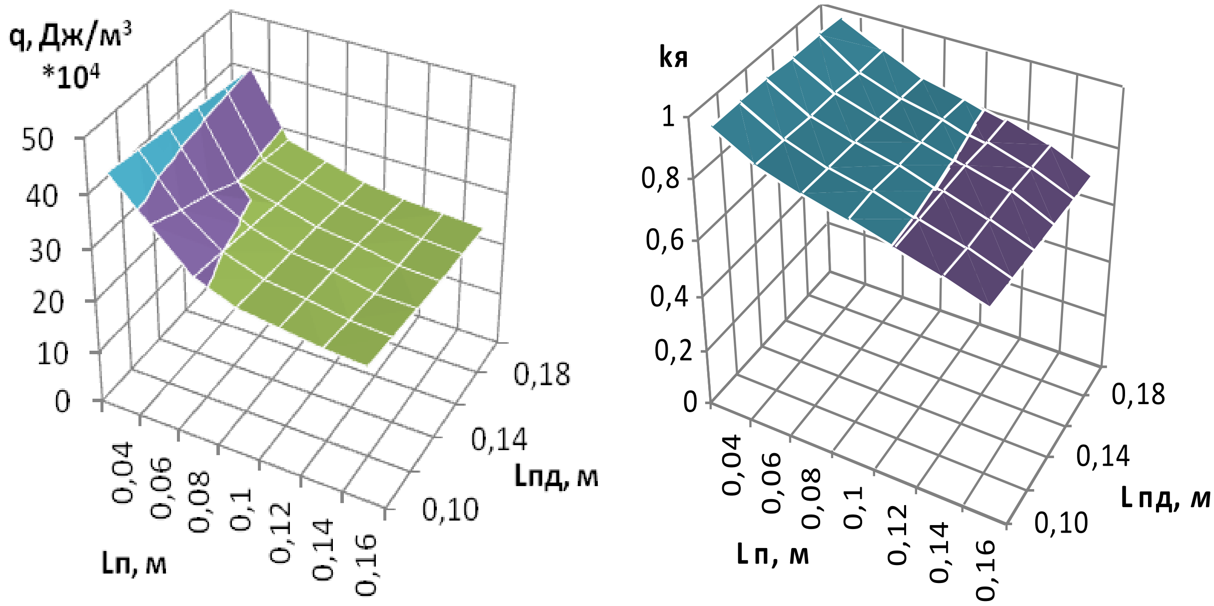
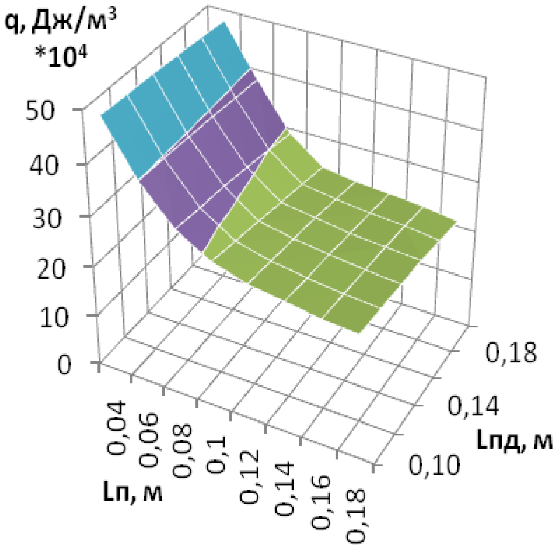


Fig. 6 - Dependence of specific energy of destruction and the quality of road pavement cleaning on the distance between contiguous destructive elements at *H* = 0.08 m



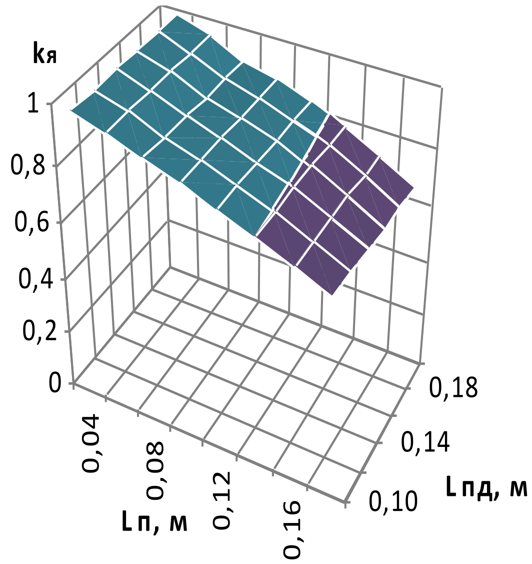


Fig. 7 - Dependence of specific energy of destruction and the quality of road pavement cleaning on the distance between contiguous destructive elements at *H* = 0.10 m

CONCLUSION

In the course of experimental researches it has been determined (fig. 5–7) that the energy capacity of the process diminishes proportionally with the growth of the distance between destructive elements and the quality of road pavement cleaning diminishes with the increase of the distance between contiguous destructive elements (fig. 5–7). The performed experimental researches have enabled to select the rational parameters of wedge-shaped destructive elements placement on a working body for the removal of ice formations which will satisfy minimum energy capacity at the set index of the quality of road pavement cleaning.

As a result of studies, there were found the rational placement options of destructive elements on your body to remove ice formations $L_{ПД}$ = 80-100 mm. $L_{П}$ =100-150 mm aspect $L_{П} / L_{ПД}$ = 0.7-0.8 with minimum power consumption for a given indicator as cleaning coating $k_{я}$ = 0.85-0.90.

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NON-CONVENTIONAL PRESERVATION METHODS FOR HORTICULTURAL PRODUCTS IN FRESH CONDITION
/
METODE DE CONSERVARE NECONVENTIONALE PENTRU PRODUSELE HORTICOLE ÎN STARE PROASPĂTĂ

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Keywords: *Post-harvest treatment, ultraviolet radiation, ozone, horticultural products* **.**

ABSTRACT

Consumed horticultural products in fresh condition may be carriers of optionally pathogenic microorganisms: bacteria, yeast, molds. Due to the post-harvest decomposition process, these micro-organisms can cause either loss of preserved horticultural products or disease or food poisoning with direct effects on the health of the human consumer. As a result of these factors, the conservation duration of these products is limited. For the preservation of horticultural products and the extension of the allowed preservation and commercialization period, non-conventional methods have occurred. The paper aims to present two of the most commonly used non-conventional conservation methods: UV radiations and ozone use for decontamination of horticultural products.

REZUMAT

Produsele horticole consumate in stare proaspata pot fi purtatoare ale unor microorganisme facultativ patogene: bacteria, drojdii, mucegaiuri. Datorita procesului de descompunere postrecoltare. aceste microorganisme pot provoca fie pierderi de produse horticole la pastrare. fie imbolnaviri sau toxinfectii alimentare cu efecte directe asupra sanatatii consumatorului uman. In urma actiunii acestor factori durata de conservare a acestor produse este limitata. Pentru conservarea produselor horticole si prelungirea perioadei admisibile de pastrare si comercializare au aprarut metode neconventionale de conservare. Lucrarea isi propune sa prezinte doua dintre cele mai folosite metode atermice neconventionale de conservare: conservarea cu ajutorul radiatiilor UV si utilizarea Ozonului pentru decontaminarea produselor horticole.

INTRODUCTION

Fresh fruits have been and continue to be a finished product of nature that is consumed without being subjected to energy-consuming cooking processes, consumed in the state in which it is found ready prepared by nature.

As living organisms, in their tissues complex metabolic processes take place under the action of own enzymes and after harvest. The optimum harvest time is established using criteria, tests and indices simultaneously analyzed and that depend on the following factors: the evolution of fruit on plants, the way of capitalizing the products and their maturation capability.

The duration of the fruit's evolution on the plant depends on the species, variety, environmental factors and agro-technical factors during which time the following steps are taken: growth, ripening, maturation and over-maturation.

For fresh consumption or preserved one, choosing the optimal harvest time for a particular destination is made at a certain stage of evolution depending on the time of consumption and the mode of use. Depending on the ripening capacity, the products are grouped into two categories: horticultural products that remain at the stage of evolution and maturation they had at the time of harvesting and horticultural products that are harvested at different moments of the ripening phase, following to improve their sensory properties due to the continuation of biochemical transformations during long and short-term preservation (apples and pears in autumn and winter), or large-scale transformations in view of capitalization (peaches).

Harvesting at a different stage than the optimal time is correlated with an incomplete fruit growth with insufficient accumulation of nutrients and implicitly with quantitative harvest reductions, decreased preserving capacity, alteration of products and poor transport resistance [2. 6]. The methods for keeping products in fresh state aim to maintain commercial-food acceptability for as long as possible. Nutritional evaluation of freshly consumed horticultural products is given especially by the large quantities of vitamins they synthesize, so it is necessary to prolong the shelf life of these products to eliminate as much as possible the seasonal nature of consumption and to reduce as much as possible losses through the degradation of perishable food products.

Freshly consumed horticultural products can be carriers of pathogenic facultative microorganisms: bacteria, yeasts, molds. These microorganisms can cause either loss of preseved horticultural products due to the post-harvest decomposition process or disease or food poisoning with direct health effects. Losses due to the post-harvest decomposition process lie at the level of 10-50% depending on the development of the area and the temporary preserve facilities.

For fresh consumption, horticultural products undergo a conditioning process. By conditioning, a unique and homogeneous quality is achieved in the consignments of products intended for delivery. The conditioning is differentiated and specified for each product and for each direction of capitalization [1. 6. 9].

Extending the keeping duration time is done by preservation ensuring the increasing of the relative stability of these products properties. The use of one or other of the preservation processes involves various additional technological operations resulting in the products undergoing chemical and even biological changes. Usually, the nutritive and taste related value is improved.

The ultimate goal of preservation by a particular process or by the concurrent application of several conservation processes is to inhibit or even destroy the products and microorganism’s enzymes that habitat the products so that storage stability is as great as possible.

MATERIAL AND METHOD

The classic conditioning technology for horticultural products destined for fresh consumption involves the following operations:

a) Cleaning (presorting): it is executed manually with the harvesting or emptying of the picking containers and consists in removal of the qualitatively inadequate specimens and of the various impurities (leaves, branches. etc.) from the horticultural product mass;

b) Sorting: is done by choosing fruits in relation to existing defects, maturation degree, colour etc in different quality groups;

c) Calibration: represents the grouping of horticultural products according to their size according to the standard, the internal technical norms, etc. It can be done manually or mechanically. Mechanical calibration is often used either in relation to the diameter of the fruits or their weight;

d) Washing and brushing: it is done in order to remove any remaining substances on the surface of the fruit due to the application of chemical treatments in culture, adhesions of other nature (dust), ensuring a pleasant commercial appearance. Washing is done by immersing the fruit or by exposing it to fine jets. In the washing water can be added chemicals that prevent the attack of the pathogens. Washing can be completed with the brushing operation which increases the washing efficiency. Brushing is sometimes applied without a pre-wash (eg, on peaches), removing quantities of chemicals, dust. etc.. being less in the same situation. Any washing operation must be followed by the hot or warm air sounding operation. The biological principles underlying conservation processes are as follows: anabiosis. cenoanobiosis and abiosis.

Anabiosis: (the principle of latent life) is the basis for preserving products conserved by processes involving the vital processes of horticultural products as well as their altering factors (micro pests, microorganisms, parasites, etc.). Blocking enzymes, stopping the development of microorganisms or macro-pests and, as a consequence, preventing the alteration of products by anabiosis can be ensured by cold storage using refrigeration at temperatures below 60 ° C., but above freezing point.

Abioza: (the principle of lack of life) is the basis for the preservation of products preserved by processes that partially or totally destroy the microorganisms in the product by using high temperatures (pasteurization. sterling), radiation, chemicals (antiseptic, antibiotic) or other methods.

The most important conservation methods [6. 10] for freshly consumed horticultural products are: the use of low temperatures (refrigeration), addition of antiseptics, phytonocides and use of radiation (ionizing. ultraviolet).

RESULTS

Non-conventional preservation methods for horticultural products

Decontamination by conventional thermal methods when used for fresh fruit and vegetables produces permanent changes in color, smell, flavor and loss of nutritional value.

Recent researches have identified a number of alternative technologies to improve the safety of fresh and freshly cut fruits and vegetables: ultraviolet radiation, electron beam irradiation, visible light radiation technology, cold plasma technology, ozone. etc. In some cases, such as ultraviolet radiation these technologies have a substantial information database on use in other areas and can be adapted to be used for fresh products.

Other technologies, such as visible light and cold plasma pulse technology are new research areas that promise to be used as antimicrobial processes that can reduce the viability of bacterial pathogens in fresh products.

Among the above-mentioned non-conventional methods, there is a great potential for preserving using UV-C non-ionizing radiation and conserving using ozone.

In the case of ultraviolet UV-C non-ionizing radiation, the wavelength between 200 and 280 nm, which is considered lethal to most types of microorganisms affects the replication of the DNA of the pathogenic microorganisms.

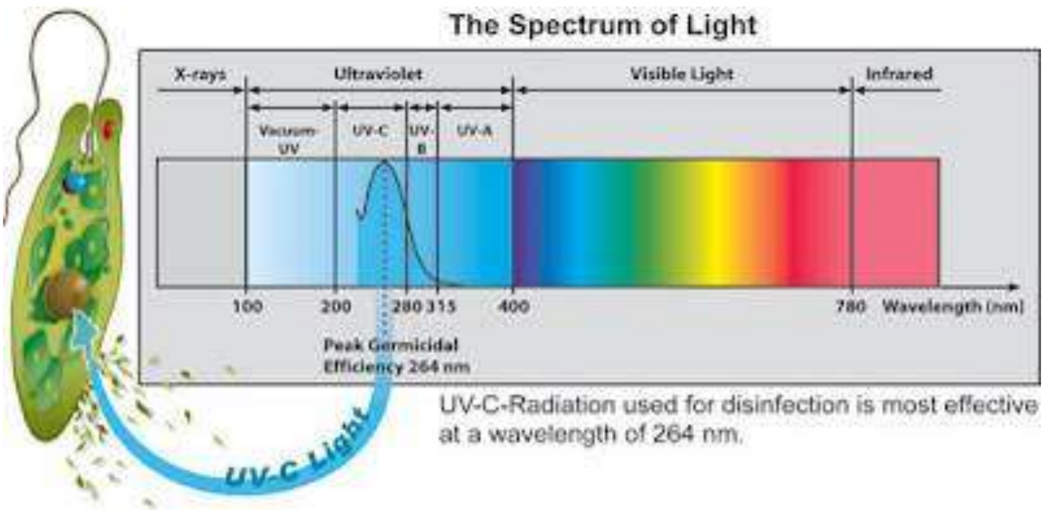

Fig. 1 - Curve of germicidal efficiency of UV radiation on pathogens depending on wavelength (nm) [14]

Non-ionizing UV irradiation may produce breakdowns of molecular chemical bonds and may induce photochemical reactions. The biological effects of ultraviolet irradiation depend on wavelength and exposure time. Ultraviolet UV-C radiation is already successfully used in various fields such as medicine (air and medical decontamination), ecology (wastewater treatment), packaging industry (decontamination of packaging for various foods), etc. Worldwide, there are concerns about the use of this process for the decontamination of external food surfaces.

As a post-harvest treatment of horticultural products, ultraviolet irradiation with UV-C radiation has been shown to be beneficial in reducing breathing rate, controlling product degradation and delaying ripening and baking processes on various fruit and vegetables, whole or matured, such as apples, citrus, peaches, melons, grapes, tomatoes, green lettuce, spinach and mushrooms [4. 5. 8. 7. 3].

Among the ultraviolet UV-C UV radiation decontamination facilities, can be mentioned those produced by: UV Technology (UK) - fig. 2 and fig. 3. Water Sterilization Aqua Clean - fig. 4. INMA Bucharest - fig. 5.

Fig. 2 - Technical equipment for UV-C decontamination [17]
Tunnel for food products decontamination

Fig. 3 - Technical equipment for UV-C decontamination [17]
Tools for air decontamination

Fig. 4 - Equipment for water desinfection. Water Sterilization Aqua Clean [14]

Fig. 5 - UV-C ultraviolet radiation decontamination installation [11]

Products decontamination by ozone. Ozone is a strong oxidizer which destroys major existent pathogen agents. In food industry have been demonstrated that ozone is by 50% stronger then chlorine in distroying the microorganisms and has effect to a much larger specter against the others disinfectants. A positive aspect of ozone is that it does not leave chemical residues that can contaminate products and acts on pathogens by oxidizing their membrane, thereby altering their molecular structure. Ozone is much more effective than most of the methods currently practised in food industry for disinfection and preservation. It is also much cheaper and easier to implement because it takes place on the spot and does not require special methods of application.

The main advantages of ozone are the following:

- Is a very strong non-chemical disinfectant; has a unique quality to descompose and transform in a non-toxic substance, which is not harmful.
- Fast reduce toxical and harmless substances (carbon monoxide, sulphur and benzene in the air, bacteria and viruses in the water, insecticide traces and harmful substances on the surface of plant products);
- Can oxidize, decompose and neutralize quickly (in only 10-15 minutes) and completely different unpleasant smells from water and air, wastewater, smoke or incomplete combustion, mold, paint and other construction materials penetrating after home renovation, toxic chemicals and harmful natural gas such as in-room carbon monoxide;
- Enriches air with oxygen and negative ions. It can purify potable water containing chlorine, iron, manganesium or other organic compound harmful to the human body so that air and water are cleaner and cleaner;
- Can destroy parasites such as "Giardia lamblia" and chemically attacks water contamination with iron, sulfate arsenic, nitrogen and organic complexes.

The destruction rate of bacteria and other microorganisms with ozone is 3500 times faster than that of chlorine. In the case of fruit and vegetables, ozone destroys bacteria, reduces exposure to pesticides, herbicides or other fertilizer residues. Ozone can oxidize and break down traces of insecticides, fertilizers. Hormones, antibiotics from vegetables, fruits, meat, pastes; Ozone water also improves the appearance and taste of products [1].

Ozone production: due to short lifetimes, ozone is always generated where it is used with an ozone generator. Ozone production is done in two ways:

- with UV radiation;

- by Corona discharge.

Generation of ozone via Corona discharge is more used today and is more advantageous: ozone generation equipment has a longer life and costs are lower. Ozone production using Corona discharge is mainly based on the transit of an alternative high-voltage discharge system through a low-humidity air or oxygen flux. At a certain voltage dependent on the thickness of the air or oxygen layer, its pressure and humidity the Corona discharge occurs, which generates ozone.

UV radiation can be used when small amounts of ozone are needed, for example in laboratories. Ozone can be used both in gaseous form and as aqueous solution.

The ozone treatment process in aqueous solution is based on the mechanism of direct and indirect reactions. This is due to the decomposition of ozone in water in OH radicals. These radicals have a very short life time and have a higher oxidation power than ozone. When the number of OH radicals in water increases, treatment is called Advanced Oxidation Process. This process results in the oxidation of solids dissolved by ozone (by direct action) and by OH radicals (indirect action).

The principle of obtaining ozonated water is presented in figure 6.

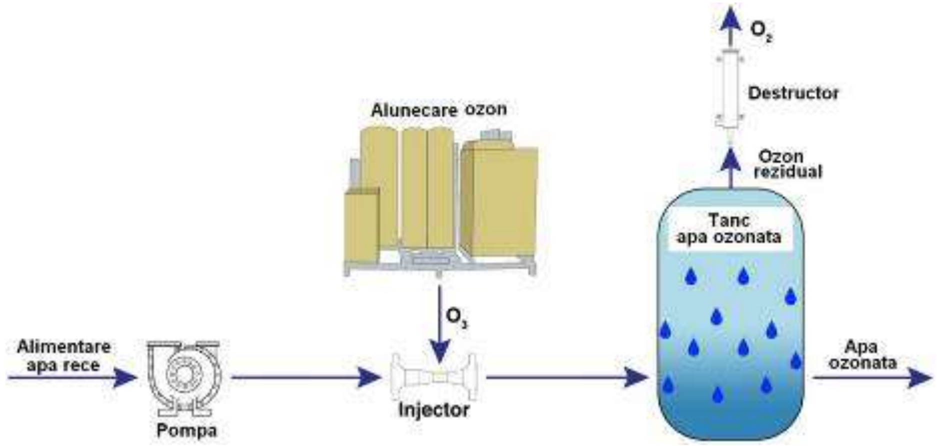

Fig. 6 - Principle of ozonated water formation [16]

Ozone Solutions. USA. produces a wide range of industrial ozone generators (Figure 7) with capacities ranging from 10 to 600 grams / hour with an ozone dosing rate of between 1.5-17.6 ppm.

a. b. c.

Fig. 7 - Equipment produced by Ozone Solutions company [15]

a –*Waterzone system; b – Waterzone SE system; c – Waterzone IS system*

ICPE Bistrita Company produces a compact water treatment plant with ozone, the component of which is shown in Figure 8:

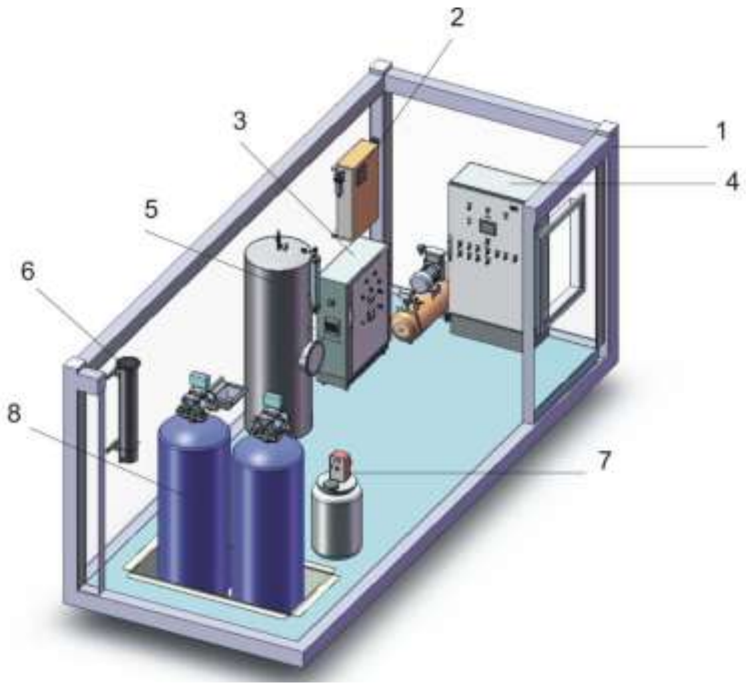

Fig. 8 - Compact water treatment plant with ozone [13]

1. Equipment containers; 2. Air dryer/ oxygen concentrator; 3. Ozone generator ; 4. Control and automation panel; 5. Contact vessel and water/ozone reaction; 6. Thermo-catalitic distructor of residual ozone; 7. Remaining disinfecting injection system (soil. 13% NaOCl); 8. Multimedia filters under pressure

CONCLUSION

Although they have a much lower content of energy than animal products, fruits and vegetables are important for their intake of vitamins, minerals, fibers, enzymes, volatile aromatics, etc. Contributing to the proper development of metabolic processes in the human body, vegetables and fruits due to the role, they play in nutrition enter in percentage of 25% in food ratio and is one of the indicators of living standards in a country. The preservation of fresh horticultural products is a complex of mechanical-physical operations and a complicated physiological and biochemical process whose purpose is to maintain the commercial-food acceptability of the products over a long period of time.

After the preservation processes, the relative stabilization of the properties of a product is achieved, after a preservation procedure or by the conjugate application of some preservation methods, it is attempted to inhibit or even destroy the enzymes of the products and of the microorganisms that habitat the products so that the stability at preserving the horticultural products as high as possible.

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EXPERIMENTAL RESEARCHES ON THE BENEFITS OF ADDITIVE ADDITION TO AGRICULTURAL BIOMASS PELLETS
/
CERCETĂRI EXPERIMENTALE ASUPRA BENEFICIILOR ADĂUGĂRII DE ADITIVI PELETELOR DIN BIOMASĂ AGRICOLĂ

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Keywords: *agricultural biomass, pellets, additives, renewable energy.*

ABSTRACT
The manner in which we obtain our energy represents one of today's priorities in the context of climate changes and of increased levels of pollution worldwide. The orientation towards renewable energy was first triggered by the inevitable and rapid depletion of fossil fuels, but also by a more active involvement of authorities in problems related to environmental protection. Biomass is one of the most important sources of renewable energy and has the advantage that after an adequate processing, it can be used in the same purposes as fossil fuels. The paper presents a series of experimental researches for assessing the benefits of introducing additives (corn starch) in the recipes for obtaining pellets from agricultural biomass.

REZUMAT
Modul în care ne producem energia reprezintă una din prioritățile actuale în contextul schimbărilor climatice și al creșterii nivelului poluări la nivel global. Orientarea către energia regenerabilă a fost determinată în primul rând de epuizarea invitabilă și cu pași repezi a combustibililor fosili. dar și de o implicare mai activă a autorităților în probleme legate de protejarea mediului înconjurător. Biomasa reprezintă una din cele mai importante surse regenerabile de energie și are avantajul că în urma unei procesări adecvate poate avea aceleași utilizâri ca și combustibilii fosili. Lucrarea prezintă o serie de cercetări experimentale pentru evaluarea beneficiilor aduse de introducerea de aditivi (amidon porumb) în reţetele de obținere a peletelor din biomasă agricolă.

INTRODUCTION
Biomass is the first source of energy on earth that was used by humans, except for solar energy. This began when man first discovered fire and realised that he can produce heat by burning wood. This way, biomass was the most known source of energy until the industrial revolution and man started to use fossil fuels to fulfil the more and more extensive energy needs. Unfortunately, our planet cannot transform and produce energy in the form of fossil fuels as fast as humans consume it. Therefore, it became imperative to find new ways to produce energy for everyday use. For this, man turned again towards biomass, as its advantages were already known. Biomass is available on every continent and it can be easily accessed or produced and if processed correctly, it can be used in the same manner and for the same applications as fossil fuels. (*Abbasi T.. Abbasi S.A.. 2010; Kofman. 2010. Vlăduţ et al.. 2012*)

One of the most common ways to process biomass is to transform it into solid biofuels, namely pellets and briquettes, through compression. Pellets represent the biofuel that can be produced from wood or agricultural waste. They are cylindrical granules of standard sizes between Ø-5...8mm with variable length of approximately 20-50 mm. They have increased mechanical resistance and good combustion characteristics. The pelleting process offers a real possibility of valorising the biomass potential.

Pellets can be obtained from wood processing waste, agricultural residues or from energetic plants. Pellets are a non-polluting fuel because from their combustion there are no harmful emissions. The mass of one m^3 of pellets weighs approximately 650-700 kg and produces around 3250 kWh of energy. (*Nosek et al.. 2011*)

The main advantages of compressing biomass are:

• Increasing the density of compressed material (from 80-150 kg / m^3 for straws or 200 kg / m^3 for sawdust to up to 600-700 kg / m3 for pellets);

• A higher calorific value and a homogeneous structure of densified products;

• A low moisture content (lower than 12%);
• Improved storage characteristics;
• Extending the usage period of biomass materials.

Understanding some of the major chemical changes that take place during processing of biomass can be useful in understanding their compaction behaviour. As the densification of biomass is coupled with process variables like temperature, pressure, die geometry and mechanisms of densification changes in these variables will bring about significant changes in the chemical composition of the biomass by the mechanisms known as interaction reactions. (*Samuelsson et al.. 2012; Kofman P.D.. 2010*)

Besides the variables of the process, the use of an additive for the particles of biomass could have a positive effect on the resistance of pellets. Starch, proteins, fibers, fat / oil, lignosulfonate, bentonite, modified cellulose as well as other additives have proven to positively influence the overall quality of densified products. (*Satyanarayana et al.. 2010; Stahl et al.. 2012*)

The paper presents a series of experimental researches conducted on pellet samples that were obtained with and without additives, in order to determine their influence on the most important quality attributes of pellets produced for energy purposes.

MATERIAL AND METHOD

Pellets were produced using three types of biomass materials, namely corn cobs, wheat straws and rapeseed stalks. To these materials, additives were added to determine their effect on the quality attributes of pellets obtained from the process. Six recipes were used to produce pellets – 3 without using additives and three using additives. The agricultural biomass materials used had the same characteristics for all the recipes tested.

The process of forming pellets consists in subjecting biomass to high pressures, period when particles are forced to agglomerate. Pellets were obtained using a large-scale ring die pelleting installation (fig. 1). composed of the following main elements: plant chopper, dryer, feeding bunker, feeding augers (with motor), 2 pelleting chambers, blades for cutting the exiting pellets, pellet outlet, conveyors, cooling station. etc.

The pellets were obtained by following the methodology:

- the biomass materials were grinded to the required dimensions;
- the grinded materials were then dried, homogenised and additives were added depending on the recipe used for compaction;
- the prepared material was introduced into the bunker that feeds the two ring die pelleting equipment from where it entered the actual densification process;
- resulting pellets fall from the outlet on the conveyor that takes them to the cooling area where they are left to reach room temperature in order to be packed.

Fig. 1 – Ring die pelleting installation used for obtaining pellets

The recipes used for obtaining pellets from agricultural biomass are shown in table 1.

Table 1

Recipes used for obtaining pellets

Sample no.	Sample composition
1	50% corn cobs + 50% wheat straws
2	50% corn cobs + 50% rapeseed stalks
3	50% wheat stalks + 50% rapeseed stalks
4	48% corn cobs + 48% wheat straws + 4% corn starch
5	48% corn cobs + 48% rapeseed stalks + 4% corn starch
6	48% wheat stalks + 48% rapeseed stalks + 4% corn starch

After the pellets were produced, the following quality attributes were verified:

- Moisture content – fig. 2a (according to SR EN ISO 18134-1:2015. Solid biofuels - Determination of moisture content - Oven dry method - Part 1: Total moisture -- Reference method);
- Inferior calorific value fig. 2b (according to SR EN ISO 14918:2010 - Solid biofuels. Determination of calorific value;
- Bulk density fig. 2c (according to SR EN ISO 17828:2016 – Solid biofuels – Determination of bulk density);
- Ash content fig. 2d (according SR EN ISO 18122:2016 - Solid biofuels -- Determination of ash content);

Fig. 2 – Aspects during the experiments

RESULTS

The results registered after conducting the experiments are shown in table 2 and figure 3.

Table 2

Results after conducting the experiments of agricultural biomass pellets

Sample no.	Moisture content [%]	Inferior calorific value [MJ/kg]	Ash content [%]	Bulk density [kg/m^3]
1	9.54	16.175	7.98	587.65
2	9.78	16.203	8.12	576.91
3	10.42	16.150	7.68	558.66
4	9.21	16.240	8.02	609.28
5	9.27	16.335	8.22	601.28
6	9.89	16.240	7.55	621.52

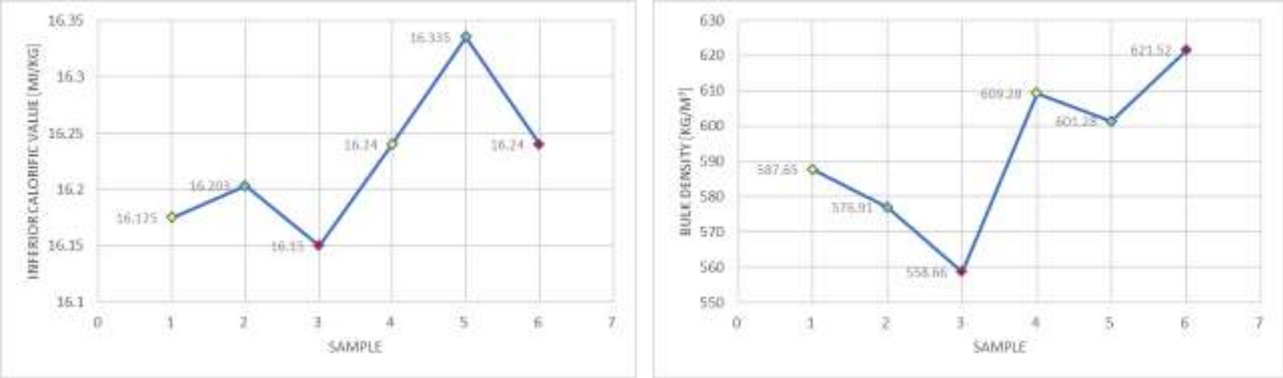

Fig. 3 – Results from the experiments highlighting the benefits of additives in biomass pellets

CONCLUSIONS

After conducting the experiments on pellets obtained from agricultural biomass with and without additives, the following conclusions can be given:

- the addition of corn starch had a positive impact on the moisture content of pellets for all the samples;
- the ash content was higher in samples where corn starch was added, but the increase was not very significant;
- corn starch addition also had a positive impact on inferior calorific value registering increases in all samples;
- the biggest benefits were registered for bulk density, the addition of corn starch leading to more dense and compact pellets also with smoother surface area and less dust.

Biomass pelleting offers a real alternative to the use of fossil fuels for obtaining energy. Also, it represents a method of using all the agricultural biomass residues that otherwise would go to waste.

ACKNOWLEDGEMENT

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EXPERIMENTAL RESEARCHES REGARDING THE INFLUENCE OF ACTIVE BODIES GEOMETRY ON QUALITATIVE AND ENERGETIC WORKING INDICES OF COMBINATORS FOR SEEDBED PREPARATION
/
CERCETARI EXPERIMENTALE PRIVIND INFLUENTA GEOMETRIEI ORGANELOR ACTIVE ASUPRA INDICILOR CALITATIVI DE LUCRU ŞI ENERGETICI LA COMBINATOARE PENTRU PREGĂTIREA PATULUI GERMINATIV

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Keywords: *soil loosening, tillage, active bodies, chisel*

ABSTRACT
The main direction for perfecting THE combinators is constituted by the improvement and constructive diversification of active bodies in the purpose of increasing the qualitative working indices. The paper presents the influence of active parts geometry on the qualitative and energetic working indices of combinators for seedbed preparation.

REZUMAT
Principala direcţie de perfecţionare a combinatoarelor. o constituie îmbunătăţirea şi din diversificarea constructivă a organelor active în scopul creşterii indicilor calitativi de lucru. In lucrare se prezinta influenta geometriei organelor active asupra indicilor calitativi de lucru şi energetici la combinatoare pentru pregătirea patului germinativ.

INTRODUCTION
Combinators are used in spring, on fields that were ploughed in autumn (frosted) for seedbed preparation (grinding and loosening the soil, levelling the fields in depths of max 12 cm) within the crop technology of cereals legume beans, vegetables and technical plants. Specific agrotechnical requirements demand that seedbed preparation should be performed with an optimum ratio between capillary and non-capillary porosity, with water, air and nutrients regime as favourable as possible to avoid water loss in the soil through evaporation, in order to obtain a good growth and development of plants grown [3].

Seedbed preparation using the combinator allows to break the water-resistant layer of soil allowing the infiltration of water and air from the superior layers [5]. This work is performed without turning the furrow, leaving at the surface of the soil a layer of plant waste with important advantages from an environmental point of view, meaning that the presence of this layer solves the problem of soil erosion and compaction, thus increasing its fertility level. In dry areas, water accumulated in the deep is an important reserve for periods of lacking precipitations when the plant needs water to germinate [2. 4]. To avoid puddle formation and plant destruction in areas with excessive humidity, water needs to be eliminated [8].

Compared to the traditional ploughing work, scarification produces substantial reduction of fuel consumption per hectare due to a larger working width, high productivity due to a superior working speed, high soil permeability. All these advantages lead to a qualitative and quantitative yield increase on the basis of reduced expenses [1].

Lately, researches were conducted for knowing the forces and moments acting on the combinator's elements in order to make a correct dimensioning of mechanisms for deep loosening [6]. Also, researches have been conducted to determine the wear of two active bodies for soil tillage in the field (in real conditions), respectively on laboratory stand (in accelerated regime, in sand). [7]

MATERIAL AND METHOD
The combinator used for conducting the experiments in field conditions is formed of two folding stations having a 3.5 m width, fitted with levelling blades, rollers with blades, corsskill rollers and modules with reversible-chisel and/or arrow type vibrating acting bodies. Its characteristics are presented in table 1.

Fig.1 - Combinator with reversible-chisel and/or arrow type vibrating acting bodies used for conducting the experimental researches

Table 1

Characteristics of the combinator used for conducting the experiments

No.	Characteristic	MU	Measured values
1.	Mass	kg	5670
2.	Length in transport	m	6.6
3.	Height in transport	m	3.95
4.	Width in transport	m	2.93
5.	Length in aggregate with JD 8530 tractor	m	12
6.	Width during operation	m	7.1
7.	Width of reversible chisel type active parts	mm	35
8.	Width of arrow type active parts	mm	150
9.	Width of arrow type active parts	mm	250

The experiments were conducted on three parcels (P1. P2. P3). In table two are shown the experimentation conditions in the field.

Table 2

Experimentation conditions in the field

No.	Characteristics	Results		
		P1	P2	P3
1.	Parcel surface	2.25 ha	1.59 ha	2.72 ha
2.	Soil type	vertisol	vertisol	vertisol
3.	Previous work	25-30 cm deep ploughing followed by harrowing	de 25-30 cm deep autumn ploughing	scarification
4.	Previous crop	corn	corn	corn
5.	Field status	Flat and smooth	Flat and smooth	Flat and smooth
6.	Field inclination	0.8°	1.7°	2°
7.	Mass of plant waste	110-120 g/m^2	180-190 g/m^2	370-380 g/m^2

Within the experimental researches, the following qualitative working indices were determined:

- Working depth. by measuring the distance between the surface of the field and the bottom of the furrow using a measuring device in minimum 20 points, at a 2m interval between the measurement points. Based on the measurements conducted, the average working speed a_m was determined as follows:

$$a_m = \frac{\sum_{1}^{n} a_i}{n} \text{ [cm]} \tag{1}$$

where:

- a_i is the working depth [cm];
- n is the number of measurements performed.

- the working width was determined in at least 20 points (the same as for the working depth). For each measurement, at a distance of 1 m from the furrow's wall in the direction of the processed area, pegs were placed at 2m intervals, on the forwarding direction. After the equipment passed, the distance from each peg was measured at the wall of the furrow and the working width was determined from the difference between the results obtained before and after the combinator passage. On the basis of measurements for the actual working width conducted in different points of the furrow, the average working width B_m is calculated as in the case of working depth, thus:

$$B_m = \frac{\sum_1^n B_i}{n} \quad [\text{cm}] \tag{2}$$

where:

- B_i is the working width [cm];
- n is the number of measurements performed.

- soil grinding degree. For performing the determinations, a soil sample was randomly delimited having 1m x 1m dimensions (determined using the metric frame) and the depth equal to the combinator's working depth. From the respective sample, soil fractions with the following sizes were separated:
- >100 mm;
- between 50-100 mm;
- between 20-50 mm;
- < 20 mm.

Soil grinding degree G_{ms} represents the weight proportion of soil fractions based on the total mass of the soil sample, calculated using the relation (3):

$$G_{ms} = \frac{\sum_1^n \frac{M_{ci}}{M_{ti}}}{n} \cdot 100 \quad [\%] \tag{3}$$

where:
- M_{ci} is the measured weight of the soil fraction taken from the soil sample. [kg];
- M_{ti} is the measured weight of the entire soil sample. [kg];
- n is number of measurements performed.

- degree of plant residues destruction: represents the ratio between the quantity of plant mass remained (undestroyed) on the surface of the soil and the plant mass existing on the surface of the field before passing with the equipment (expressed as percentage). Determinations were made at approximately 20 m from the ends of the polygon. The following operations were performed for determining the degree of plant residue destruction: before and after conducting the experiments with the combinatory, 5 samples were harvested on the diagonals of the parcel by gathering all plant residues found on the surface of the soil in plastic bags (if they were partially caught in the soil, they were cut at soil level). The 5x2 samples were air dried, weighed and then the average values of the plant mass found on a square meter was calculated in the two situations – before and after the aggregate passed. By dividing these average values to the value of plant residues found on one square meter before the combinator passed, the degree of plant residues destruction G_v was calculated using the relation:

$$G_v = \frac{\sum_1^n \frac{G_{t_i} - G_{S_i}}{G_{t_i}}}{n} \cdot 100 \quad [\%] \tag{4}$$

where:
- G_{ti} is the measured plant residue mass remained on the surface of the soil per sample taken after the combinator passed [g]
- G_{Si} is the measured mass of the total plant residues on the surface of the soil. per sample taken before the combinator passed [g];
- n is the number of measurements performed.

- energetic indices:
-the working speed was determined using a chronometer and a measuring tape;
-fuel consumption C_c [cm^3/h] was calculated using the device for determining fuel consumption;

Fig. 2 - Flowtronic 215 [9]

-traction force F_t [N] was determined through the means of a data acquisition system type QuantumX MX 1615 with 2 modules and 32 measuring channels.

Fig. 3 - QuantumX MX1615 strain gauge bridge amplifier [10]

RESULTS

The combinator was equipped with three types of active working bodies: chisel, arrow 1 and arrow 2. The determinations were conducted on 100 m long parcels with a theoretical working width of 7 m. Three repetitions were conducted for each determination, the average calculated values being presented in tables 3. 4 and 5.

In table 3 are shown the qualitative and energetic working indices determined for the chisel type active working bodies.

Table 3

Qualitative and energetic work indices determined for the chisel type active working bodies

<table>
<tr><th rowspan="2">Type of active working body</th><th rowspan="2">Qualitative and energetic working indices determined</th><th rowspan="2">M.U.</th><th colspan="4">Parcel</th></tr>
<tr><th colspan="2">P1-Tractor 225 HP</th><th colspan="2">P2-Tractor 330 HP</th></tr>
<tr><td rowspan="24">Chisel (70 pcs.)</td><td>Working depth</td><td>cm</td><td colspan="2">10.85±0.81</td><td colspan="2">10.8±1.26</td></tr>
<tr><td>Working width</td><td>m</td><td colspan="2">6.98±0.07</td><td colspan="2">6.87±0.08</td></tr>
<tr><td>Degree of plant residue destruction</td><td>%</td><td colspan="2">86.5</td><td colspan="2">85.3</td></tr>
<tr><td>Degree of soil grinding:</td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>clods:- > 100 mm ;</td><td>%</td><td colspan="2">5.2</td><td colspan="2">12.2</td></tr>
<tr><td>- 50-100 mm;</td><td>%</td><td colspan="2">9.2</td><td colspan="2">15.7</td></tr>
<tr><td>- 20-50 mm;</td><td>%</td><td>17.5</td><td rowspan="2">85.6</td><td>27.7</td><td rowspan="2">71.8</td></tr>
<tr><td>- < 20 mm.</td><td>%</td><td>68.1</td><td>44.4</td></tr>
<tr><td>Speed</td><td>km/h</td><td colspan="2">8.8</td><td colspan="2">9.55</td></tr>
<tr><td>Traction force</td><td>kN</td><td colspan="2">57.4</td><td colspan="2">62.4</td></tr>
<tr><td>Necessary power</td><td>kW</td><td colspan="2">140.31</td><td colspan="2">165.53</td></tr>
<tr><td>Fuel consumption</td><td>l/ha</td><td colspan="2">7.43</td><td colspan="2">19.2</td></tr>
<tr><td>Driving wheels skidding</td><td>%</td><td colspan="2">8.7</td><td colspan="2">9.1</td></tr>
<tr><td>Soil moisture:</td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>- In the 0-5 cm layer</td><td>%</td><td colspan="2">16.5</td><td colspan="2">21.6</td></tr>
<tr><td>- In the 5-10 cm layer</td><td>%</td><td colspan="2">17.8</td><td colspan="2">31.5</td></tr>
<tr><td>- In the 10-15 cm layer</td><td>%</td><td colspan="2">18.9</td><td colspan="2">36.3</td></tr>
<tr><td>Soil temperature</td><td>°C</td><td colspan="2">20.7</td><td colspan="2">15.1</td></tr>
<tr><td>Soil compaction:</td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>- 0-2.5 cm;</td><td>N/ mm²</td><td colspan="2">0.23</td><td colspan="2">0.55</td></tr>
<tr><td>- 2.5-5 cm;</td><td>N/ mm²</td><td colspan="2">0.30</td><td colspan="2">0.68</td></tr>
<tr><td>- 5-7.5 cm;</td><td>N/ mm²</td><td colspan="2">0.34</td><td colspan="2">0.73</td></tr>
<tr><td>- 7.5-10 cm;</td><td>N/ mm²</td><td colspan="2">0.60</td><td colspan="2">0.86</td></tr>
<tr><td>- 10-12.5 cm.</td><td>N/ mm²</td><td colspan="2">1.20</td><td colspan="2">0.91</td></tr>
</table>

In table 4 are shown the qualitative and energetic working indices determined for the arrow 1 type active working bodies.

Table 4

Qualitative and energetic work indices determined for the arrow 1 type active working bodies

Type of active working body	Qualitative and energetic working indices determined	M.U.	Parcel					
			P1-Tractor 330 CP		P2-Tractor 330 CP		P3-Tractor 330 CP	
Arrow 1 (70 pcs.)	Working depth	cm	6.0±0.76		7.8±0.89		6.58±1.05	
	Working width	m	7.21±0.03		7.10±0.05		7.16±0.04	
	Degree of plant residue destruction	%	84.5		83.3		78.2	
	Degree of soil grinding:							
	clods:- > 100 mm ;	%	4.7		6.7		2.1	
	- 50-100 mm;	%	8.3		18.0		4.6	
	- 20-50 mm;	%	15.5	87	20.0	75.3	13.7	93.3
	- < 20 mm	%	71.5		55.3		79.6	
	Speed	km/h	15.1		12.2		11.6	
	Traction force	kN	54.27		59.04		-	
	Necessary power	kW	227.63		200.08		-	
	Fuel consumption	l/ha	15.7		22.8		15.0	
	Driving wheels skidding	%	9.6		7.6		9.3	
	Soil moisture:							
	- In the 0-5 cm layer	%	10.0		22.0		21.4	
	- In the 5-10 cm layer	%	19.8		29.0		28.8	
	- In the 10-15 cm layer	%	21.9		31.5		35.7	
	Soil temperature	°C	24.2		18.7		23.7	
	Soil compaction:							
	- 0-2.5 cm;	N/ mm^2	0.30		0.83		0.25	
	- 2.5-5 cm;	N/ mm^2	0.48		1.08		0.31	
	- 5-7.5 cm;	N/ mm^2	0.52		1.09		0.38	
	- 7.5-10 cm;	N/ mm^2	0.63		1.17		0.53	
	- 10-12.5 cm.	N/ mm^2	0.85		1.22		0.67	

In table 5 are shown the qualitative and energetic working indices determined for arrow 2 type active working bodies.

Table 5

Qualitative and energetic work indices determined for the arrow 2 type active working bodies

Type of active working body	Qualitative and energetic working indices determined	M.U.	Parcel			
			P1-Tractor 330 HP		P2-Tractor 330 HP	
Arrow 2 (28 pcs.)	Working depth	cm	11.5±0.62		8.63±1.24	
	Working width	m	7.1±0.05		7.20±0.03	
	Degree of plant residue destruction	%	88.7		83.8	
	Degree of soil grinding:					
	clods:- > 100 mm ;	%	7.0		14.3	
	- 50-100 mm;	%	10.2		31.8	
	- 20-50 mm;	%	26.8	82.8	11.9	53.9
	- < 20 mm.	%	56.0		42.0	
	Speed	km/h	9.6		8.9	
	Traction force	kN	82.95		74.92	
	Necessary power	kW	221.2		185.21	
	Fuel consumption	l/ha	13.6		14.3	
	Driving wheels skidding	%	8.5		8.6	
	Soil moisture:					
	- In the 0-5 cm layer	%	22.4		24.2	
	- In the 5-10 cm layer	%	23.5		29.8	

	- In the 10-15 cm layer	%	26.3	34.7
	Soil temperature	°C	23	19.8
	Soil compaction:			
	- 0-2.5 cm;	N/ mm^2	0.33	0.48
	- 2.5-5 cm;	N/ mm^2	0.52	0.63
	- 5-7.5 cm;	N/ mm^2	0.80	0.81
	- 7.5-10 cm;	N/ mm^2	1.15	0.89
	- 10-12.5 cm.	N/ mm^2	1.77	1.03

CONCLUSIONS

By analysing the results from determinations shown in tables 3.4 and 5. the following were found:

- an increase of working width when arrow 1 and arrow 2 type active working bodies are used compared to the chisel type ones;

- the degree of plant residues destruction decreases when using arrow 2 type active working bodies compared to the other two types of active bodies;

- the degree of soil grinding decreases very much when using arrow 2 type active working bodies compared to the other two types of active bodies;

- the traction force increases when using arrow 2 type active working bodies compared to the other two types of active bodies;

- the speed increases when using arrow 1 type active working bodies compared to arrow 2 and chisel type active bodies;

- fuel consumption increases when using arrow 1 type active working bodies compared to arrow 2 and chisel type active bodies.

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USE OF SOLIDWORKS IN DESIGNING AGRICULTURAL MACHINES (A SAMPLE: ROTARY TILLER) / *TARIM MAKİNALARI TASARIMINDA SOLIDWORKS KULLANIMI (ÖRNEK: TOPRAK FREZESİ)*

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Keywords: *Cad, cam, SolidWorks, rotary tiller, machine design.*

ABSTRACT

Nowadays, computer and software technologies which are progressing rapidly are spreading in machine design applications as it is in many areas. In the past sixty years, systems have been successfully implemented in which computers, software and numerical methods are integrated. The data show that more than five million people around the world are interested in machine design. One of these is SolidWorks, a three-dimensional solid modelling design program that is most commonly used in the world open to development, easy to use and able to work comfortably in the windows applications. In this work, the general features of the program and its ease of use will be mentioned and the usage of the agricultural machine design will be tried to be explained with the example of the rotary tiller.

ÖZET

Günümüzde oldukça hızlı ilerleyen bilgisayar ve yazılım teknolojileri. birçok alanda olduğu gibi makina tasarımı uygulamalarında da hızla yaygınlaşmaktadır. Son altmış yıl içerisinde bilgisayarların. yazılımların ve sayısal yöntemlerin entegre edildiği sistemlerde son derece başarılı sonuçlar elde edilmiştir. Veriler. dünyada yaklaşık beş milyondan fazla insanın makina tasarımı ile ilgilendiğini göstermektedir. Bunlardan biri olan SolidWorks dünyada en sık kullanılan. geliştirilmeye açık. kullanımı kolay. windows ortamında rahatlıkla çalışabilen üç boyutlu bir katı modelleme tasarım programıdır. Bu çalışmada. programın genel özellikleri ve kullanım kolaylıklarından bahsedilerek. tarım makinaları tasarımındaki kullanımı toprak frezesi örneği ile anlatılmaya çalışılacaktır.

INTRODUCTION

Agricultural mechanization is defined as the mechanization of agricultural production activities with the use of power sources and agricultural machines and includes the power sources necessary for the application of advanced production techniques in agriculture and the design, production, development and use of agricultural equipment and machines *(Akıncı İ.. 2011)*. In the course of historical development, human powered hand tools were first replaced by animal powered tools and then mechanized by the development of mechanical systems *(Okursoy R.. 2006)*. However, short-term, high-quality and low-cost design and development of different type and function agricultural equipment and machines have gained importance in order to meet different needs arising in agricultural works.

In addition, in order to meet the different needs arising in agricultural work, it has become important to design and develop various types and functional agricultural tools and machines in a short time with a high quality and low cost. Computer and software technologies that step in the direction of these demands, especially in the design and manufacture of complex multifunction systems offer great benefits in terms of cost, time and labour savings.

Computer-integrated applications have some important advantages over conventional manufacturing applications *(Çelik and Akıncı. 2012)* (table 1).

Table 1

Comparison of classical manufacturing methods with computer integrated systems

Parameters	Computer-integrated applications	
Design costs	15-30 %	↓
Manufacturing time (per part)	30-60 %	↓
Productivity	40-70 %	↑
Saving parts based on product quality	20-50%	↑
Design speed	3-30 times	↑

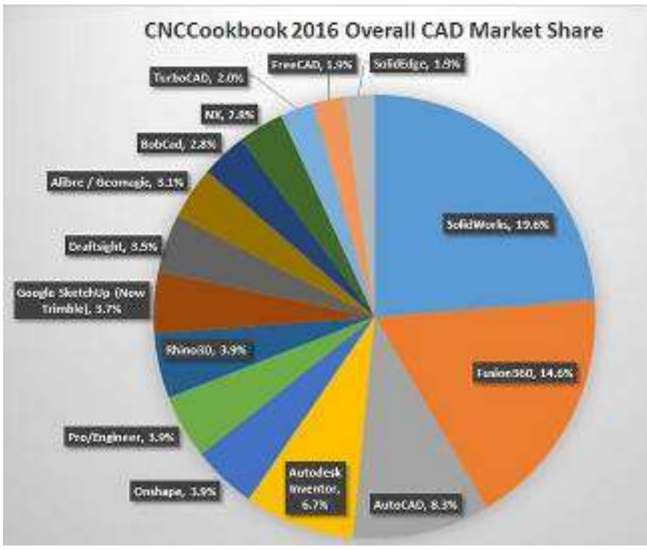
Computer-aided design (CAD) as critical module of a computer integrated manufacturing (CIM) system is an interaction of human and machine working together to optimize design and manufacture activities of products in product development environment (PDE). Generally, it is used to design a product to be produced by the introduction of computer technology, for example, architects and engineers have access to 3D Computer Aided Design (CAD) tools, which not only help them build a virtual prototype, but also simulate the structural integrity of their model *(Fristcher and Pigneur. 2014)* and finally this advantage reduces engineering costs for any company and also results in products getting to market much faster *(Ayağ Z.. 2015)*.

CAD applications are based on reinforced geometry. The first applications of CAD technology started in the 1950's with numerical control studies. However, in 1960, Ivan E. Sutherland's work at the Massachusetts Institute of Technology (MIT) showed the basic principles and applicability of computer-aided technical drawing applications *(Sanders N.. 2008).*

Nowadays, CAD software can be classified in 3 basic areas as " General CAD. Custom CAD and Design CAD with Template" depending on the usage area and the ability to model complex structures *(Ariadi Y.. 2009)*.

- General CAD software is more suitable for multi-module and general purpose applications. Depending on the modules required, the purchase prices may change.
- Custom CAD software has been developed for more complex surface work. Using the CAD software requires a great deal of knowledge. At the same time the costs are higher.
- Designed CAD software is used according to the concept of designing and assembling previously prepared and defined elements in software.

More than five million people around the world are interested in machine design. However, only one of them is using the existing CAD software. The percentage of market share of CAD software used in design works around the world is given in fig.1.



First five Cad software and others		Market Share [%]
1.	SolidWorks	19.6
2.	Fusion360	14.6
3.	AutoCAD	8.3
4.	Autodesk Inventor	6.7
5.	Onshape-Pro/Engineer	3.9
6.	Others (nine programs)	46.9

Fig. 1 – 2016 Overall Cad market share (CNCCookbook-2016) (URL-2)

MATERIAL AND METHOD

Some basic features of the SolidWorks program

SolidWorks Corporation is a commercial company founded in 1993 by Jon Hirschtick in Concord, Massachusetts. The first version of the software was released in 1995. In 1997, Dassault Systemes SolidWorks Corp. has purchased the program. It is the first 3-D solid modelling program (3D CAD) integrated in Windows in the world. With SolidWorks. a 3D design program, the following operations can be performed sequentially:

- It can allow to measure and vector-based three dimensional drawings.
- Allows the work to be carried out on other similar programs.
- Technical data can be obtained through drawing.
- By means of the assembly module, the individual tasks can be put together and simulated by running them together.
- It is possible to perform impact, static and similar tests on the finished parts and the detailed analysis results of these tests can be obtained.
- Because SolidWorks works with the principle of parasolid, it allows the user to intervene at every stage of the design, allowing the dimension, size and details of the model to be modified as desired. It makes it possible to make technical drawings and settings in very short time intervals.
- The sequence of operations performed with the feature tree and the structures can be changed. If the changes are made on this page, the assembly and technical drawings that are made will update immediately. This gives the user a chance to intervene in the technical drawing or assembly.
- SolidWorks is also a program with the application " smart mate ". Apart from this, sheet metal parts can be expanded and elongation quantities can be calculated.
- All transactions can be recorded or transferred in IGES. DXF. DWG. SAT. STL. STEP. VDA. VRML format
- Allows you to reuse objects frequently used with the object library.
- Applications such as drag-and-drop, cut-and-paste used in Windows can be executed in SolidWorks.
- Allows the configuration of different sizes from one part to be automatically obtained by creating a table in Excel. (URL-1).

General usage areas of SolidWorks

The SolidWorks have wide range of applications in industries (fig.2) such as;

- Aerospace
- Defense
- Automotive
- Transportation
- Machinery
- Heavy Equipment
- Electronics
- Sheet metal work
- Process Plant
- Consumer products
- Mold & Tools design
- Energy conservation
- Construction
- Medical tools
- Product design and other engineering services.

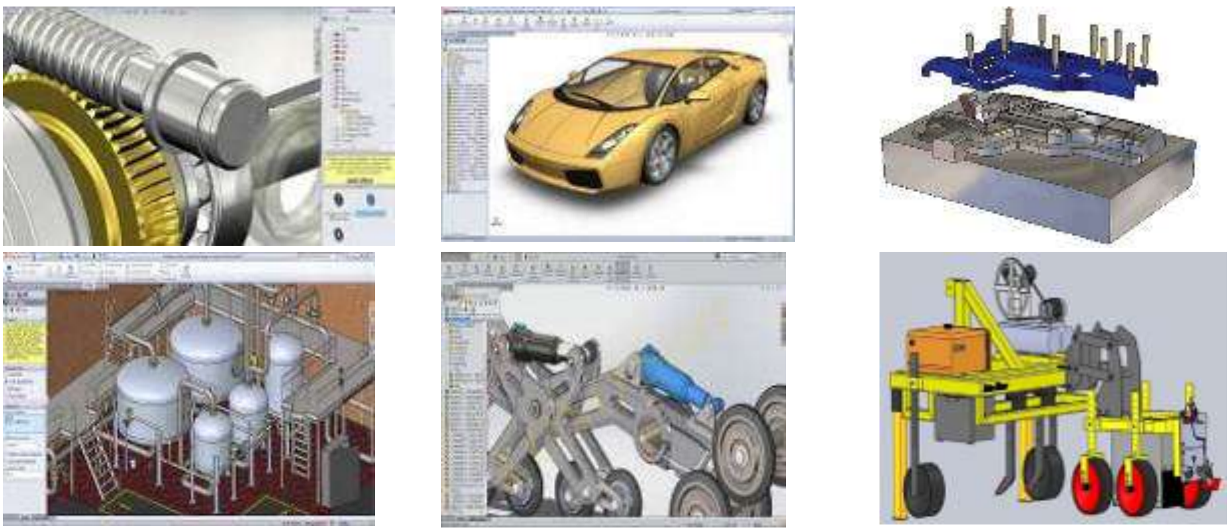


Fig. 2 – Some example of SolidWorks usage

RESULTS

A sample: Rotary Tiller

With the rapid spread of computer technology in the world, especially after the 1990s. we are seeing a lot of different ideas and speed up our original work which will make our life easier like many other custom designs. This area has been enhanced with software and in all other areas, computers have been provided to function as a virtual workshop and situations that can vary greatly in very different environments have begun to take place in a short time and with considerable labour and material savings.

It is possible to see examples of these studies in the field of agricultural machinery production. Many researchers around the world have conducted different studies on this subject. For example; Topakçı et al. (2010) worked on the optimization of the subsoiler. They have done a subsoiler tine, design and used finite element method (FEM) to simulate stress solutions on the subsoiler tine. Biriş et al (2016) studied the stress and strains distribution in the frame of agricultural cultivators using the finite element method. Shinde et al (2011) designed rotary blade from three different materials and they studied at the different working conditions as a soil structure in computer environment when working with tractors with 35 and 45 hp. Mandal et al (2013) studied the rotary tillers' blade design optimization and development in their research. Similarly, Yegül et al (2014) worked on the optimum geometry parameters of tine harrow without any plastic deformation under defined condition. It is possible to increase the number of such works.

If these works are studied carefully, they will be seen to have similar and different aspects of the designers' perspectives and analysis stages, even though they work on similar issues. In our work, we tried to explain the steps that took place in the design of a sample rotary tiller.

In agricultural processes, even though the soil conditions are in very good condition, soil treatment results in a maximum power consumption of 60% in general *(Gözübüyük et al. 2012)*. Thus, soil treatment is the most expensive process. The largest part of the measures to reduce the cost of agricultural operations can cover land processing costs. With some measures to be taken, the cost of tillage can be reduced by 30-50% *(Baran et al. 2013)*.

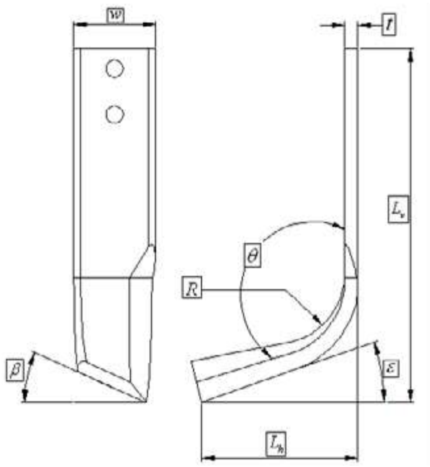
In conventional tillage methods, where mostly pulled tools are used, there are undesirable increases in time and energy consumption along with field traffic, since seed beds can be prepared with only a few passes *(Çelik A.. 1998)*. These negative aspects of the pulled type tools have been tried to be solved by using rotating tillage machines by moving from tractor PTO's. shaft. The rotary tiller is considered to be the most important of the tillage machines that operate by moving from the PTO's shaft.

Design stages of a sample rotary tiller

Rotary tillers, generally, can be examined in three main sections; processing (active parts) carriers and protective and transmission sections. Before designing the rotary tiller, it is necessary to specify the blade parameters and boundary conditions (input parameters for the analysis) that can be used during design. The related parameters of sample rotary tiller are tried to be given in table 1 and table 2 respectively.

Table 1

Blade parameters and values



Parameters	Notations	Units	Values
W	Blade span	mm	-
L_v	Effective vertical length	mm	-
L_h	Blade cutting width	mm	-
R	Curvature between L_v and L_h	mm	-
θ	Blade angle	°	-
β	Clearance angle	°	-
t	Blade thickness	mm	-
ε	Bending angle	°	-

Values may vary depending on design features.

Table 1

Some other input parameters dealing with rotary tiller

No	Parametreler	Units	Value
1	Working depth of rotary tiller	mm	-
2	Working width of rotary tiller	mm	-
3	Rotor revaluation	rpm	-
4	Blade peripheral velocity	m/s	-
5	Total number of blade	Number	-
6	Number of blades on each side of the flanges	Number	-
7	Prime mover forward speed	m/s	-
8	Number of blades which action jointly on the soil	number	-
9	Prime mover power	HP	-
10	Traction efficiency	µ	-

Design of active parts (First stage)

According to the determined parameters, the blades were started to be designed in the first stage. In this example, an L-type blade is selected (fig. 3). The reason of this is the fact that in most of the studies carried out, the best performance on the cutting of organic material on the surface of the soil, the control of weeds and the uniform fragmentation of the soil are generally achieved in L-type blades *(Çelik A.. 1998; Ashok et all. 2013)*.

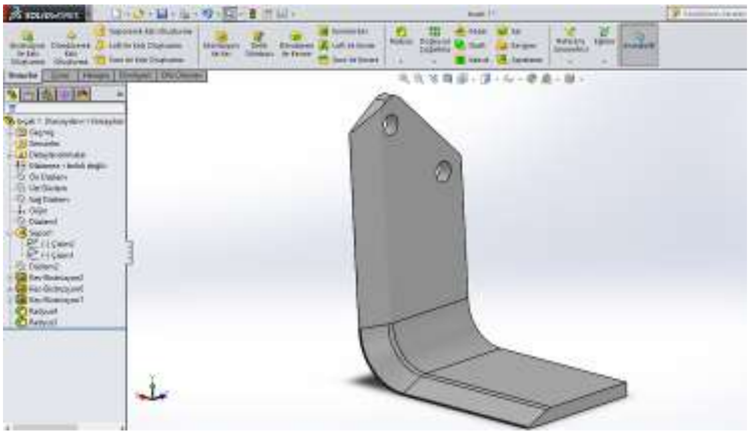


Fig. 3 – Some example of SolidWorks usage

After the blades were designed, it was decided how many blades were in a flange. The number of blades per flange was determined by taking into account the speed of the rotor rotation unit and machine speed. In this design operation, four blades are mounted on the flange with a 90° (fig. 4). Bolts and nuts are available from SolidWorks' part library, which are the fasteners. The diameter of the rotor is one of the important points in the installation of the blades. The diameter of the rotor is directly related to the peripheral speed. As the rotor diameter increases at constant feed rate, the peripheral speed increases. In this design study, the rotor diameter is designed to be 500 mm.

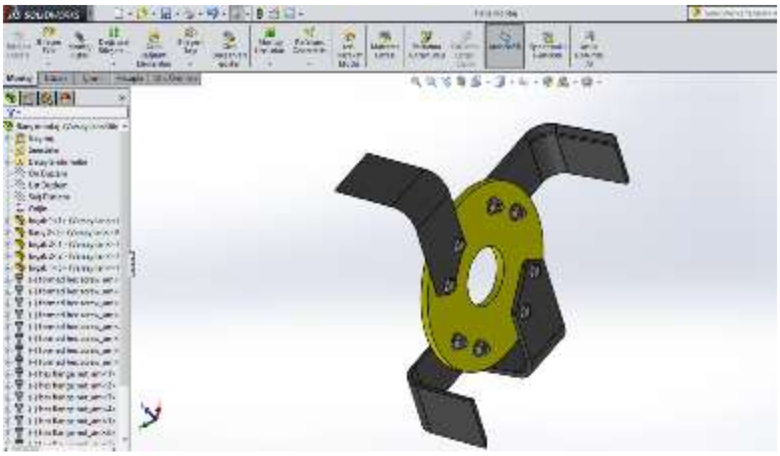


Fig. 4 – Flange mounting of blades

After the blades are mounted on the flange, the number of flanges on the rotor shaft is determined. depending on the working width of the machine. Depending on the soil conditions, blade geometry and velocity ratio, the interference of the backside of the blade and the uncut soil may result in severe soil compaction and high power consumption. This is the main reason that causes vibrations, which are a result of the reaction of soil upon the tiller blades. The proper design of the rotary tiller blades is essential to efficient operation *(Mandal et al.. 2015).* In this sample the blades are mounted together tangentially so that they do not touch each other at certain intervals (fig. 5).

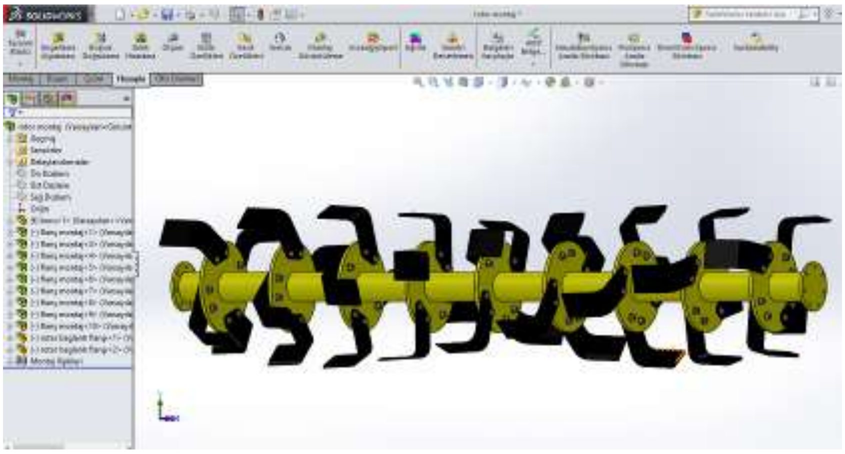


Fig. 5 – Rotor assembly of blades

Design of carrier and protective parts (Second stage)

In this sample, a hanging type rotary tiller was designed. After the design of active parts, the standard arm openings of the tractor must be considered so that the tool can easily be connected to the tractor three-point linkage. After the connection was designed, the protective sheet and back cover were designed to cover the blades (fig. 6). The 3-point linkage unit is then mounted on the protective cover according to the centre of gravity. The hinge system is used to open and close the back cover at desired ratios. One of the important factors in the disintegration of soil in processing with soil tillage is the shape and position of the back cover. The disintegration increases as the cover is lowered to the rotor, while the disintegration decreases as it is removed *(Bell B.. 1985).* By mounting the upper roof and the rear cover connection, the rotor bearing plates, which are referred to as side shields, are designed and assembled. The working depth can be easily adjusted with the slides mounted on the side guards.

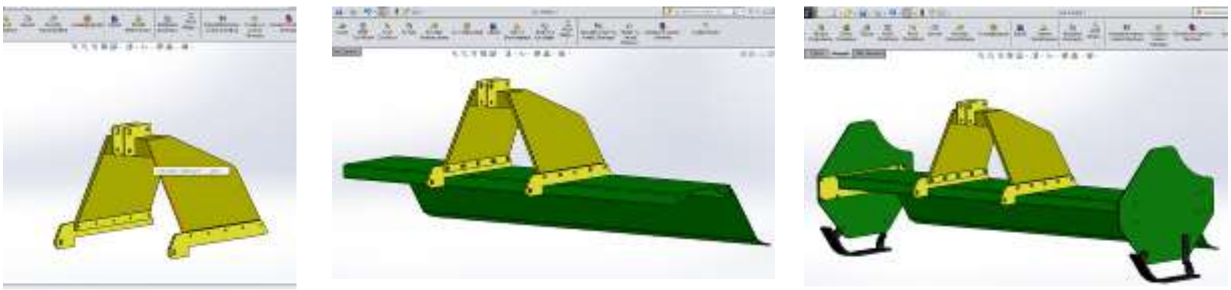


Fig. 6 – Design of carrier and protective parts of rotary tiller

Design of transmission parts (Third stage)

The transmission parts consist of gear teeth in the gearbox and transfer gears that transmit the motion to the rotors. It is recommended that the number of rotation of the rotor be reduced by 1/3 or 2/3 of the standard PTO rotation *(Okursoy R.. 2012).* In this study, the tractor PTO rotation was lowered by means of small gears at first and then adjusted to a speed of 255 rpm with bevel gears having a ½ ratio (fig. 7). There are two small spare gears in the design. Depending on the soil conditions, working rotation of rotary tiller can be increased or decreased to a certain amount. After the PTO rotation is lowered in gear box, the motionis transmitted to transmission gears. The transfer and gearbox gears are selected from the SolidWorks spare parts library. The number of teeth is determined by calculating the required number of revolutions. After the gears have been assembled, the design of the moving parts is completed by mounting the rotary tiller rotor with the transfer gears.

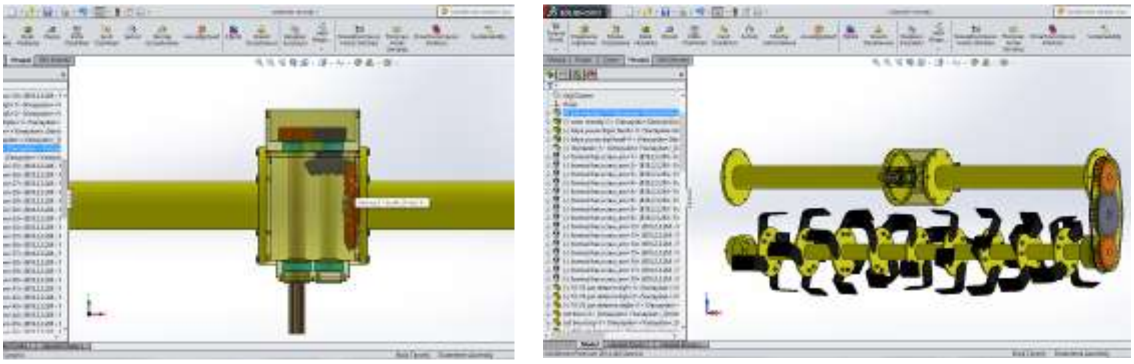


Fig. 7 – Design of transmission gears and moving parts

Finally, all main parts are assembled and the design process is completed (fig.8).

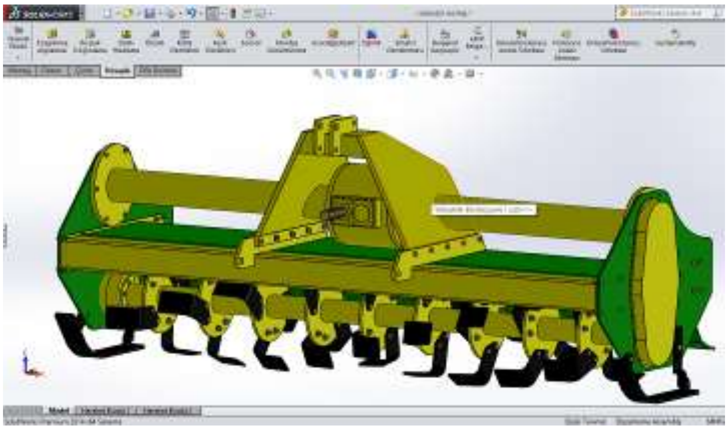


Fig. 8 – Rotor assembly of blades

CONCLUSIONS

Here, the use of the SolidWorks program has been summarized in the design of a rotary tiller selected as a soil tillage implement. The SolidWorks program is a tool that enables designers to save time and manpower. Therefore, this program which is a virtual workshop must be tested in real conditions after the design of tools and equipments which are considered to work especially in environments with dynamic structure, like soil, and which can show great variability even at very short distances.

Also, it should be noted that for this tool, where the design order is given, the path to be traced may vary from designer to designer.

For each designer, these sequences can exhibit variability, the important thing being that the designer can give the basic parameters of the design.

The point that should be mentioned here is that such a program can provide significant cost savings in both time and labour.

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HYDRAULIC COMPONENTS FATIGUE ASSESSMENT BASED ON REAL-LIFE LOAD HISTORIES
/
EVALUACIÓN DE LA FATIGA DE COMPONENTES HIDRAULICOS BASADA EN HISTORIAS DE CARGA REAL

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Keywords: *Fatigue, hydraulic components, damage factor, pressure trace, pressure spectrum, cumulative damage, off-road mobile machinery.*

ABSTRACT

Many safety-critical hydraulic components in agricultural and other off-road mobile machinery experience static as well as time-varying loads and, obviously they undergo the latter during a major portion of their service life. Fatigue behaviour is, therefore, a key consideration in design and performance evaluation of hydraulic components.

The durability evaluation of components based on experimental results obtained from field is time-consuming and expensive, so simpler approaches that include a limited number of component verification tests have become popular. A problem that arises when studying the fatigue behaviour of such components with simpler approaches as mentioned, is the transferability of data from those limited number of verification tests, which provide real-life load histories (recorded data of load vs time that machine will experience repeatedly during service life) to be used in the accelerated test methods (laboratory environment) for validating the internal rated fatigue pressure (RFP) of components. The RFP is the pressure (component specification) which a component is verified to achieve with a known probability the rated life without failure.

Derived from the know-how and experimental background of the authors, the paper describes a simple procedure for the assessment of hydraulic components against fatigue based on the real-life load histories of a predetermined machine application using fatigue damage and life prediction rules. Conclusions are (1) that real-life load histories can essentially be reproduced, equivalently in terms of damage produced and life obtained, by constant amplitude fatigue tests and (2) that this method not only permits to decide the design specification (pressure-life) of components already in serial production, but also of those components that are still in the design phase.

RESUMEN

Muchos componentes hidráulicos críticos relativos a la seguridad en máquinas agrícolas y otro tipo de maquinaria móvil sufren cargas estáticas y variables en el tiempo. Obviamente son sometidas a estas últimas durante la mayor parte de su vida de servicio. Así pues. el comportamiento a fatiga es un factor clave a considerar durante el diseño y la evaluación del desempeño de los componentes hidráulicos.

La evaluación de la durabilidad de componentes basada en datos experimentales obtenidos en campo requiere mucho tiempo y tiene un coste elevado. por lo que enfoques más simples basados en un numero de ensayos de verificación limitado se han popularizado. Un problema que surge en el estudio del comportamiento a fatiga de estos componentes. con uno de los mencionados métodos más simples. es la transformación de los datos procedentes de los ensayos de verificación. que proporcionan historias de carga real (registros de carga vs tiempo que la máquina experimentará repetidamente durante su vida de servicio). para su uso en ensayos acelerados (entorno de laboratorio) para validar la presión de fatiga nominal (PFN). La PFN es la presión (especificación de componente) a la que un componente se ensaya para comprobar que alcanza. con una probabilidad conocida. la vida deseada o especificada sin fallo.

Derivado del conocimiento y los antecedentes experimentales de los autores. el artículo describe un procedimiento simple para la evaluación de componentes hidráulicos a fatiga basándose en las historias de carga real de una aplicación de máquina predeterminada utilizando reglas de predicción de daño y vida. Las conclusiones son (1) que las historias de carga real pueden ser esencialmente reproducidas. con equivalencia en términos de daño producido y vida obtenida. por ensayos de fatiga de amplitud constante y (2) este método no solo permite determinar la especificación de diseño (presión-vida) de los componentes ensayados ya en fabricación. sino que también para aquellos componentes todavía en fase de diseño.

INTRODUCTION

Fatigue behavior study provides manufacturers a better understanding about the lifetime of their product. In turn, it is a support for the marketing of extended warranty periods and how the product will perform in the future , which can be a very powerful tool to differentiate from the competition.

The service life of machines and components relies on both the load conditions and the fatigue strength. The phenomenon of mechanical damage of machine components is a very complex issue and it occurs as result of interaction of many different factors, such as: loads (external and internal), time of loads duration, temperature, corrosion, etc. These factors may interact with each other, which often intensifies their destructive effects. Furthermore, they interact with the element structure (e.g. notches, joints.), manufacturing technology (e.g. quality of a surface, heterogeneity of the metallographic structure, grain structure, grain size, defects of materials), mechanical properties of materials (e.g. anisotropy). etc. That gives an evidence on the complexity of this phenomenon and the diversity of mechanical damage.

Because of the complexity of load variations in many mechanical systems the variety of possible regimes and the different time distributions of the latter, obtaining a representative history of loads, is rather an arduous task.

For some time now, some researchers *(Heuler P.. Klätschke H.. 2003)* have strived to obtain standard load histories that can be applied efficiently to fatigue analysis as representative of the whole loading process of the system concerned. The automobile and aerospace industries have developed standard load-time histories (SLH's) that can be applied to different structural or mechanical parts of vehicles and airplanes. Such is the case with the bracket and suspension histories of SAE. TWIST and FALSTAFF histories for airplanes, HELIX and FELIX histories for helicopters and CARLOS. TURBISTAN and WASH histories for automobiles, gas turbines rotors and sea rigs respectively, among others. The acronym SLH is generally used for 'Standardized Load–time Histories' as well as for 'Standardized Load Sequences'. including 'Load Spectra'. More specifically, it is distinguished between 'Load–time History' for processes with actual time information (e.g. multiaxial, real-time processes) and 'load sequence' as a succession of loading events without explicit time information (e.g. load turning points, typically uniaxial applications).

Unfortunately, for agricultural and other off-road mobile machinery, this type of standardized load-time histories is not available.

On the other hand, the driving behavior may not be predicted to the same degree of reliability, because it should cover a wide variety of working conditions (e.g. mobile machinery digs, elevates, swings and dumps material by the action of its mechanism of working devices) and driving modes (conservative up to extraordinary events like misuse or accidental scenario) which results in large scatter levels. Therefore, the philosophies of manufacturers differ considerably regarding machine operation profile determination, generally laid down within particular driving rules for special test modules.

Although there are many initiatives that are being taken to update this data base by investigations on real customer usage, they are still not completely satisfactory and bigger effort and research is needed (life test or field tests are time-consuming and expensive).

After all the aforementioned paragraphs, it may be considered necessary to establish a simple methodology that allows to define the design specifications of a hydraulic component (pressure & number of cycles).

The paper describes a simple procedure for linking data recorded from real-life load histories (application dependent) to accelerated test methods (laboratory environment) for validating the internal rated fatigue pressure (RFP) of hydraulic components using load histories (recorded from real machine) analyzed with a counting method, Miner's rule and the S-N curve. This may be interesting for an assessment of the necessary effort in terms of testing time and cost.

MATERIAL AND METHOD

All machines are designed with a purpose. Agricultural machines' design and in general mobile machines pursue the goal of becoming a useful, efficient and safe tool performing different tasks. Loading, handling, digging, plowing, pulling (as a replacement of animal force) are some examples of what is expected from those machines. Maximizing the number of tasks which the machine performs properly. increases its versatility, so it allows to target higher market share and sales.

But even for those more specialized machines, it will be necessary to carry out different tasks and operations. Then, one of the machine designers' challenge is how to define the specification of the machine & machine components which will allow to match the market expectancy about effectiveness, cost efficiency and life among others.

This article describes the method, while illustrating the application of it with hydraulic cylinders for a loader for a tractor.

Application, task, operations.

Machine application, tasks and operations should be identified. For the machine example, a loader for a tractor following tasks and operations can be considered:

- Loading:

1. Machine moves forward the load (soil in the fig.1) with the bucket in top down position.
2. Machine introduces the bucket into the soil.
3. Bucket is tilt upwards to retain the load inside the bucket.
4. Lifting cylinders are operated upwards.
5. Move back while turning the steering wheels if necessary to orientate towards the place where the load will be discharged.
6. Translation until the discharge area (the area can be the rear trailer of a tractor, a hook loader truck, skip loader truck or simply at ground level).
7. Bucket is tilt downwards to discharge the load.
8. Move back turning steering wheels if necessary for orientate towards load, is located.
9. Positioning down lifting cylinders to repeat the cycle again.

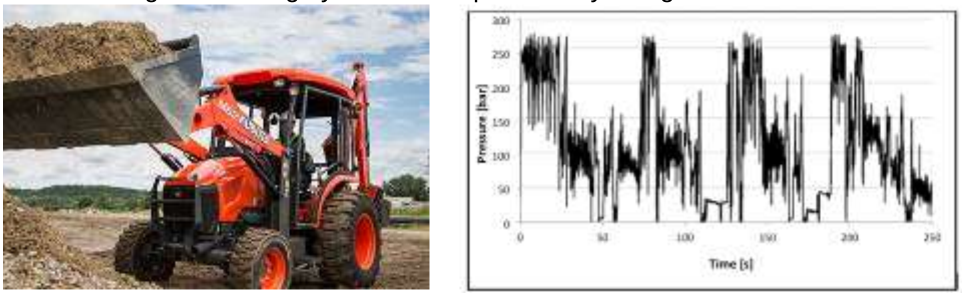

Fig.1 - Loading task and pressure history

- Stacking:
  1. Operations involved should be identified as they have been done for loading task.

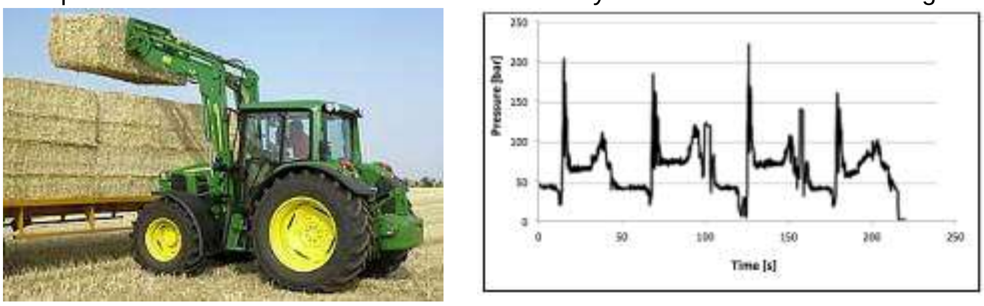

Fig.2 - Stacking task and pressure history

- Transport:
  1. Operations involved should be identified as they have been done for loading task.

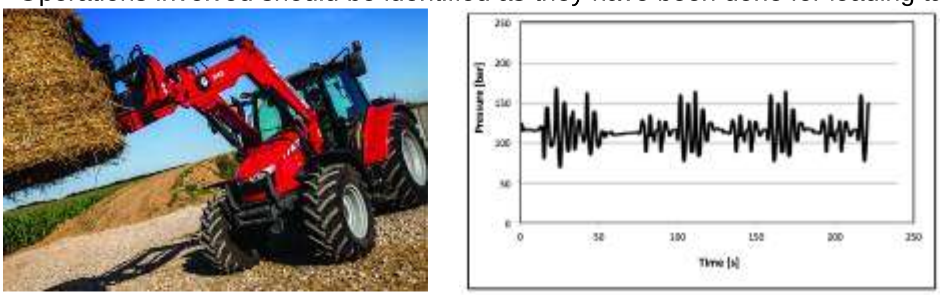

Fig.3 - Transport task and pressure history

Pressure: history and spectrum

Taking those three simple tasks described above (loading, stacking, transport). the **Pressure Histories (traces)** for all of them can be obtained by pressure transducers installed in cylinder's ports. The pressure trace describes the pressure value inside the cylinder at every single time step that the recording system allows (experimental data).

As the loader has 4 cylinders (2 for lifting, 2 for tilting) and each cylinder 2 ports, a total of 4 traces should be obtained in each graphic (right side from figures 1. 2 & 3). But for illustrative purpose, one trace from each will be analyzed separately to develop the method.

Current design method employs cycle counting to interpret the varying pressure range of the varying loads. The following two methods are the most commonly applied in the field of fatigue studies: Reservoir method and Rain-flow method.

In this procedure, the obtained data (pressure vs time) from every pressure trace have been treated by reservoir cycle counting method recommended in *(EN 13445-3 standard - Unfired pressure vessels - Part 3:*

Design). This topic is not developed deeper in this article. Also, this algorithm is standardized according to *(ASTM E 1049-85. Cycle Counting in Fatigue Analysis)*.

A certain number of pressure ranges should be selected to build the **Discrete Pressure Spectrum** graph. The smaller pressure ranges are, the higher number of rows creates. Following figures (fig.4. fig.5 and fig.6). it is illustrated how the pressure ranges considered modify the Discrete Pressure Spectrum. For that purpose, data from fig.1 are used.

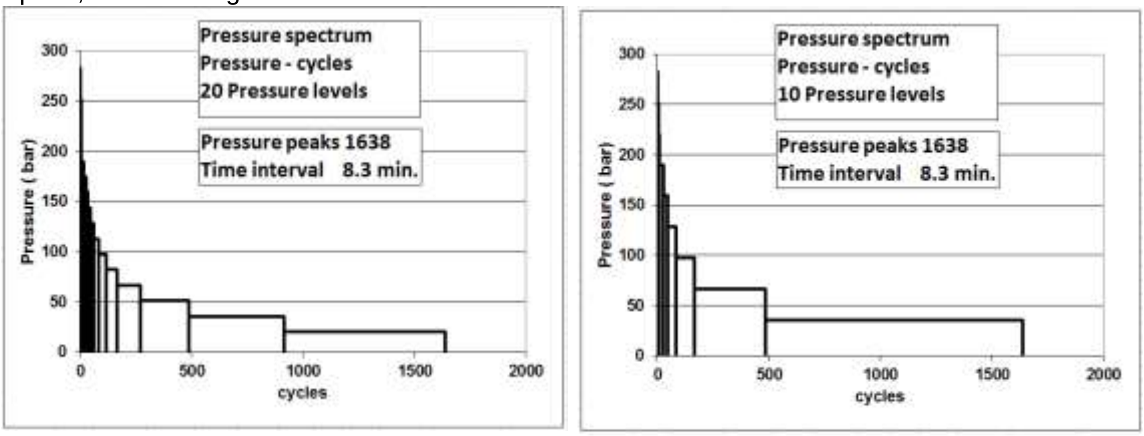

Fig. 4. - Pressure spectra (left: 20 pressure levels. right: 10 pressure levels)

Fig.4 shows how the pressure trace from fig.1 is translated into a Discrete Pressure Spectra, depending on how many specific pressure levels are used. (Left side shows pressure spectrum with 20 pressure levels and right side with 10. according a cycle counting method recommended in *(EN 13445-3 standard - Unfired pressure vessels - Part 3: Design)*).

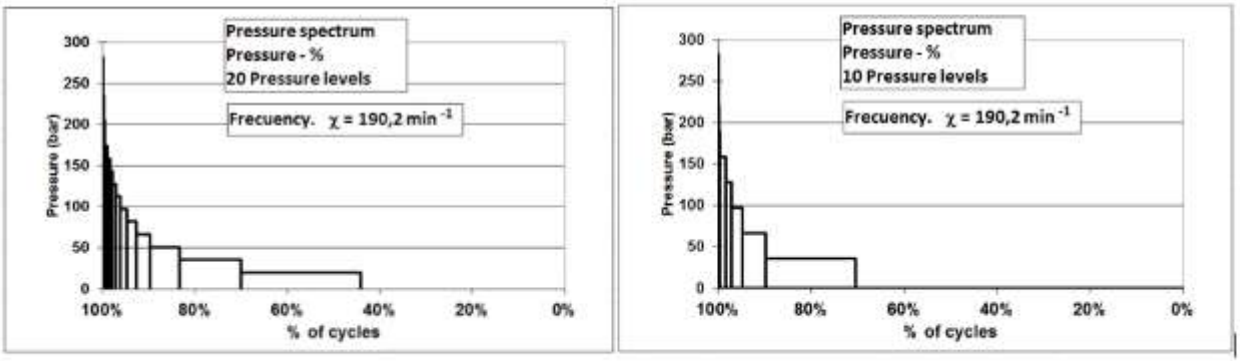

Fig.5 - Pressure spectra vs % cycles

Fig.5 shows how pressure spectra obtained by the cycle counting method based in number of cycles (X-axis in fig.4) are transformed in pressure spectra based in the time percentage of application of the given pressure level in the X-axis.

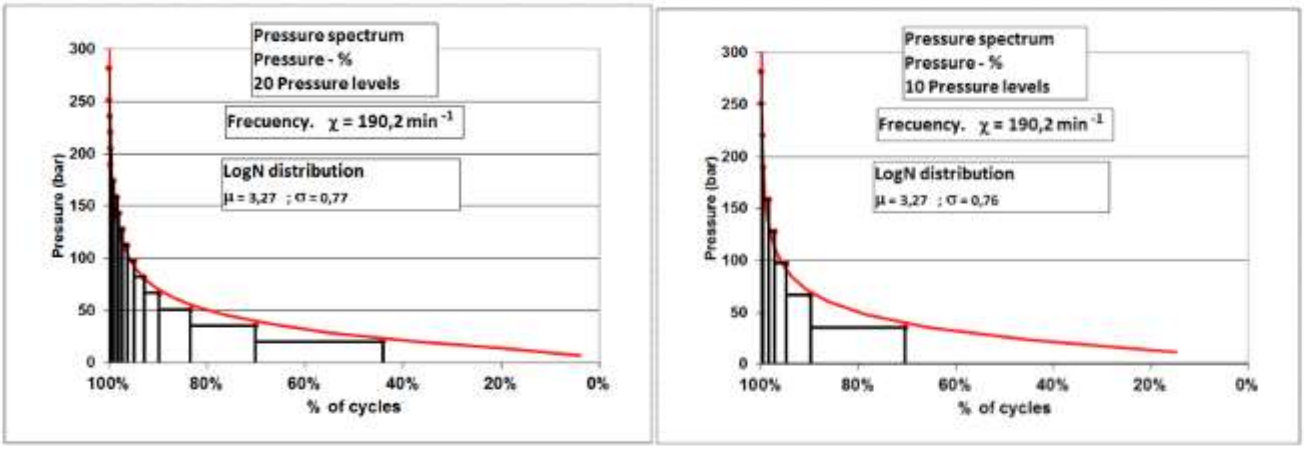

Fig.6 - Pressure spectra adjustment

Fig.6 shows the pressure spectra of fig.5. with a statistical lognormal Distribution adjustment. It is necessary to note that the number of rows used for building the spectrum influences the accuracy of the method. It can be demonstrated that transforming the Discrete Pressure Spectrum into a continuous pressure spectrum (by adjusting a statistical distribution to the discrete pressure spectrum as shown in fig. 6), is possible.

Different Discrete Pressure Spectra with different pressure ranges obtained from same pressure trace source fit properly with the same statistical distribution. Then, the accuracy of the method is improved. For didactic purpose of the overall method, this adjustment from discrete pressure spectrum to a continuous pressure spectrum is summarized in annex 1.

Once cycles have been identified for one task (i.e. loading from figures 1. 4. 5 & 6). the fatigue damage of all the cycles that occur (recorded in the loading history and the and then transformed into pressure spectrum) is summed with Miner´s linear damage rule to obtain the damage for the entire loading history.

A linear damage accumulation rule, such as Miner's Rule, simply states that if you use up to half of the fatigue life at one stress (pressure is equivalent for this article) level you have half the life remaining at any other stress level.

Miner’s rule is probably the simplest cumulative damage model. It states that if there are k different pressure (or stress) levels (with linear damage hypothesis) and the average number of cycles to failure at the “ith” pressure. P_i (or stress S_i). is N_i. then the damage fraction generated. D. is:

$$\sum_{i=1}^{k} \frac{n_i}{N_i} = D \tag{1}$$

where:

- n_i is the number of cycles accumulated at pressure P_i.
- N_i is the number of cycles to failure at pressure level P_i.
- D is the fraction of life consumed by exposure to the cycles at the different pressure levels.

According to Miner´s rule. fatigue damage for an individual cycle is the reciprocal of the fatigue life. N_i. Fatigue lives for a cycle, Ni. are computed using constant amplitude methods with the appropriate pressure or stress ranges, mean stresses and material properties. Damage can be obtained as the sum for all pressure cycles in the loading history.

Then, what should be the value of damage at failure of the component? If damage was truly a linear process the damage at failure would be equal to 1. Experiments on typical laboratory loading histories have shown that the value is usually between 0.3 and 1.0 depending on the type of loading history. In a simple two step block loading, a sequence of high amplitude cycles followed by low amplitude cycles will result in a damage sum D < 1.0. Similarly, a sequence of low amplitude cycles followed by high amplitude cycles will have a damage sum D > 1.0. Random loading histories have D ~ 1.0.

Spectrum relative damage

From the pressure spectrum vs % cycles (fig. 5), it can be defined the **Step Damage for every pressure step** of the spectrum obtained (ε_i) as:

$$\varepsilon_i = \upsilon_i P_i^{\beta} \tag{2}$$

where:

ε_i is the Spectrum Relative Damage for the *“i”* pressure step of a task.
υ_i is the time-portion of the task in unified percentage, while the P_i pressure level occurs.
β is the material coefficient from Basquin equation. It is considered 3 for steel for hydraulic cylinders.
P_i is the pressure value assigned to i pressure step of a task.
i is the index which identifies the pressure step number.

The **Spectrum Relative Damage** (δ_k) is defined as the sum of all step damages (ε_i) for one spectrum.

$$\delta_k = \sum_1^n \varepsilon_i \tag{3}$$

where:

δ_k is the Spectrum Relative Damage for a single task (k).
ε_i is the Spectrum Relative Damage for every pressure step.
i is the index which identifies the pressure step number.
k is the index which identifies the task number.

Fig. 7 illustrates the result of applying the previous equation (2). See. also. annex 3.

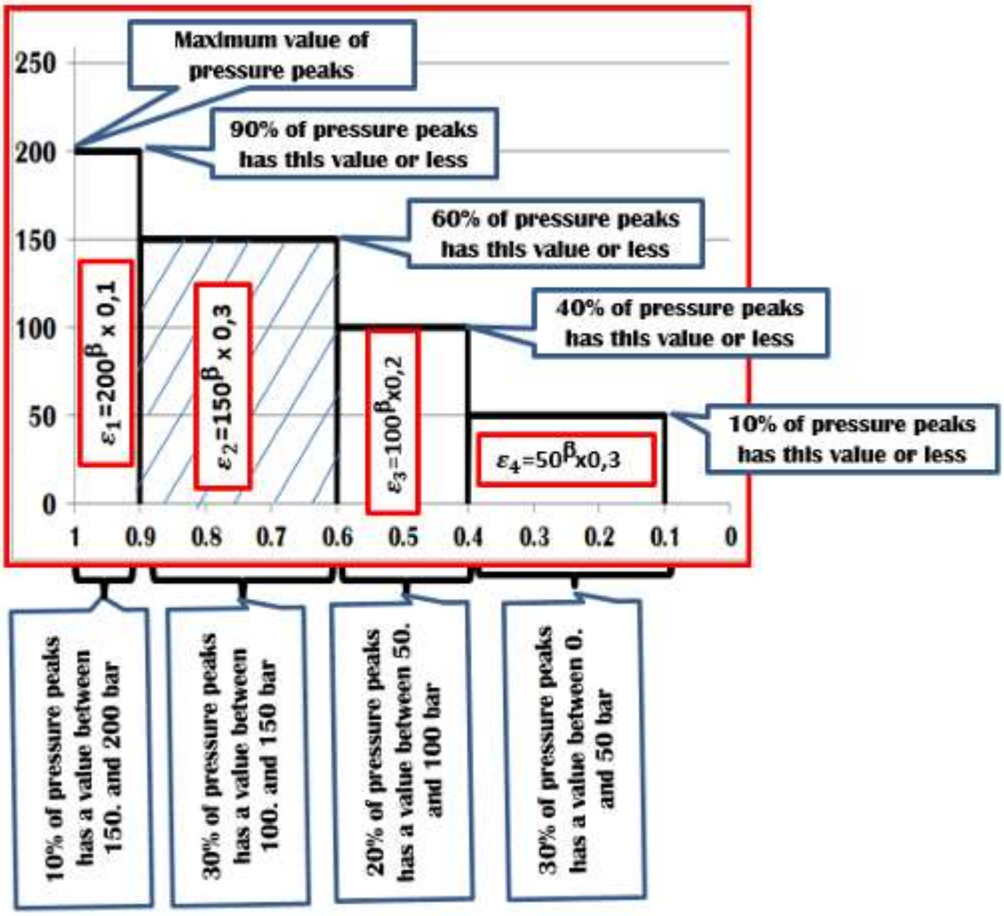

Fig.7 - Example for 4 steps pressure spectrum and step damages

Spectrum absolute damage factor

Although the Spectrum Relative Damage (δ_k) provides a quantification of the severity that the *k* task has in the durability of the hydraulic component. (i.e.: cylinder). it has no consideration on the loading frequency.

Spectrum Absolute Damage Factor is defined as the multiplication of the relative damage factor (δ_k) by the frequency of the application pressure cycles. (X_k):

$$\phi_k = \chi_k \delta_k \tag{4}$$

where:

ϕ_k is the Spectrum Absolute Damage Factor
X_k is the frequency factor (see fig. 5 & 6).
δ_k is the Spectrum Relative Damage.
k is the index which identifies the task number.

The frequency of the application pressure cycles (X_k) used for the Spectrum Absolute Damage Factor evaluation (ϕ_k). is obtained from the reservoir cycle counting the method used. This new factor is defined as the number of pressure peaks in a time unit.

At this point, only the damage of one portion of the job performed by the machine has been calculated (task *k*). Following the steps described above, it is possible to calculate the damage generated to the hydraulic components by the other tasks ϕ_k.

Total Absolute Damage Factor of the loader for a tractor can be obtained as the sum of the Absolute Damage Factors for all the tasks considered pondered by a time factor π_k as follows:

$$\Phi = \sum_1^n \phi_k \, \pi_k \tag{5}$$

where:

ϕ_k is the Absolute Damage Factor for the *k* task.
ϕ is the Total Absolute Damage Factor for all the tasks performed by the machine.
π_k is the time portion in unified percentage, in which machine operates performing the task *k*.
k is the index which identifies the task number.

Design specification

As it has been described above, at this stage it is possible to quantify the damage generated to the hydraulic components by all the tasks to be performed by the machine (i.e.: loader).

Commonly, the market defines the machine life expectancy in different modes, but always specifying the working hours (i.e.: 4000 hours without failures). More often, statistical concepts are being considered, so the life expectancy is expressed as *"4000 hours β_{10}"*. The latter means: when a sampling of 100 machines is tested for 4000 hours, only a 10 of them (10%) are accepted to fail before reaching those working hours.

For better understanding and focusing on the method described in this paper, the life expectancy is just taken as a working time *T*. expressed in proper units. So, it is necessary that all damage generated during the life of the machine, when the identified and analyzed tasks are carried out by the machine do not generate a failure earlier the *T* target life.

In that case it can be stated:

$$\Phi\,.T = \textstyle\sum_1^n \phi_k\, \pi_k.T = \alpha \tag{6}$$

And using Basquin equation:

$$N = \alpha S^{-\beta} \qquad \textit{Basquin equation} \tag{7}$$

It is possible to deduce (see annex 2) that

$$T\textstyle\sum_1^n \phi_k\, \pi_k = \alpha = N_{eq} P_{eq}^{\beta} \tag{8}$$

where:

α is Basquin coefficient

N_{eq} is the equivalent number of cycles at a pressure level P_{eq} under constant amplitude conditions.

T is working time.

ϕ_k is the Absolute Damage Factor for the *k* task

π_k is the portion of time in unified percentage, in which machine operates performing the task *k* at field for which the machine is designed.

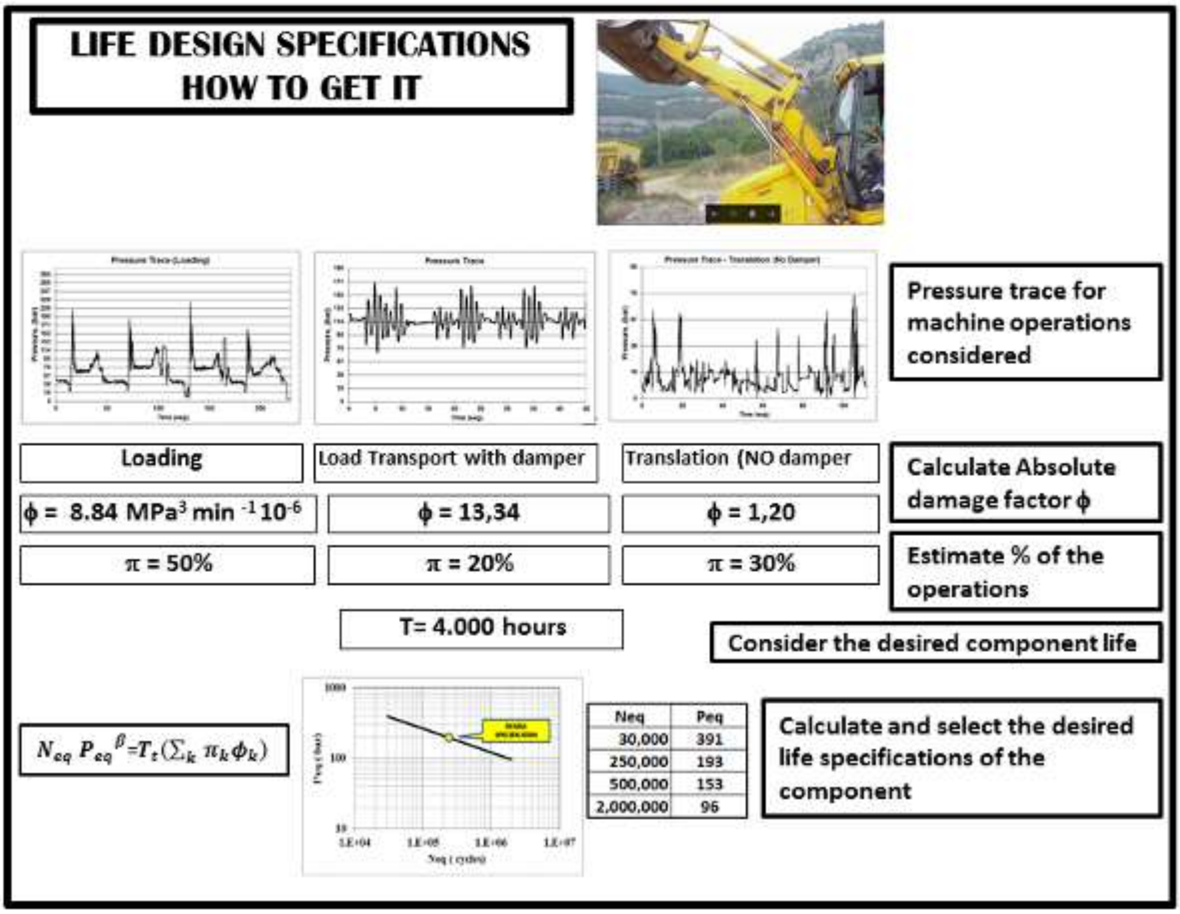

Fig.8 - Life design specifications (How to get it)

Figure nº 8 shows an example of procedure to calculate life-design specifications (in the form of a required number of cycles of a given pressure (N_{eq}. P_{eq})).

RESULTS

Research on fluid power components fatigue and methods to determine and estimate the design specifications based in real loads began during the PROHIPP project (2004-2008) whose technological aspects were coordinated by P. Roquet and E. Codina. This research line is still open with the cooperation of Roquet Hydraulics, which permits to have a nice data base on real pressure records of different machinery.

One of the topics still under development is the “normalization” of “typical” loads histories that permits to estimate the expected pressure behavior in a machinery still under development. Several relations and correlations have been tried. The development of the concept of “damage” factor, which includes both concepts: the pressure spectrum and the pressure peaks frequency and discrimination between “Machine operations”. seems to be a promising way to that goal.

Fig. 9 presents the empiric correlations found between the damage factors of different operations. vs equivalent pressure for several types of front and back loaders. This correlation is not the same for other types of machinery (such as, for example, vibrators). But, probably, other types of correlations may be possible. Restricting more the type of machinery (limiting it to a single brand, for example) can provide more adjusted correlations.

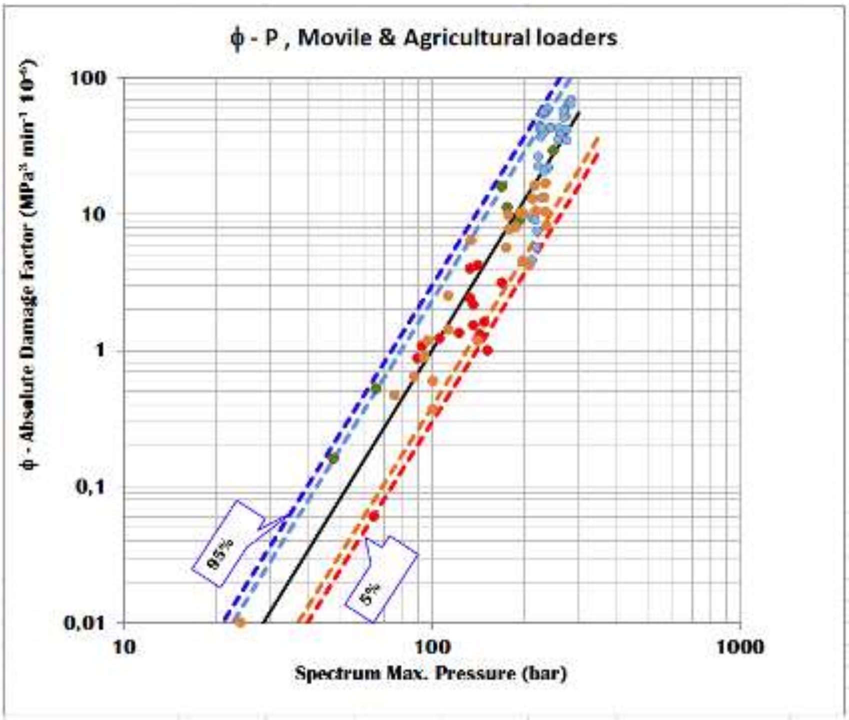

Fig.9 - Correlation between the damage factors of different operations vs equivalent pressure

CONCLUSIONS

The defined absolute damage factor permits:

1. Estimation of damage produced in a component due to different balance of operations.
2. Building up data-base of operations and associated damage.
3. Associated with the assumption that a load history of an operation is just a sample of the real total history of the pressure loads of this operation, it allows easily manipulate different samples of damage factors to reach a better approach of the total damage of this operation during the life of the machine.
4. Define the life design specifications

The method presented in this article represents a step ahead in terms of tools for designers. Clear advantages derived from it are:

- Ease of concepts, as vast majority are not complex and machine engineers/designers are used to work with them.
- Time to invest is dramatically reduced in comparison with a more traditional system because of:
    1. Less time to test.
    2. Less data to analyze.
    3. No special software required for calculation.

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- *EN 13445-1: Unfired pressure vessels - Part 1: General*
- *EN 13445-2: Unfired pressure vessels - Part 2: Materials*
- *EN 13445-3: Unfired pressure vessels - Part 3: Design*
- *EN 13445-4: Unfired pressure vessels - Part 4: Fabrication*
- *EN 13445-5: Unfired pressure vessels - Part 5: Inspection and testing*
- *EN 13445-6: Unfired pressure vessels - Part 6: Requirements for the design and fabrication of pressure vessels and pressure parts constructed from spheroidal graphite cast iron*
- *EN 13445-8: Unfired pressure vessels - Part 8: Additional requirements for pressure vessels of aluminum and aluminum alloys*
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STATISTICAL ADJUSTMENT

Several statistical distributions has been considered to fit the spectra results, Normal, Exponential, Log-Normal, and Weibull.

Normal was discarded from the beginning. Exponential presents the advantage of its simplicity, but fits in a limited type of spectra.

Weibull and log Normal fits reasonably well majority of spectra without evidence of a major advantage of Weibull. So the present research is basically done on the basis that a logNormal distribution fits the data

Log-Normal distribution is Normal distribution of natural logarithms of Pressure. Assuming that it's the distributions that fits conveniently , its parameters (average and standard deviation) may be estimated

a.-Plotting the accumulated probability in a "Normal Probability paper" and building up the "Henry line" that better fits the values.

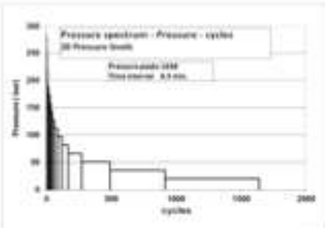
b.- Calculating the average and standard deviation of all the ln(P), from the all the pressure pics values.

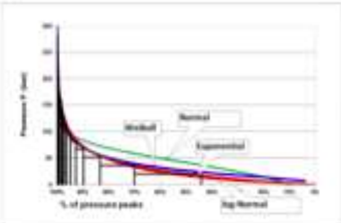
c.- Simplifying "b": calculating the average and standard deviation ,of products of "Pressure "P" x "number of cycles"

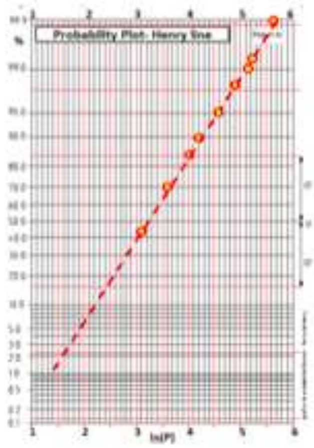
$$F(x) = \frac{(r - 0,3)}{(n + 0,4)}$$

	level	pressure	number of cycles	Accumulated cycles "r"	F(x)	ln(Pressure)
max	1	282	1	1,638	99.96%	5.6
	2	267	0	1,637		5.6
	3	251	2	1,637	99.9%	5.5
	4	236	1	1,635	99.8%	5.5
	5	221	1	1,634	99.7%	5.4
	6	205	1	1,633	99.7%	5.3
	7	190	9	1,632	99.6%	5.2
	8	174	12	1,623	99.0%	5.2
	9	159	7	1,611	98.3%	5.1
	10	144	12	1,604	97.9%	5.0
	11	128	16	1,592	97.1%	4.9
	12	113	23	1,576	96.2%	4.7
	13	97	33	1,553	94.8%	4.6
	14	82	49	1,520	92.8%	4.4
	15	67	105	1,471	89.8%	4.2
	16	51	217	1,366	83.4%	3.9
	17	36	425	1,149	70.1%	3.6
	18	20	724	724	44.2%	3.0
min.(*)	19	5	0		0.0%	1.6
		total, "n"	1638			

(*) values under "min", not considered.







The accuracy of the fitting between real pressure behavior and statistical distribution depends , evidently, on the number samples considered covering different situations of the operation.

A special situation is when the data covers different phenomena in a simple record, as it is the pressure trace of a cylinder with end stroke cushioning. In that case pressure behavior corresponds to two different phenomena, that of the "normal operation" and that of the "cushioning", and two different distributions has to be considered to cover both.

ANNEX 1 - Statistical adjustment of the pressure spectrum

DAMAGE FACTOR

$$D = \sum_i \frac{n_i}{N_i} \qquad (1)\ Palgrem\ Miner\ equation$$

$$N_i = \alpha' S_i^{-\beta} \qquad (2)\ Basquin\ equation$$

$or, considering\ that\ S_i = P_i$

$$N_i = \alpha P_i^{-\beta} \qquad (3)\ Basquin\ equation\ (P\ as\ variable)$$

$$D = \sum_i \frac{n_i}{N_i} = \sum_i \frac{n_i}{\alpha P_i^{-\beta}} = \frac{N_t}{\alpha} \sum_i \frac{n_i}{N_t} S_i^{\beta} = \frac{N_t}{\alpha} \sum_i \nu_i S_i^{\beta} \qquad (4)$$

as D = 1

$$\alpha = N_t \sum_i \nu_i S_i^{\beta} \qquad (5)$$

The aim is to find the equivalent load P_{eq} associated to
A life N_{eq} produces the same damage (D=1, failure of component)

$$D = 1 = \frac{1}{\alpha} N_{eq} P_{eq}^{\beta} \qquad (6)$$

$$\alpha = N_{eq} P_{eq}^{\beta} \qquad (7)$$

Obviously if we consider a given spectrum of N_f pulses as a sample of a given operation "C" times longer, the associated damage is:

$$D = CN_f \Sigma \frac{1}{\alpha} \nu_i P_i^{\beta} \qquad (8)$$

And considering that total damage to a component is due to the addition of damages of different operations:

$$D = \sum_k C_k N_{fk} \sum_i \frac{1}{\alpha} \nu_{ik} P_{ik}^{\beta} \qquad (9)$$

$$D = T_t \left\{ \sum_k \frac{C_k N_{fk}}{T_t} \sum_i \frac{1}{\alpha} \nu_{ik} P_{ik}^{\beta} \right\} \qquad (10)$$

$$N_{fk} = T_k \chi_k \qquad (11)$$

$Considering\ D = 1\ (failure)$
$and\ matching\ and\ clearing\ equations\ (6) and\ (10) and\ 11$

$$N_{eq} P_{eq}^{\beta} = T_t \left(\sum_k \pi_k \chi_k \sum_i \varepsilon_i \right) \qquad (12)$$

$$N_{eq} P_{eq}^{\beta} = T_t \left(\sum_k \pi_k \phi_k \right) \qquad (13)$$

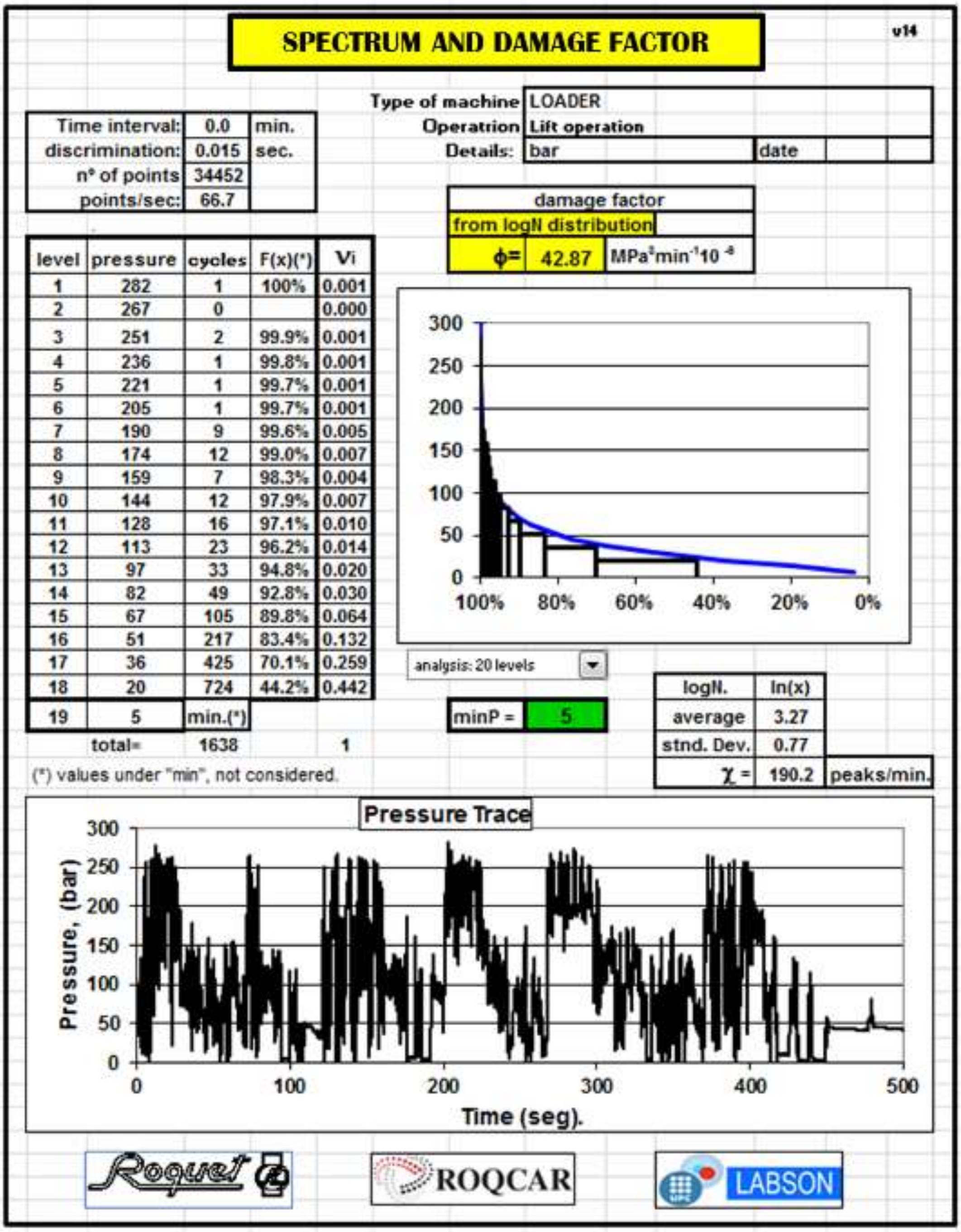
$With$:

$$\varepsilon_{ik} = \nu_{ik} P_{ik}^{\beta} \qquad (14)$$

$$\delta_k = \sum_i \nu_{ik} P_{ik}^{\beta} = \sum_i \varepsilon_i \qquad (15)\ Relative\ Damage\ factor$$

$$\phi_k = \delta_k \chi_k \qquad (16)\ Absolute\ Damage\ factor$$

ANNEX 2 - Shows the mathematical development derived from the Palgrem-Miner equation and Basquin equation to the concepts of RELATIVE and ABSOLUTE DAMAGE FACTOR



SPECTRUM AND DAMAGE FACTOR v14

Time interval:	0.0	min.
discrimination:	0.015	sec.
n° of points	34452	
points/sec:	66.7	

Type of machine	LOADER		
Operatrion	Lift operation		
Details:	bar	date	

damage factor		
from logN distribution		
ϕ=	42.87	$MPa^3min^{-1}10^{-8}$

level	pressure	cycles	F(x)(*)	Vi
1	282	1	100%	0.001
2	267	0		0.000
3	251	2	99.9%	0.001
4	236	1	99.8%	0.001
5	221	1	99.7%	0.001
6	205	1	99.7%	0.001
7	190	9	99.6%	0.005
8	174	12	99.0%	0.007
9	159	7	98.3%	0.004
10	144	12	97.9%	0.007
11	128	16	97.1%	0.010
12	113	23	96.2%	0.014
13	97	33	94.8%	0.020
14	82	49	92.8%	0.030
15	67	105	89.8%	0.064
16	51	217	83.4%	0.132
17	36	425	70.1%	0.259
18	20	724	44.2%	0.442
19	5	min.(*)		
	total=	1638		1

(*) values under "min", not considered.

analysis: 20 levels

minP = 5

logN.	ln(x)	
average	3.27	
stnd. Dev.	0.77	
χ =	190.2	peaks/min.

ANNEX 3 - A program has been developed to obtain the concepts developed in this article (□□) from a trace of a given machine operation. The program has capacity for traces of 50.000 points and is used either for industrial or research purposes.

SCIENTIFIC ADVANCES IN UKRAINE AND WORLD EXPERIENCE OF CREATING INNOVATIVE PRODUCTS MADE FROM OILSEED FLAX STRAW
/
НАУЧНЫЕ ДОСТИЖЕНИЯ В УКРАИНЕ И МИРОВОЙ ОПЫТ СОЗДАНИЯ ИННОВАЦИОННОЙ ПРОДУКЦИИ С СОЛОМЫ ЛЬНА МАСЛИЧНОГО

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Keywords: *oilseed flax, straw, fibre, innovative products, burning, processing, quality.*

ABSTRACT

World practice of flax straw burning goes back to generations and oilseed flax is regarded not only as a seed production crop, but also as a cost-effective supplementary textile raw material. In Ukraine, oilseed flax is the only domestic raw material, which can be an alternative to imported cotton and fibre flax for use in the textile, pulp and paper industries and the production of reinforced composite materials.

The article presents scientific and practical achievements in creating innovative products based on oilseed flax straw, both in Ukraine and abroad.

The analysis of standardization of straw and oilseed flax products indicates the absence of regulations determining their quality, the development of such regulations being a crucial issue. At present, there is no clear classification of fibres and physical and mechanical properties that would characterize the scope of their industrial application.

РЕЗЮМЕ

В мире. практика сжигания соломы льна масличного уходит в прошлое и его рассматривают не только. как культуру для получения семян. но и как экономически эффективное дополнительное текстильное сырье. В Украине. лён масличный - это единственный отечественный сырьевой ресурс. который может стать альтернативой импортному хлопку и льну-долгунцу для использования в текстильной. целлюлозно-бумажной промышленностях и производства армированных композиционных материалов.

В статье представлены научные и практические достижения в создании инновационной продукции на основе соломы льна масличного. как в Украине. так и в мире в целом.

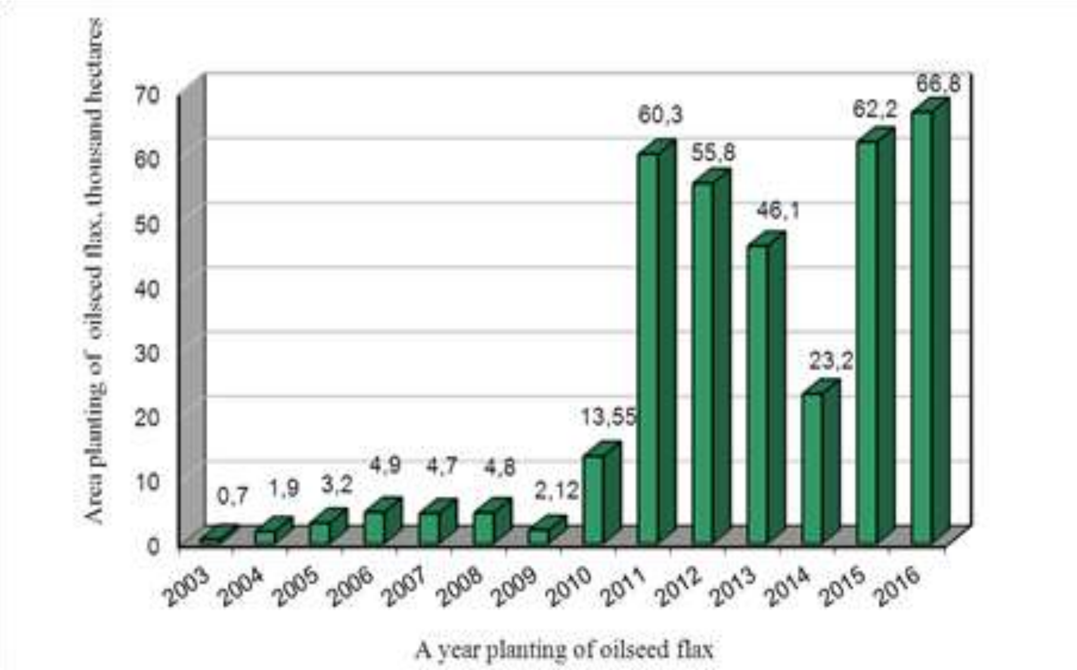
Анализ состояния стандартизации соломы и продукции со льна масличного. свидетельствует. об отсутствии нормативных документов для определения их качества. разработка которых является актуальным вопросом. В настоящее время не существует четкой классификации волокон и физико-механических показателей. которые бы характеризовали сферу их промышленного применения.
для текстильной промышленности.

INTRODUCTION

Oilseed flax, Linum Usitatissimum L is a valuable commercial crop of the Linum genus and the Linaceae family. It is considered that the main advantage of oilseed flax is production of seeds which have medicinal, bactericidal and antioxygenic properties. Therefore, seeds are widely used in food, formula-feed, pharmaceutical and chemical industries. The oil received from seeds can be used as raw material for the technical purposes in the paint and varnish, soap-producing and tanning industries, as well as in typographical production, production of aluminum and oil paints for painting and in many other areas [The story of flax. 1997].

In Ukraine, until recently, farmers have massively ignored oilseed flax, fearing further problems with the sale of seeds. However, the successful marketing of the oilseed at high prices in the world dramatically changed the situation [Business Publications. 2015].

In recent years, in Ukraine, according to the data of the State Statistics Committee of Ukraine [State Statistics Service of Ukraine, 2016], the structure of sown areas of oilseed flax has substantially changed (fig,1). The main areas are concentrated in Dnieper, Zaporizhya, Mykolayiv and Sumy regions. At the same time, active participants in the oilseed flax market became "Agricultural enterprise" Zaria "(Zhytomyr region), the enterprises of production and commercial firm" Siaivo "(Chernihiv region), state enterprise" Experimental farm "Askaniiske", Institute of irrigated agriculture of the southern region NAANU (Kherson region,) (*Business Publications, 2015*).



Fig, 1 - Dynamics of cropped areas of oilseed flax grown in the territory of Ukraine from 2003 to 2016

At the same time, there is no practical application of oilseed flax straw in Ukraine. After collecting seeds by combine harvesters in the fields, the straw remains and is then burned. If earlier in case of small areas of crops, straw was burned and it did not cause disturbance of ecological security, today, it cannot do without penalty. So, in 2016, with yield of 2 tons of straw per hectare, 136, 600 tons of oilseed flax straw were burned. This issue appears on the agenda at the farmers and this concerns not only Ukraine.

MATERIAL AND METHOD

According to the analysts of Oil World, the largest cropped areas of oilseed flax are concentrated in Canada (about 2 million hectares), Argentina (101 thousand hectares), China (570 thousand hectares), India (930 thousand hectares), Great Britain (101 thousand hectares), the USA (135.17 thousand hectares), Germany (110.048 thousand hectares). Such countries as Finland, Poland, France, Belgium and Belarus (2.5 thousand hectares) have begun to cultivate this crop recently (*Saskatchewan Flax Development Commission, 2015)*.

The government of Canada which is the leading country in the world by the number of acreage of oilseed flax is also puzzled with a subject of burning straw. One can only imagine what ecological damage will be caused to the environment if about two million hectares are burned annually. Farmers, in the 1990s called this phenomenon "the intended large-scale fires". Speaking at the symposium, they appealed to the state bodies of this country to create the market of oilseed flax straw of flax as of an additional source of textile fibre. (*Comeau G, 2006; Heuzé V, Tran G, Lebas F, 2015*).

Today, on the basis of conducted research and development activities in Canada, 6 firms were created for processing flax straw (laxStalk / SWM, Biolin, Stemia, Vegreville Decortication, Crailar Flax, and Stemergy), 14 firms for processing flax fibre and and three companies for the production of bio-energy products, that are concentrated in Western Canada, North Dakota, and North America,.

This industrial complex manufactures multifunction products of "new generation" from oilseed flax straw: household textile materials (In Alberta, processing firms are located in the Lethbridge), filter paper (company Delstar) and cigarette paper (SWM (Schweitzer Mauduit International, Canadian flax straw processor is FlaxStalk which is located in Manitoba), composite and non-woven fabrics, industrial geotextile, biofuel and others.

Fuel, chemical, food and beverage, pulp and paper companies are increasingly finding advantageous uses of biotechnology in their production processes. The company CIC has developed a composite that will be used for the the next generation hood of Buhler tractors. National program Flax Canada 2015 has developed a strategic plan on research and development, commercialization and branding of products based on oilseed flax due to full utilization of the plant.

These products are manufactured and sold only for the domestic market on a small scale since the global marketing of innovative products is only possible upon condition of availability of documents regulating quality. To solve this problem, the FibreCity was created (part of Composite Innovation Centre) which is developing quality standards and grades of natural fibres. This will allow to potential users to know what they are getting and how the fibre can be used (*Dr, Shelley Thompson, 2015*).

In China, at high-level of scientific research, experiments are carried out on microscopic fibres derived from flax straw, with the aim of producing "know-how" products. Namely, it is the creation of bicomponent fibres by means of thermal bonding for creating innovative nonwoven and composite materials and technical textiles (*Kulmaa ., 2015; Krzysztof H, 2015; William A, 2007; Hegde G.S, 2011; Sikkema M., 2003*),

Agricultural Research Centre of Finland presented a report on the scientific advances in the study of the properties and processing of oilseed flax straw and monoecious non-narcotic hemp for producing high-quality fibres of various industrial uses: decorative and household textiles, technical textiles, agro-fibre composite materials, paper of special and technical use, insulation materials, wood-fibre boards. At the moment, their research is focused on evaluating the quality of oilseed flax fibres and establishing classification system that would characterize their scope (*Sankari ., 2000*).

In Russia, oilseed flax is also cultivated, particularly in Altai Krai and Bashkortostan. Structures of industrial use of flax straw are just beginning to develop, so the practice of burning straw in the fields still exist. But farmers already understand that flax straw is a valuable raw material, from which you can obtain textile low cost cellulose fibre and sell it at a reasonable price. Entities interested in the processing of flax straw are usually mostly non traditional flax-scutching mills but small private enterprises cooperating with research centers (All-Russian Research Institute of mechanization of flax cultivation VNIIML). Scientists of Kostroma State University are engaged in development of resource-saving technologies for processing oilseed flax straw in order to obtain fibre of a wide industrial application and assess its quality (*Uschapovsky, I. V., 2009*).

In Ukraine, the scientists of the Department of commodity science, standardization and certification of Kherson National Technical University (KNTU), under the supervision of Doctor of Science, professor, head of the department L,A, Chursina, have carried out a thorough research. For processing of oilseed flax retted straw, in order to obtain fibres of different functional purpose, experts of KNTU developed a new resource-saving technology requiring renovating existing production equipment,.

According to the results of experimental and theoretical research in the laboratory and production environment samples of innovative products from this flax straw were obtained. Namely, the mixed yarn: oilseed flax-cotton, oilseed flax- polyethyleneterephthalate (lavsan), oilseed flax-wool (LLC "Boguslaw Textile", Kiev region), composites (SE "Plastmass" LLC "TD Plastmass-Priluki" Chernihiv region) semi-finished cellulose materials, filter paper (LLP "Tsyurupinsk pulp and paper mill", Kherson region,) and non-woven fabrics (JSC "Flax processing mill Starosamborskyi» Lviv region,) (*Tihosova, GA. 2011*).

This product is of great economic importance, environmentally friendly, meets modern consumer needs of the population, can compete with imported products, but above all we have domestic raw materials for its production.

As it is known, nowadays the light industry of Ukraine is in economic crisis, and one of the main reasons is its dependence on imported raw materials. Therefore, oilseed flax is the only domestic raw material, which is able to fully replace imported cotton and fibre flax for the textile industry, thereby ensuring a strategic and financial independence of our state.

For moving these innovative products beyond laboratory research, its large-scale production and sales in the domestic and global markets, it is necessary to develop and adopt national regulations to assess the quality of the straw, fibres and products from this group of flax.

Since Ukraine has no standards for conducting trade analysis of stems, retted straw, and innovative products from oilseed flax, existing standards on fibre flax and cotton were used, the vast majority of which were created in Soviet times.

Oilseed flax straw and retted straw were evaluated according such physical and mechanical properties: moisture, content of bast (fibre), handful length, diameter and color of stems, maturing degree, separability of fibres from wood, mass content of shives and the breaking load were determined by instrumental method according to the standards GOST 28285-89 и DSTU 4149: 2003 [GOST 28285-89, 1990; DSTU 4149: 2003, 2003].

The main quality indicators of oilseed flax fibres, which were determined during the experiments according to DSTU 5015: 2008 and TU.U.05495816.005 - 2000 were the following parameters: strength, shives and impurity content, flexibility, linear density, average mass and length of fibres and their irregularity [DSTU 5015: 2008, 2008; TU.U.05495816.005 – 2000, 2000].

But the results of studies of physical and mechanical properties of stems and fibres, their morphological and anatomical structure show a significant difference of qualitative characteristics from flax and cotton [Golovenko T.N., 2016].

Furthermore, the given characteristics of straw and oilseed flax fibres depend not only on the parameters and modes of processing, but also on the climatic conditions of cultivation, carried out agricultural activities and seed collection methods [Ferguson G., 2009; Jonn A. (2009)], a change which can significantly affect the quality indicators of finished products.

Therefore, vitally important and acute issues today for Ukraine are as follows:

- developing standards for evaluating the quality of straw, fibres and innovative products from oilseed flax;
- creating classification of fibres according to physical and mechanical characteristics, which will determine their functional purpose;
- determining complex and integral indicators of the quality of innovative products from oilseed flax;
- developing technology of the expert examination of innovative products from oilseed flax;
- determining dependence of the qualitative characteristics of fibres on growing conditions, harvesting techniques and mechanical processing of oilseed flax straw.

CONCLUSIONS

As world practice shows oilseed flax is an annually renewable “biological raw material” of new generation.

Organization of the industrial complex for processing oilseed flax straw in Ukraine will provide domestic textile enterprises with cellulose-containing raw material, which is of strategic importance, in conditions of complete import dependence of our country.

Taking into account the world experience, the scientists of Kherson National Technical University developed the technology of oilseed flax straw processing to produce fibres of different functional purpose. As a result of research work carried out in the laboratory and in industrial conditions, innovative product samples have been created from fibres of this group of flax: blended yarn, composite materials, semi-finished cellulose materials, filter paper and nonwovens.

However, large-scale manufacturing of innovative products for the purpose of domestic and international marketing opportunities is only possible upon condition of their standardization. In developing regulations for assessing quality of oilseed flax straw stems and fibres obtained in order to determine the scope of industrial application, it is necessary to take into account their specific anatomical, physical and mechanical properties.

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ESTABLISHMENT OF MUSTARD CROP TO IMPROVE SOIL QUALITY
/
CONSIDERATII PRIVIND UTILIZAREA CULTURII DE MUSTAR PENTRU IMBUNATATIREA PROPRIETATILOR SOLULUI

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Keywords: *mustard, soil incorporation, fertilization.*

ABSTRACT
The article addresses farmers and entrepreneurs in the agricultural field interested in implementing in their own agricultural units ecological technologies of soil fertilization, using green cultures. The present paper presents the effects produced by mustard culture incorporation in soil, in order to improve its properties, analyzing the results of soil samples taken before sowing the mustard, as well as after harvesting it. At the same time, soil humidity was tracked at a depth of 6 cm. throughout the plant vegetation period. Researches on the use of mustard crop to improve soil properties were conducted on field no. 2. an area of 9000 sqm., which is part of INMA Bucharest experimental fields, on a forest reddish brown soil type. The action was initiated in December 2015 when soil samples were taken at a depth of 10 cm. following the rules required by STAS 7184 / 1-84. These samples were analyzed using soil test kit SK 200 (Martin Lishman). We wanted to determine the pH., potassium and total nitrogen, as well as soil humidity at the time of laboratory analysis. We also wanted in case of an acid pH to establish a norm amendment for bringing it to normal levels. As green manure, you can use almost all plants, especially those pulpy and watery with a short period of vegetation, such as cruciferous vegetables, buckwheat, clover, rape. They are very favourable because they are fast growing legumes, contain water in composition and fix atmospheric nitrogen.

REZUMAT
Articolul se adreseaza agricultorilor si intreprinzatorilor din domeniul agricol interesati de implementarea in unitatile agricole proprii a tehnologiilor ecologice de fertilizare a solului cu ajutorul culturilor verzi. Prezenta lucrare prezintă efectele produse de incorporarea culturii de mustar in sol. in vederea imbunatatirii proprietatilor acestuia. analizand rezultatele probelor de sol prelevate inaintea insamantarii terenului cu mustar. precum si dupa recoltare. Totodata s-a urmarit umiditatea solului la adancimea de 6 cm pe toata perioada de vegetatie a plantelor. Cercetarile privind utilizarea culturii de mustar pentru imbunatatirea proprietatilor solului. au fost efectuate pe sola nr. 2 in suprafata de 9000mp din cadrul terenurilor experimentale ale INMA Bucuresti.. tipul solului fiind brun roscat de padure. Actiunea a fost demarata in luna decembrie 2015. cand au fost prelevate esantioane de sol la adancimea de 10cm. cu ajutorul unei sonde (fig.1). respectând normele prescrise de STAS 7184/1-84. Probele au fost analizate utilizand kitul de testare a solului SK 200 (Martin Lishman). Acesta a urmărit determinarea pH-ului. potasiul și azotul total. precum și umiditatea solului la momentul analizei de laborator. De asemenea. s-a urmarit in cazul aparitiei unui pH acid. stabilirea unei norme de amendament pentru aducerea acestuia la valori normale. Ca îngrășământ verde. puteți utiliza aproape toate plantele. în special cele carnoase si apoase. cu o scurtă perioadă de vegetație. cum ar fi crucifere. hrișcă. trifoi. rapiță.

INTRODUCTION
Green fertilizers. also called green crops, are plants chopped and incorporated in the soil before or after the main crops. They must be pulpy and watery with a short vegetation period. The most favourable plants are usually from the legume family (Fabaceae): lupin, peas, clover, etc.. because they fix atmospheric nitrogen in the soil, have short vegetation period and produce large amounts of biomass.

The main purpose of a green crop is to generate as much biomass as possible to be incorporated in the soil at the right moment in order to increase soil fertility. Seed norm in this case must be higher by 20-40%.

Mustard is not pretentious regarding soil. It gives high yields on sandy loam soils with sufficient humidity, with neutral or slightly alkaline reaction (therefore, if cultivated on podzols, the soil should be amended), rich in humus and calcium. Too loamy or sandy soils are contraindicated [7].

Other plants used as green fertilizers are those of *Cruciferae* family (*Brassicaceae*): rape, mustard, etc. This family includes over 330 genera and about 3700 species [10].

Nutrients must be available for plants step by step and in harmonious relationships corresponding to the vegetation phases, given that, by organic matter decomposition, some substances are used directly by the plants (nitrogen), others, like phosphorus and magnesium are used first by microorganisms and then, by decomposition of organic matter they return into soil solution.

Deep disposal of organic matter leads to anaerobic decomposition with production of compounds that are toxic for plants.

Organic fertilizers together with the green ones are the basis of biological fertilization. As technique, green fertilizers will be applied in such a way that fresh material will never come in contact with plant roots. Organic materials must first be composted or placed on the surface and then incorporated in the soil by a superficial work (5-10 cm) [1. 2. 3. 5. 9. 12].

MATERIAL AND METHOD

Researches on the use of mustard crop to improve soil properties were conducted on field no. 2. On an area of 9000 sqm., which is part of INMA Bucharest experimental fields, on a forest reddish brown soil type.

The action was initiated in December 2015 when soil samples were taken at a depth of 10 cm (Fig. 1)., following the rules required by STAS 7184 / 1-84.

These samples were analyzed using soil test kit SK 200 (Martin Lishman) (Fig. 2). The samples were mixed, stones and other foreign objects being removed.

Fig. 1 – The soil sampling

Fig. 2 - SK 200 Kit. (Martin Lishman) [4]

On March 31. 2016. the seedbed was prepared on field no. 2 by a combiner pass (Fig.3). The next day, the surface was seeded with mustard.,certified seed being used (Fig.4).

Fig. 3 – Preparing the seedbed using the combiner

Fig. 4 – Certified mustard seed

The machine used for sowing was SUP 29 (Fig. 5), the seed norm used was 8kg/ha and the distance between rows 25 cm at a depth of 2 cm.

Fig. 5 – Mustard sowing with SUP29

Fig. 6 – Phyllotreta atra [13]

During the vegetation period, no phytosanitary treatments were applied. Shortly after the emergence, in 3 leaves phase, the black flea appeared in the mustard culture (Phyllotreta atra - Fig.6). but without creating major damage to exceeded economic threshold (Fig.7). It winters in the ground, from where it resurfaces in early spring. The black flea is most active on sunny days. When it appears in mass, it destroys the leaves completely. They are combated by spraying the leaves with soap and nicotine emulsion, Metasystox in concentration of 0.02%. 100 l/ha [7]. Phyllotreta spp. has one generation per year [8] being part of univoltine insects group [6]. The type of damage is shot-holing on the leaves (Fig.8).

Fig. 7 – Black flea (*Phyllotreta atra*)

Fig. 8 – Shot-holing on the leaves

Throughout the vegetation period, the plants have enough humidity to grow (Table 4).

In the second half of June 2016, the mustard crop (Fig.9) was cut using the soil levelling machine. For incorporation in the soil, two passes with a disc harrow were performed.

Weekly, soil humidity was monitored at a depth of 6 cm, using HH2 portable soil humidometer (Fig.10).

Fig. 9 – Mustard crop at the time of incorporation

Fig. 10 – HH2 portable soil humidometer

When green crops are not incorporated, retained nutrients are assimilated more slowly and the fertilization plan is adjusted. In combination with no-till technology, unincorporated green cultures offer considerable advantages:

- water is retained in the soil, the vegetation layer of green cultures preventing its evaporation;
- biological activity increases under the mulch layer;
- organic matter and humus in the soil grow annually, creating a fertile soil;
- weeds are reduced; it is more difficult for them to germinate in a soil covered by green culture residues [11].

In the short-term incorporation it is beneficial, but in the long term it leads to the usual problems associated with soil processing:

- water loss from the soil;
- destruction of soil structure;
- decrease of biological activity;
- oxidation of organic matter;
- hardpan forming, in the case of ploughing [11].

RESULTS

The soil samples taken in December 2015 were analysed using the soil test kit SK 200 (Martin Lishman). We wanted to determine the pH., potassium and total nitrogen, as well as soil humidity at the time of laboratory analysis. We also wanted in case of an acid pH to establish a norm amendment for bringing it to normal levels. The results are presented in Table 1.

Table 1

Soil samples taken in December 2015

Determined parameter	Value / Concentration
pH	6.5
Required lime. [g/m^2]	0
Nitrogen [mg/l]	17.5
Potassium [mg/l]	215
Humidity. [%]	22.98

A month after mustard culture incorporation in the soil, soil samples were taken to determine and to analyse the differences that appeared (Table 2).

Table 2

Soil samples taken one month after mustard culture incorporation in the soil

Determined parameter	Value / Concentration
pH	6.6
Required lime. [g/m^2]	0
Nitrogen [mg/l]	20.6
Potassium [mg/l]	246.0
Humidity. [%]	10.04

According to the *Guidelines for soil tests interpretation* (E.S. Marks. J. Hart &R.G. Stevens. 1996), the recommended values for soil nutrients are shown in Table 3 [4].

Table 3

Recommended values for soil nutrients

Parameter	Results unit of measurement	Recommended value/concentration *
Soil pH	-	7.5
Nitrogen	mg/l	20
Potassium	mg/l	250

After monitoring soil humidity in the case of mustard culture at a depth of 6 cm. the following results presented in Table 4were obtained.

Table 4

Soil humidity at a depth of 6 cm

Data	Value
11.04.2016	31.6%
19.04.2016	29.3%
27.04.2016	42.5%
06.05.2016	28.3%
13.05.2016	29.1%
25.05.2016	27.4%
31.05.2016	23.0%
09.06.2016	20.1%
17.06.2016	27.4%

CONCLUSIONS

Following the research. we have found the following:

1. the content of nitrogen increased by 4.7mg/l
2. the content of potassium increased by 42.5mg/l;
3. soil pH increased by 0.1%.

There are many advantages of mustard green culture incorporation in soil, such as:

1. increases the content of nutrient substances in the soil;
2. reduces or even stops the application of organic and mineral fertilizers;
3. improves soil quality by increasing the amount of humus;
4. conserves humidity in the soil during growth acting like a living mulch;
5. reduces the degree of weeds;
6. reduces soil erosion;
7. absorbs nutritional substances lost through levigation;
8. provides habitat for beneficial insects;
9. very low cost of seed material;
10. does not require agricultural maintenance works.

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STUDY OF POLLUTED SOIL BIOREMEDIATION/
STUDIUL BIOREMEDIERII SOLURILOR POLUATE

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ABSTRACT

In the present paper are presented: the methods, the conditions of bioremediation of soils polluted with heavy metals and oil; the advantages and disadvantages of bioremediation; the microorganisms used for the removal of soils from heavy metals; bioremediation technologies for soils contaminated with hydrocarbons.

REZUMAT

Această lucrare prezintă metodele. conditiile de bioremediere a solurilor poluate cu metale grele si petrol. Avantajele si dezavantajele bioremedierii. Microorganismele utilizate pentru depoluarea solurilor de metale grele. Tehnologiile de bioremediere a solurilor contaminate cu hidrocarburi.

INTRODUCTION

Applying biological methods to reduce heavy metal pollution in low concentrations is an area of interest in current research (*Gavrila. 2015*).

Research on the bioremediation of heavy metal polluted environments is based on the activity of acidophilic microorganisms whose metabolic diversity explains the effectiveness of removing toxic compounds from the environment (*Gavrilescu et al.. 2009*).

A particular importance in the use of acidophilic microorganisms in biosorbtion, bioaccumulation and biosolubilization processes in industrial waste water is the resistance of these microorganisms to increased concentrations of metallic ions present in the respective media (*Gavrilescu et al.. 2009*).

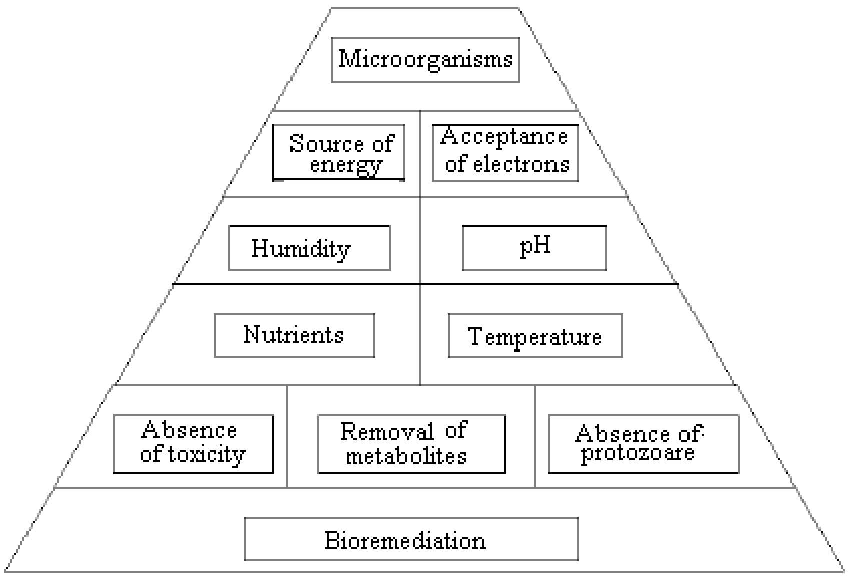

Fig. 1 - Bioremediation Conditions (Gavrilescu et al.. 2009)

Figure 1 shows the basic conditions for bioremediation. Microorganisms are required to synthesize enzymes that can degrade target pollutants. The second level of the pyramid shows that appropriate sources of energy and electron acceptability must be present. The third level shows the need for sufficient humidity and acceptable pH., the fourth level reminds of the importance of avoiding extreme temperatures and ensuring the availability of inorganic nutrients such as nitrogen. phosphorus and metal traces. At the first level of the pyramid, environmental requirements are indicated for bioremediation to be sustainable: lack of high concentrations of substances that are toxic to micro-organisms. Metabolites can inhibit specific microbial activities and the absence of large concentrations of protozoa that act as predators on bacteria cause degradation of contaminants (*Urs et al.. 2010*).

MATERIAL AND METHOD

Removal of environmental pollutants by microorganisms is called bioremediation.

Biodegradation of petroleum hydrocarbons is a slow natural process. Biodegradation decontamination technologies (bioremediation) can help the biodegradation process to be accelerated (*Purohit. 2006*).

The biodegradation of existing hydrocarbons in different environments as well as in the soil is based on the use of indigenous microorganisms in nature and adapted to the pollutant and on the introduction of allotones (*Urs et al.. 2010*). In the process of depollution, microorganisms that are appropriate to the intended purpose must be selected.

The bacteria of interest are selected from the polluted environments and are subjected to a laboratory screening, which allows the selection of those strains that degrade residual hydrocarbons.

Microorganisms using oil hydrocarbons as the sole source of carbon and energy were named by Ahearn in 1973 as hydrocarbon-oxidant or "hydrocarbon" microorganisms.

Microbial preparations marketed worldwide for the bioremediation of polluted environments are based on microbial consortia with predominantly Bacillus. Seudomonas and Xanthomonas genomes (*Mohammed et al.. 2007*).

Enhanced indigenous microbial cultures have generally biodegraded more petroleum hydrocarbons than commercial bioproducts in the first five days of the bioremediation process, the latter having a higher rate of biodegradation 18 days after inoculation (Mohammed et al.. 2007).

Biogementation of oil-soaked soil is efficient, being used to improve the biodegradation process, a swelling agent (*Cocut et al.. 2008*).

In nature and in the laboratory, microorganisms can live and multiply if optimal temperature, aeration, pH. nutrients are met.

The result of petroleum hydrocarbon pollution causes disturbances to biotic and abiotic components within ecosystems (*Okoh. 2007*).

The sources of oil contamination are: storage tanks, transport pipelines, transport tanks and refineries (*Płaza. 2008; Răuţă et al.. 1983*).

RESULTS

We used the Kalanchoe plant to determine the influence of oil toxicity on plants. Following the experiment, it was observed that the plant was no longer developed at a high oil concentration of 8%.

The influence of oil on plants was determined by phenological observations at plant level. After 10 days, during the experiment, a high sensitivity of plants was noted. They had a weaker development.

Figure 2a shows Kalanchoe planted in unpolluted soil; b. planted in oil polluted soil with a 4% concentration; c Kalanchoe planted in polluted soil with an 8% oil concentration.

a b c

Fig. 2 - Effect of Oil Polluted Soil on Plant Growth

Ten days after the soil was polluted, it can be noticed that the leaves and the flowers have dried.

Microrganisms capable of degrading organic pollutants in areas contaminated are chemo-organotrophic bacteria, which have the ability to use one huge numbers of naturally occurring synthesis sources as carbon sources and as donors electrons (Table 1). Although many bacteria can metabolize organic pollutants, only one species do not possess the enzymatic ability to degrade all or most of the soil polluting. Bacteria carry out biodegradation of pollutants both through growth mechanism and co-metabolism. Mixed microbial communities have the most potent biodegradability potential because of degradation complex pollutant mixtures require more than one genetic information bodies.

Table 1

Bacteria existing in soils polluted with aromatic and aliphatic hydrocarbons, polycyclic aromatic hydrocarbons and halogen derivatives

Gram-negative bacteria	Gram positive bacteria
Pseudomonas	Nocardia
Acinetobacter	Mycobacterium
Alcaligenes	Corynebacterium
Flavobacterium / Cytophaga	Arthrobacter
Xanthomonas	Bacillus

In the case of aromatic compounds, whether they are hydrocarbons (benzene, toluene, ethylbenzene, xylenes, naphthalene). Phenols, chlorophenols, aminoacids, quinones and hydroquinones, these may be transformed enzymatically into natural biodegradation intermediates: 1.2-dihydroxybenzene (pyrrocatechin) or 3.4-dihydroxybenzoic acid (protocatechic acid). These are then decomposed in several steps or up to acetyl-CoA succinate or up to pyruvate acetaldehyde.

Another category of organisms capable of degrading organic pollutants are fungi existing in the various environments (freshwaters, marine waters, soil, debris) plants and animals, living organisms. etc.). Molds and yeasts can be considered as straight microfungii (*Gavrila. 2015*).

The microorganisms used for the removal of soils of heavy metals are:

Acidophilic autotrophic microorganisms. This category includes the genus Acidithiobacillus containing four species: A. albertensis. A. ferroxidans. A. thiooxidans and A. caldus.

The first one was first isolated from an acidic soil in Alberta, Canada in 1983, then a new species was validated in 1988. A. ferrooxidans and A. thiooxidans are classical biolixive bacteria which also have been used to treat sludge from sewage treatment plants and coal desulphurisation (*Răuţă et al.. 1983*).

The bacteria most commonly used in biosoliding are A. ferrooxidans and A. thioxoxidans. Since bacterial leaching occurs in an acidic environment (pH 1.5-3) where most ions remain in solution, the acidophilic A. ferrooxidans and A. thioxoxidans are of particular importance (*Stanescu. 2006*) as they can withstand the harsh conditions that exist in concentrated heavy metal solutions (*Płaza et al.. 2008*).

Another type of acidophilic microorganisms are those belonging to the genus Leptospirillum. They are very important in the biolichiviere process and are part of a new bacterial division Nitrospora (*Doboş et al.. 2010*).

Leptospirillum ferrooxidans has a higher affinity for ferrous ions than A. ferrooxidans (*Răuţă et al.. 1983*).

Thermophilic autotrophic microorganisms. This category of microorganisms includes Sulphobacillus bacteria, which are used for the biosolubilization of metals from metal sulfides (*Purohit. 2006*).

Thermophilic microorganisms capable of oxidizing sulfur and iron (II) are: Sulfolobus. Acidianus.

Metallosphaera and Sulfurisphaera (*Doboş et al.. 2010*).

The heterotrophic microorganisms. Some species of heterotrophic microorganisms, such as Aspergillus and Penicillium have shown a potential for biolichivazi metal (*Potra et al.. 2012*). Solubilization of the metal by heterotrophic microorganisms involves a indirect process with the microbial production of amino acids, organic acids, as well as other metabolites. These metabolites dissolve the metals from minerals by displacement of metal ions from the ore or the soil matrix by hydrogen ions, or by the formation of soluble and chelated metal complexes (*Zarnea. 1994*).

For the biodegradation of oil hydrocarbons, the natural species existing in the soil, such as Arthrobacter, Achromobacter, Novocardia, Pseudomonas, Flavobacterium, etc.. are used.

Bioremediation is very effective for contaminated soils with hydrocarbons.

Remediation of soils polluted with hydrocarbons through biological processes is called biomedication (Puia. 1998). Bioremediation is achieved through indigenous microorganisms or introduced and specifically created to reduce the concentration and / or toxicity of various chemicals, such as aliphatic and aromatic petroleum-based hydrocarbons, industrial solvents. pesticides and metals (*Stanescu et al.. 2006*).

Bioremediation has the following advantages:

1. Bioremediation is a natural treatment process for contaminated materials. Microorganisms have the ability to degrade a large number of contaminants (*Vidali. 2001*).

2. Bioremediation can be done on the spot without interrupting activity (*Doboş et al.. 2010*).

3. Operational costs are lower compared to conventional methods (washing, incineration, thermal desorption).

4. It is possible to use inoculation and / or hydrogen peroxide to increase the efficiency of the process.

Bioremediation has the disadvantages:

1. Bioremediation is limited, applying only to biodegradable compounds.

2. Biodegradation products may be more toxic than the parent compound.

3. It is difficult to extrapolate from large scale (field) laboratory conditions (*Doboş et al.. 2010*).

4. They do not work well in compact soils, where oxygen or nutrients are difficult to enter the treated area [11].

5. The bioremediation process takes place over a longer period than other remedial treatments such as digging, soil incineration.

Ideal microorganisms in the biodegradation processes of crude oil should:

- rapidly and intensely degrade a range of oil compounds;
- reproduce quickly;
- multiply in natural environments;
- be genetically stable and can be preserved and recultivated without undergoing major changes;
- not to produce toxic effects and not to be pathogenic

They can be used in combination with other active microorganisms to ensure the degradation of different types of hydrocarbons (*Zarnea. 1994*).

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Hydrocarbon-contaminated soil bioremediation technologies include a number of processes that use microorganisms to treat soils and groundwater for the degradation or decomposition of petroleum hydrocarbons (Table 2). Bioremediation has been used to control oil contamination (*Potra et al.. 2012*).

Table 2

Bioremediation technologies for soils contaminated with hydrocarbons (*Potra et al.. 2012*)

	Technologies	***Facility***	***Inconvenience***
In situ	Biodegradation Bioventingul Biospargingul Phytoremediation Shrinking natural controlled	- offers the possibility of simultaneous depollution of both a soil and water underground; - the equipment is easy to place; - can be applied to several types of pollutants; can be used in association with other technologies remediation; - can be used for long-contaminated sites Time and freshly contaminated	- The equipment implies a specialized delicate exploitation - during exploitation it is difficult to appreciate the volume treated, its configuration and the efficiency of the depollution process; - Removal efficiency may vary from site to site - Long treatment time (6 months to 3 years)

Ex situ	Bioreactor Biopile Composting Land farming	-Rapid and relatively complete removal of polluted components; - the possibility of continuing on-site activities; - high efficiency of depolarization. by treatment in specialized plants	-high transportation costs; - the necessity of excavating and preparing the soil; - the risk of partial spillage of pollutants during the evacuation, loading, transport and discharge operations; - the imposition of concentration limits in pollutants before treatment.

The bioremediation process can be executed on or off the site. The in situ process is used in cases where excavation is an impractical solution and involves methods such as biostimulation, bioventilation, biosparing or natural mitigation.

Biostimulation involves the aeration and application of carefully selected micronutrients and biostimulants. It is effective when indigenous microbial populations present in the substrate are in an amount sufficiently large for the degradation of contaminants and if these microorganisms can readily adapt to foreign contaminants.

Biosparing is a rehabilitation technique where air is injected into the saturated area to stimulate local microorganisms. The injected air vaporizes the pollutants retained in the capillaries of the soil, mobilizing them to the surface. On their upward path, pollutants are degraded via aeration stimulated biomass and nutrient intake.

Bio-ventilation (bioventing) consists in stimulating in situ biodegradation of soil pollutants by providing the microflora present in the soil with the oxygen required for bacterial metabolism (*Potra et al.. 2012*).

Natural Attenuation or Intrinsic Remediation is a simpler method of bioremediation. which means demonstrating that indigenous populations exist and can have degenerative action of pollutants and monitor the achievement of the degradation process.

For ex-situ bioremediation, there are various technologies already in use that can be used both for the depollution of the unsaturated zone and the saturated area: biopile method, land farming method, composting or soil treatment in the bioreactor.

The biopsy method consists in the biological treatment of excavated soils placed in the pile on the site or outside the site with control parameters such as: oxygen concentration, soil moisture, mineral nutrient content and microorganisms.

The land farming method consists of depositing soils polluted with organic products on a prepared surface. The deposition is made in a layer of a small thickness (a few tens of centimeters) in well-insulated areas to protect the basement from any risk of infiltration (eg by installing a high density polyethylene film that can support the cultivation /).

Treatment in the bioreactor involves the introduction of conditioned sludge contaminated soil into a reactor fitted with agitation and aeration systems. Excavated soils first require adequate mechanical preparation: homogenization, grinding and volumetric classification.

Composting is the process by which organic residual materials are degraded into humus as the final product. Composting involves the interaction of a variety of microorganisms including bacteria, protozoa, actinomycetes and fungi. Composting consists of mixing the excavated soil with organic matter (compost) and placing in trapezoidal heaps (furrows) regularly spaced to favor biodegradation (*Potra et al.. 2012*).

CONCLUSIONS

The effectiveness of biological decontamination methods depends on the following parameters: knowledge of existing pollutants and their biodegradability; Choice of oxidant and nutrients; The characteristics of the environment subject to depollution; Type of microorganisms used.

Aspergillus niger heterotrophic bacteria demonstrate a very high solubilization yield because they produce organic acids (malic, oxalic, gluconic and citric) which are of the greatest importance in a biolixive process.

These acids are well-known lixiviants for the percolation of heavy metals from ore and solid waste. They can reduce the commercial costs of decontamination of soils polluted with heavy metals and have the effect of reducing any environmental impact resulting from metal contamination.

Soil pollution and quality degradation due to chemical compounds is one of the most serious forms of pollution because unlike water and air where pollutants are able to disperse and dilute slightly, they accumulate into the soil.

ACKNOWLEDGEMENT

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EXPERIMENTAL RESEARCHES ON ASSESSING THE QUALITY OF VARIOUS TYPES OF CAMELINA OIL OBTAINED FOR ENERGETIC PURPOSES
/
CERCETĂRI EXPERIMENTALE ASUPRA EVALUĂRII CALITĂȚII MAI MULTOR TIPURI DE ULEI DE CAMELINĂ OBȚINUTE ÎN SCOPURI ENERGETICE

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Keywords: *camelina sativa, oil, renewable energy, liquid biofuels.*

ABSTRACT

Due to the rapid depletion of fossil fuels and the problems caused by global warming, society is now facing the challenge of finding new and efficient forms of renewable energy. One of the most important form of renewable and clean energy is represented by liquid biofuels. The paper presents a series of experimental researches for assessing some quality parameters of four samples of crude camelina oil from four different varieties (Mădălina conventional, Mădălina organic, Camelia conventional and GP 202) obtained in energetic purposes.

REZUMAT

Din cauza epuizării rapide a combustibililor fosili și din cauza problemelor cauzate de încălzirea globală. societatea de azi se confruntă cu rpovocarea găsirii de forme noi și eficiente de energie regenerabilă. Una din cele mai importante forme de energie regenerabilă și curate este reprezentată de biocombustibili lichizi. Lucrarea prezintă o serie de cercetări experimentale pentru evaluarea unor parametri de calitate pentru 4 mostre de ulei crud de camelină din patru soiuri diferite (Mădălina clasic. Mădălina ecologic. Camelia clasic și GP202) obținute în scopuri energetice.

INTRODUCTION

Camelina (fig. 1) known as false flax or gold-of-pleasure is a spring-planted crop species. Although camelina has been cultivated in Europe since the Bronze Age, even at this time it still is an underexploited oilseed crop. Recent interest in the species has increased mainly due to the demand for alternative low-input oilseed crops with the potential for a non-food utilization of the seed oil. (*http://www.susoils.com/camelina; Fröhlich A.. Rice B.. 2005*)

Camelina oil has a unique fatty acid pattern and is characterized by a linolenic acid content of 30% to 40% and an eicosenic acid content of around 15% with less than 4% erucic acid, which suggests a utilization of the seed oil as a drying oil with environmentally safe painting and coating applications similarly to linseed oil. Seed oil content averages at 37% by weight. (*http://www.agmrc.org/commodities__products/grains__oilseeds/camelina/)*

Fig. 1 – Camelina sativa plant (left) [15] and seeds (right)

Moreover, camelina. unlike soybeans, thrives in cool, arid climates and is nicely adapted to the more northerly regions of North America, Europe and Asia. Therefore, it may serve as a rotational crop with winter wheat and the use of C. sativa in such a rotation system would disrupt undesirable weed and pest cycles. (*Ciubota-Rosie C. et al.. 2013; Schillinger W.F. et al. 2012*; *Soriano N.. Narani A.. 2012*)

If every drop of moisture in the soil is precious, camelina is the plant to be taken into consideration. It can produce seeds with less moisture so you're assured of something to harvest. Furthermore, by maturing earlier than most other crop options, it's not as dependent on rain later in the summer when weather can be fickler. And since camelina can be harvested early, it allows ground to absorb later-season rainfall so it can enter the new year in a better position. (*http://www.biozio.com/sou/cam/cam.html*)

Camelina typically contains 35-38% oil which is high in omega-3 fatty acid. This makes the oil fit for biofuels production and the meal (which comes out of the process in the form of pellets or cakes) a good option for livestock feed. Researches have also been conducted to transform the oil into biofuel for planes and other high-value chemicals. (*Guya S. et al.. 2014; Russo R.. Reggiani R.. 2012*)

Camelina meal is likely to become increasingly available for use in livestock feeds due to a projected increase in camelina production. Because the meal has a high protein (>300 g/kg) and remaining oil (>100 g/kg) content, it has potential as a dietary source of protein and energy for livestock. (*Kahindia R.K. et al.. 2013*)

The paper shows a series of experimental researches conducted on samples of camelina oil in order to assess some of the most important quality parameters in the purpose of using the oil for as biofuel.

MATERIAL AND METHOD

Camelina oil was obtained through the process of cold extrusion. The four varieties of seeds were first conditioned and dried and then they were introduced in a special oil press. The products that resulted from the extrusion process were camelina oil and pellets (fig. 2).

Fig. 2 – Camelina oil (left) and camelina pellets (right)

After the oil was obtained, the following quality attributes were verified:

- Dynamic viscosity (fig. 3a) – using a VIBRO VISCOMETER SV-10 AND, according to the method described in ASTM D445 - 17a - Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity) [1];
- Kinematic viscosity – calculating the ration between dynamic viscosity and density;
- Density at 25 ºC (fig. 3b) according to the method described in SR EN ISO 3675:2005 - Crude petroleum and liquid petroleum products -- Laboratory determination of density -- Hydrometer method [11];
- Inferior calorific power and unburned substance (fig. 3c) – using a bomb calorimeter CAL 2K. according to the method described in SR EN ISO 14918:2010 - Solid biofuels. Determination of calorific power [10];
- Flash point (fig. 3d) – using a Pensky-Martens flash point analyser according to the method described in SR EN iSO 2719:2016 – Determination of flash-point. Pensky-Martens closed cup method) [9].

a b c d

Fig. 3 – Aspects during the experiments conducted on camelina oil

Although the study was focused on the energetic characteristics of camelina oil, the energy units of pellets (camelina meal) were also determined in order to assess their suitability for animal consumption.

RESULTS

The results obtained after conducting the test on camelina oil are shown in table 1.

Table 1

Results obtained after conducting the experiments on crude camelina oils

Characteristic determined	SAMPLE				M U
	MĂDĂLINA organic	***MĂDĂLINA conventional***	***CAMELIA conventional***	***GP 202***	
Density at 25 ºC	0.9170	0.9170	0.9165	0.9165	[g/cm^3]
Dynamic viscosity at 25 ºC	45.7	47.2	45.9	49.1	[mPa/s]
Kinematic viscosity at 25 ºC	49.84	51.47	50.08	53.57	[mm^2/s]
Refraction index at 25 ºC	1.4762	1.4755	1.4766	1.4752	(n)
Flash point	221.0	210.0	224.0	206.0	[°C]
Calorific power	39.350	39.718	39.675	39.579	[MJ/l]
Unburned substance	0.131	0.219	0.536	0.414	[%]

A comprehensive view of the results is shown in figures 4 and 5.

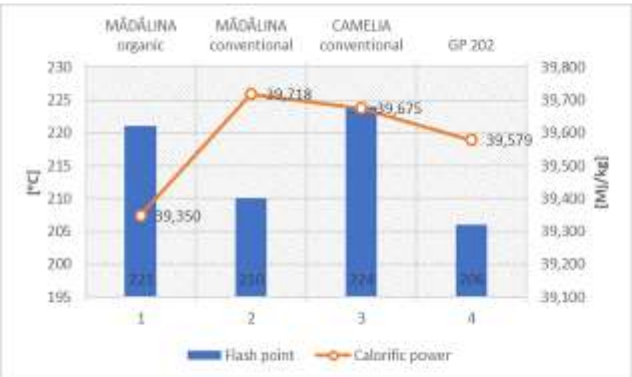

Fig. 4 – Relation between flash point and calorific power

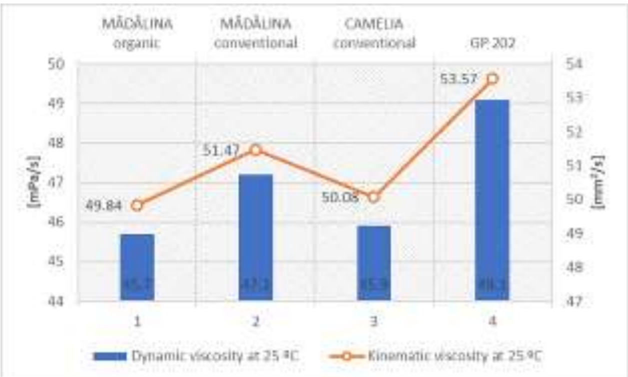

Fig. 5 – Relation between dynamic viscosity and kinematic viscosity

The values registered from determining the energy units of camelina pellets were the following ones: 4722.94 kcal/kg for Mădălina organic, 4659.25 kcal/kg for Mădălina conventional, 4676.84 kcal/kg for Camelia conventional and 4681.42 kcal/kg for GP 202, making them suitable for animal consumption, guarantying a good energy input along with the necessary nutrients contained by camelina seeds.

CONCLUSIONS

The results obtained showed the following:

- The density of the four types of oil was similar, being a little higher for the two types of Mădălina varieties;
- Both dynamic and kinematic viscosity were highest in the case of GP202 variety and lowest for Mădălina organic;
- The flash point of samples does not have an influence on the inferior calorific power;
- The inferior calorific power (the most important parameter of fuels) has very good values ranging from 39.350 to 39.718 MJ/l. these being comparable to those of other crude oils, natural gas, diesel fuel and higher than the normal values of methanol, wood, coal or other solid fuels (values from *World Nuclear Association*).

The results from the experiments show that these types of crude camelina oils are suitable to be used as liquid biofuels in the purpose of obtaining green renewable energy, thus ensuring a sustainable development and environment protection.

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[12] http://www.biozio.com/sou/cam/cam.html;
[13] http://www.agmrc.org/commodities__products/grains__oilseeds/camelina/;
[14] http://www.susoils.com/camelina;
[15] https://es.wikipedia.org/wiki/Camelina_sativa;
[16] http://www.world-nuclear.org/information-library/facts-and-figures/heat-values-of-various-fuels.aspx

KINEMATIC ANALYSIS OF THE MOTOR HEXADE *(RRR-Ta-RRR-TRR)* / *ANALIZA CINEMATICA A HEXADEI MOTOARE (RRR-Ta-RRR-TRR)*

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Keywords: *motor groups, kinematic analysis, kinematic parameters.*

ABSTRACT

The motor groups underpin the actuation of the mechanisms which compose the machines and equipment. For kinematic analysis of motor groups, several methods are used such as contours method, bar method, matrix method etc.

In this paper, the kinematic analysis of the motor hexade by using the contours method (Chr. Pelecudi) is presented. To ease the numerical calculations of the kinematic parameters of the motor hexade, a procedure was established using the MATLAB. This procedure was used in a program in order to determine the kinematic parameters of a gripper of an industrial robot.

REZUMAT

Grupele motoare stau la baza acționării mecanismelor din componența maşinilor şi utilajelor. Pentru analiza cinematică a grupelor motoare se folosesc mai multe metode. cum ar fi: metoda contururilor. metoda barelor. metoda matriceală etc.

În lucrare se face analiza cinematică a hexadei motoare. folosind metoda contururilor (Chr. Pelecudi). Pentru a uşura procesul de calcul al parametrilor cinematici ai hexadei motoare. s-a întocmit o procedură de calcul în sintaxa MATLAB. Această procedură a fost utilizată într-un program principal de calcul. pentru determinarea parametrilor cinematici ai unui mecanism de prehensiune din componen'a robo'ilor industriali.

INTRODUCTION

The kinematic analysis of the mechanisms can be fulfilled by considering modular groups [4. 5. 6. 7. 8. 9. 11. 12. 13. 14. 15] or by taking into account the linkage as a whole [16. 17. 18]. If the modular groups are utilize for the analysis of mechanisms, the number of equations is small leading to a reduced calculation time. The kinematic analysis of mechanisms using the matrix method is successfully addressed in papers [15. 16].

In this paper the kinematic analysis of the hexade motor group *RRR-Ta-RRR_RRT*. is fulfilled by a special procedure using the MATLAB.

MATERIAL AND METHOD

Kinematic analysis of the motor hexade

1. Input and output data

Figure 1 shows the kinematic scheme of the hexade motor group *RRR-Ta-RRR_RRT*.

To determine the kinematic parameters of the motor hexade, the following data are known:

- XA, YA, XH, YH, XP, YP - the coordinates of points *A*. *H* and *P*;
- $\dot{XA}, \dot{YA}, \dot{XH}, \dot{YH}, \dot{XP}, \dot{YP}$ - the projections of linear velocities of points *A*, *H* and *P*;
- $\ddot{XA}, \ddot{YA}, \ddot{XH}, \ddot{YH}, \ddot{XP}, \ddot{YP}$ - the projections of linear accelerations of points *A*, *H* and *P*;
- S_6 - the independent parameter of the active joint *I* ;
- $\dot{S}_6$ -the linear relative velocity between the links **6** and **7** (the relative velocity of the active joint *I*);
- $\ddot{S}_6$ - the linear relative acceleration between the links **6** and **7** (the relative velocity of the active joint I);
- θ - the angle between the *OX* axis unit vector and the unit vector attached to the direction of linear motion corresponding to the prismatic joint *J*;
- $\dot{\theta}$ - the angular velocity of the link ***j*** ;

- $\ddot{\theta}$ - the angular acceleration of the link ***j***;
- $d_1 = CC'$ – distance from point *C* to the direction of linear motion corresponding to the prismatic joint *J*;
- $d_2 = DD'$ – distance from point D to the direction of linear motion corresponding to the prismatic joint *J*;
- AB. BC. CD. DE. EH. HF. EF. AG. BG - the kinematic dimensions of the motor hexade links;
- φ_1. φ_2. φ_4. φ_5. φ_6 - the approximate angles between the axis *OX* and the vectors $\overline{AB}$. $\overline{BC}$. $\overline{DE}$. $\overline{HF}$. $\overline{GF}$;
- S_3 - the approximate distance PC'. measured positively in the sense of angle θ;

Observation: By knowing the linear dimensions of the links, it results the angles α_1. α_2 and α_3.

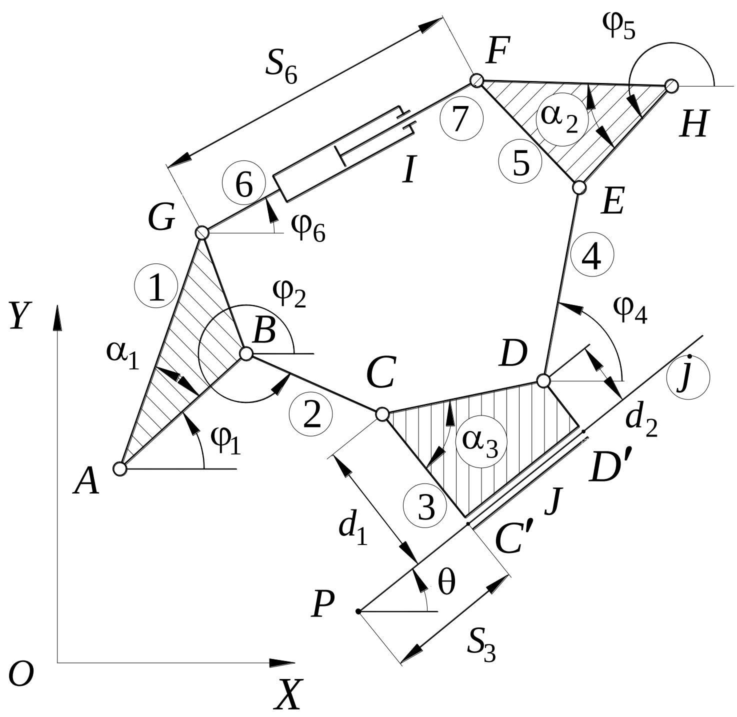

Fig. 1 - Kinematic scheme of the motor hexade

The parameters to be determined are:

- φ_1. φ_2. φ_4. φ_5. φ_6 - the precise angles between the axis OX and the vectors $\overline{AB}$. $\overline{BC}$. $\overline{DE}$. $\overline{HF}$. $\overline{GF}$;
- S_3 - the variable parameter in the prismatic joint *J*;
- $\dot{\varphi}_1$. $\dot{\varphi}_2$. $\dot{\varphi}_4$. $\dot{\varphi}_5$. $\dot{\varphi}_6$ - the angular velocities of the links **1**, **2**, **4**, **5** and **6**;
- $\dot{S}_3$ - the relative velocity in the prismatic joint *J* ;
- $\ddot{\varphi}_1$. $\ddot{\varphi}_2$. $\ddot{\varphi}_4$. $\ddot{\varphi}_5$. $\ddot{\varphi}_6$ - the angular accelerations of the links **1**, **2**, **4**, **5** and **6**;
- $\ddot{S}_3$ - the relative acceleration in the prismatic joint *J*;
- XB, YB. XC, YC. XD, YD. XE, YE. XF, YF. XG, YG.- the center coordinates of the joints *B*. *C*. *D*. *E*. *F* and *G*;
- $\dot{X}B, \dot{Y}B$. $\dot{X}C, \dot{Y}C$. $\dot{X}D, \dot{Y}D$. $\dot{X}E, \dot{Y}E$. $\dot{X}F, \dot{Y}F$. $\dot{X}G, \dot{Y}G$. - the projections of the linear velocities of the joints centers noted *B*. *C*. *D*. *E*. *F* and *G*;
- $\ddot{X}B, \ddot{Y}B$. $\ddot{X}C, \ddot{Y}C$. $\ddot{X}D, \ddot{Y}D$. $\ddot{X}E, \ddot{Y}E$. $\ddot{X}F, \ddot{Y}F$. $\ddot{X}G, \ddot{Y}G$. - the projections of the linear accelerations of the joints centers denoted *B*. *C*. *D*. *E*. *F* and *G*.

2. The analysis of the positions in the case of the motor hexade

The system of the positions equations is obtained by projecting the following vector equations

$$\overline{OA}+\overline{AB}+\overline{BC}+\overline{CD}+\overline{DE}=\overline{OH}+\overline{HE};$$
$$\overline{OA}+\overline{AG}+\overline{GF}=\overline{OH}+\overline{HF};$$
$$\overline{OA}+\overline{AB}+\overline{BC}+\overline{CC'}=\overline{OP}+\overline{PC'}.$$

on the axis of the coordinates system, namely:

$$\begin{aligned}
&AB\cdot\cos\varphi_1+BC\cdot\cos\varphi_2+CD\cdot\sin(\theta+\alpha_3)+DE\cdot\cos\varphi_4-HE\cdot\cos\varphi_5+XA-XH=0;\\
&AB\cdot\sin\varphi_1+BC\cdot\sin\varphi_2-CD\cdot\cos(\theta+\alpha_3)+DE\cdot\sin\varphi_4-HE\cdot\sin\varphi_5+YA-YH=0;\\
&AG\cdot\cos(\varphi_1+\alpha_1)+S_6\cdot\cos\varphi_6-HF\cdot\cos(\varphi_5-\alpha_2)+XA-XH=0;\\
&AG\cdot\sin(\varphi_1+\alpha_1)+S_6\cdot\sin\varphi_6-HF\cdot\sin(\varphi_5-\alpha_2)+YA-YH=0;\\
&AB\cdot\cos\varphi_1+BC\cdot\cos\varphi_2-S_3\cdot\cos\theta+d_1\cdot\sin\theta+XA-XP=0;\\
&AB\cdot\sin\varphi_1+BC\cdot\sin\varphi_2-S_3\cdot\sin\theta-d_1\cdot\cos\theta+YA-YP=0,
\end{aligned}\qquad (1)$$

The non-linear system equations with the unknowns φ_1. φ_2. φ_4. φ_5. φ_6 and S_3. is resolved by using the iterative Newton-Raphson numerical method, starting from a given initial solution [2. 3. 10].

The system solution at the (k+1) iteration is having the form:

$$\|\varphi\|^{(k+1)}=\|\varphi\|^{(k)}-W(\varphi^{(k)})\cdot f(\varphi^{(k)})\,. \qquad (2)$$

where:

$\varphi=(\varphi_1\ \ \varphi_2\ \ \varphi_4\ \ \varphi_5\ \ \varphi_6\ \ S_3)^T$ is the unknown vector;

$f(\varphi^{(k)})=(f_1(\varphi^{(k)})\ \ f_2(\varphi^{(k)})\ \ f_3(\varphi^{(k)})\ \ f_4(\varphi^{(k)})\ \ f_5(\varphi^{(k)})\ \ f_6(\varphi^{(k)}))^T$ is the vector of the non-linear position functions of the system are stocked.

$$\begin{aligned}
&f_1(\varphi_1,\varphi_2,\varphi_4,\varphi_5,\varphi_6,S_3)=AB\cdot\cos\varphi_1+BC\cdot\cos\varphi_2+CD\cdot\sin(\theta+\alpha_3)+DE\cdot\cos\varphi_4-HE\cdot\cos\varphi_5+\\
&\qquad +XA-XH=0;\\
&f_2(\varphi_1,\varphi_2,\varphi_4,\varphi_5,\varphi_6,S_3)=AB\cdot\sin\varphi_1+BC\cdot\sin\varphi_2-CD\cdot\cos(\theta+\alpha_3)+DE\cdot\sin\varphi_4-HE\cdot\sin\varphi_5+\\
&\qquad +YA-YH=0;\\
&f_3(\varphi_1,\varphi_2,\varphi_4,\varphi_5,\varphi_6,S_3)=AG\cdot\cos(\varphi_1+\alpha_1)+S_6\cdot\cos\varphi_6-HF\cdot\cos(\varphi_5-\alpha_2)+XA-XH=0;\\
&f_4(\varphi_1,\varphi_2,\varphi_4,\varphi_5,\varphi_6,S_3)=AG\cdot\sin(\varphi_1+\alpha_1)+S_6\cdot\sin\varphi_6-HF\cdot\sin(\varphi_5-\alpha_2)+YA-YH=0;\\
&f_5(\varphi_1,\varphi_2,\varphi_4,\varphi_5,\varphi_6,S_3)=AB\cdot\cos\varphi_1+BC\cdot\cos\varphi_2-S_3\cdot\cos\theta+d_1\cdot\sin\theta+XA-XP=0;\\
&f_6(\varphi_1,\varphi_2,\varphi_4,\varphi_5,\varphi_6,S_3)=AB\cdot\sin\varphi_1+BC\cdot\sin\varphi_2-S_3\cdot\sin\theta-d_1\cdot\cos\theta+YA-YP=0,
\end{aligned}$$

and

$$W=\left\|\begin{matrix}
-AB\sin\varphi_1 & -BC\sin\varphi_2 & -DE\sin\varphi_4 & HE\sin\varphi_5 & 0 & 0\\
AB\cos\varphi_1 & BC\cos\varphi_2 & DE\cos\varphi_4 & -HE\cos\varphi_5 & 0 & 0\\
-AG\sin(\varphi_1+\alpha_1) & 0 & 0 & HF\sin(\varphi_5-\alpha_2) & -S_6\sin\varphi_6 & 0\\
AG\cos(\varphi_1+\alpha_1) & 0 & 0 & -HF\cos(\varphi_5-\alpha_2) & S_6\cos\varphi_6 & 0\\
-AB\sin\varphi_1 & -BC\sin\varphi_2 & 0 & 0 & 0 & -\cos\theta\\
AB\cos\varphi_1 & BC\cos\varphi_2 & 0 & 0 & 0 & -\sin\theta
\end{matrix}\right\|$$

is the jacobian matrix.

The iterative calculation algorithm stops when the difference of two solutions calculated consequently is smaller than a imposed value ε, meaning: $\left|\varphi^{(k+1)} - \varphi^{(k)}\right| \le \varepsilon$.

After the determination of the unknowns φ_1. φ_2. φ_4. φ_5. φ_6 and S_3. are calculated the exact coordinates of the points *B*. *C*. *D*. *E*. *F* and *G*.

3. Velocities analysis of motor hexade

It is accomplished the derivative of the system of position equations (1) with respect to the time and it is obtained:

$$
\begin{aligned}
&-AB\cdot\dot{\varphi}_1\sin\varphi_1 - BC\cdot\dot{\varphi}_2\sin\varphi_2 - DE\cdot\dot{\varphi}_4\sin\varphi_4 + HE\cdot\dot{\varphi}_5\sin\varphi_5 = \\
&\qquad = \dot{X}H - \dot{X}A - CD\cdot\dot{\theta}\cos(\theta+\alpha_3);\\
&AB\cdot\dot{\varphi}_1\cos\varphi_1 + BC\cdot\dot{\varphi}_2\cos\varphi_2 + DE\cdot\dot{\varphi}_4\cos\varphi_4 - HE\cdot\dot{\varphi}_5\cos\varphi_5 = \\
&\qquad = \dot{Y}H - \dot{Y}A - CD\cdot\dot{\theta}\sin(\theta+\alpha_3);\\
&-AG\cdot\dot{\varphi}_1\sin(\varphi_1+\alpha_1) + HF\cdot\dot{\varphi}_5\sin(\varphi_5-\alpha_2) - S_6\cdot\dot{\varphi}_6\sin\varphi_6 = \dot{X}H - \dot{X}A - \dot{S}_6\cos\varphi_6;\\
&AG\cdot\dot{\varphi}_1\cos(\varphi_1+\alpha_1) - HF\cdot\dot{\varphi}_5\cos(\varphi_5-\alpha_2) + S_6\cdot\dot{\varphi}_6\cos\varphi_6 = \dot{Y}H - \dot{Y}A - \dot{S}_6\sin\varphi_6;\\
&-AB\cdot\dot{\varphi}_1\sin\varphi_1 - BC\cdot\dot{\varphi}_2\sin\varphi_2 - \dot{S}_3\cdot\cos\theta = \dot{X}P - \dot{X}A - (d_1\cos\theta + S_3\sin\theta)\dot{\theta};\\
&AB\cdot\dot{\varphi}_1\cos\varphi_1 + BC\cdot\dot{\varphi}_2\cos\varphi_2 - \dot{S}_3\cdot\sin\theta = \dot{Y}P - \dot{Y}A - (d_1\sin\theta - S_3\cos\theta)\dot{\theta};
\end{aligned}
\tag{3}
$$

The equations system (3) is linear with the following unknowns $\dot{\varphi}_1$. $\dot{\varphi}_2$. $\dot{\varphi}_4$. $\dot{\varphi}_5$. $\dot{\varphi}_6$ and $\dot{S}_3$. Using the inverse matrix method, it results:

$$\|\dot{\varphi}\| = W^{-1}\cdot A. \tag{4}$$

where:

$$\dot{\varphi} = (\dot{\varphi}_1\ \ \dot{\varphi}_2\ \ \dot{\varphi}_4\ \ \dot{\varphi}_5\ \ \dot{\varphi}_6\ \ \dot{S}_3)^T;\ A = (A_1\ \ A_2\ \ A_3\ \ A_4\ \ A_5\ \ A_6)^T;$$

$$A1 = \dot{X}H - \dot{X}A - CD\cdot\dot{\theta}\cos(\theta+\alpha_3);\ A2 = \dot{Y}H - \dot{Y}A - CD\cdot\dot{\theta}\sin(\theta+\alpha_3);$$

$$A_3 = \dot{X}H - \dot{X}A - \dot{S}_6\cos\varphi_6;\ A_4 = \dot{Y}H - \dot{Y}A - \dot{S}_6\sin\varphi_6;$$

$$A_5 = \dot{X}P - \dot{X}A - (d_1\cos\theta + S_3\sin\theta)\dot{\theta};\ \ A_6 = \dot{Y}P - \dot{Y}A - (d_1\sin\theta - S_3\cos\theta)\dot{\theta}.$$

4. Accelerations analysis of motor hexade

It is fulfilled the derivative of the system of velocities equations (1) with respect to the time and it is ensued:

$$W\cdot\ddot{\varphi} = B. \tag{5}$$

where:

$$\ddot{\varphi} = (\ddot{\varphi}_1\ \ \ddot{\varphi}_2\ \ \ddot{\varphi}_4\ \ \ddot{\varphi}_5\ \ \ddot{\varphi}_6\ \ \ddot{S}_3)^T;\ B = (B_1\ \ B_2\ \ B_3\ \ B_4\ \ B_5\ \ B_6)^T;$$

$$B_1 = \ddot{X}H - \ddot{X}A + AB\cos\varphi_1\cdot\dot{\varphi}_1^2 + BC\cos\varphi_2\cdot\dot{\varphi}_2^2 + DE\cos\varphi_4\cdot\dot{\varphi}_4^2 + CD\cdot\dot{\theta}^2\sin(\theta+\alpha_3);$$

$$B_2 = \ddot{Y}H - \ddot{Y}A + AB\sin\varphi_1\cdot\dot{\varphi}_1^2 + BC\sin\varphi_2\cdot\dot{\varphi}_2^2 + DE\sin\varphi_4\cdot\dot{\varphi}_4^2 - CD\cdot\dot{\theta}^2\cos(\theta+\alpha_3);$$

$$B_3 = \ddot{X}H - \ddot{X}A + AG\cos(\varphi_1 + \alpha_1)\cdot\dot{\varphi}_1^2 - HF\cos(\varphi_5 - \alpha_2)\cdot\dot{\varphi}_5^2 + 2\dot{S}_6\cdot\dot{\varphi}_6\cos\varphi_6 + \\ + S_6\cos\varphi_6\cdot\dot{\varphi}_6^2 - \ddot{S}_6\cos\varphi_6;$$

$$B_4 = \ddot{Y}H - \ddot{Y}A + AG\sin(\varphi_1 + \alpha_1)\cdot\dot{\varphi}_1^2 - HF\sin(\varphi_5 - \alpha_2)\cdot\dot{\varphi}_5^2 - 2\dot{S}_6\cdot\dot{\varphi}_6\cos\varphi_6 + \\ + S_6\sin\varphi_6\cdot\dot{\varphi}_6^2 - \ddot{S}_6\sin\varphi_6;$$

$$B_5 = \ddot{X}P - \ddot{X}A + AB\cos\varphi_1\cdot\dot{\varphi}_1^2 + BC\cos\varphi_2\cdot\dot{\varphi}_2^2 - 2\dot{S}_3\cdot\dot{\theta}\sin\theta + \\ + (d_1\sin\theta - S_3\cos\theta)\cdot\dot{\theta}^2 - (d_1\cos\theta + S_3\sin\theta)\cdot\ddot{\theta};$$

$$B_6 = \ddot{Y}P - \ddot{Y}A + AB\sin\varphi_1\cdot\dot{\varphi}_1^2 + BC\sin\varphi_2\cdot\dot{\varphi}_2^2 + 2\dot{S}_3\cdot\dot{\theta}\cos\theta - \\ - (d_1\cos\theta + S_3\sin\theta)\cdot\dot{\theta}^2 - (d_1\sin\theta - S_3\cos\theta)\cdot\ddot{\theta}.$$

If we multiply relation (5) with W^{-1}. it follows:

$$\ddot{\varphi} = W^{-1}\cdot B. \tag{6}$$

Based on the presented algorithm, a calculation function was performed using the MATLAB®. This function will be called in the main calculation program to determine the kinematic parameters of the hexadecimal motor.

The definition line of the function is:

function [fi1. fi2. fi4. fi5. fi6. S3. B. C. D. E. F. G] = hexmot(A.H.P.S6.th.…
ab.bc.cd.de.eh.hf.ag.d1.d2.fi1. fi2. fi4. fi5. fi6. S3)

Output parameters have the following meanings:

fi1. fi2. fi4. fi5 – the matrix that contains the angles between the unit vector of the axis *OX* and the unit vectors attached to the segments *AB*. *BC*. *DE* and *HF*. as well as the angular accelerations and speeds of the corresponding kinematic elements;

fi6 – matrix that contains the angle between the unit vector of the axis *OX* and the unit vector attached to the segment *GF*. as well as the angular acceleration and speed of elements **6** and **7**;

S3 – table that contains the distance between the *P* and *C*' points (positive in the direction of θ). relative speed of the joint *J*. and the relative acceleration of the same joint;

B. C. D. E. F. G – matrix that contains the kinematic parameters of the points *B*. *C*. *D*. *E*. *F* and *G*.

Input parameters have the following meanings:

A. H. P - matrices of the kinematic parameters of the input poles, namely:

A = [XA YA VAX VAY AAX AAY];
H = [XH YH VHX VHY AHX AHY];
P = [XP YP VPX VPY APX APY];

S6 – matrix that contains: independent parameter in the motor joint *I*. relative velocity between elements 6 and 7. relative acceleration between elements 6 and 7;

th = [θ $\dot{\theta}$ $\ddot{\theta}$] – matrix that contains: angle between the unit vector of axis *OX* and the unit vector attached to the linear movement direction, angular speed of element ***j***. angular acceleration of element ***j***;

ab.bc.cd.de.eh.hf.ag.d1.d2 – kinematic dimensions of the elements;

fi1. fi2. fi4. fi5. fi6 – approximate angles between the unit vector of axis *OX* and the unit vectors attached to segments *AB*. *BC*. *DE*. *HF* and *GF*. to provide the starting values in the iterative process of solving the system of nonlinear equations (1);

S3 = S3(1) – the approximate value of the distance between the points *P* and *C*'.

RESULTS

In Figure 2 are presented the kinematic scheme, the multipolar scheme and the structural relation of a gripper with motor hexade.

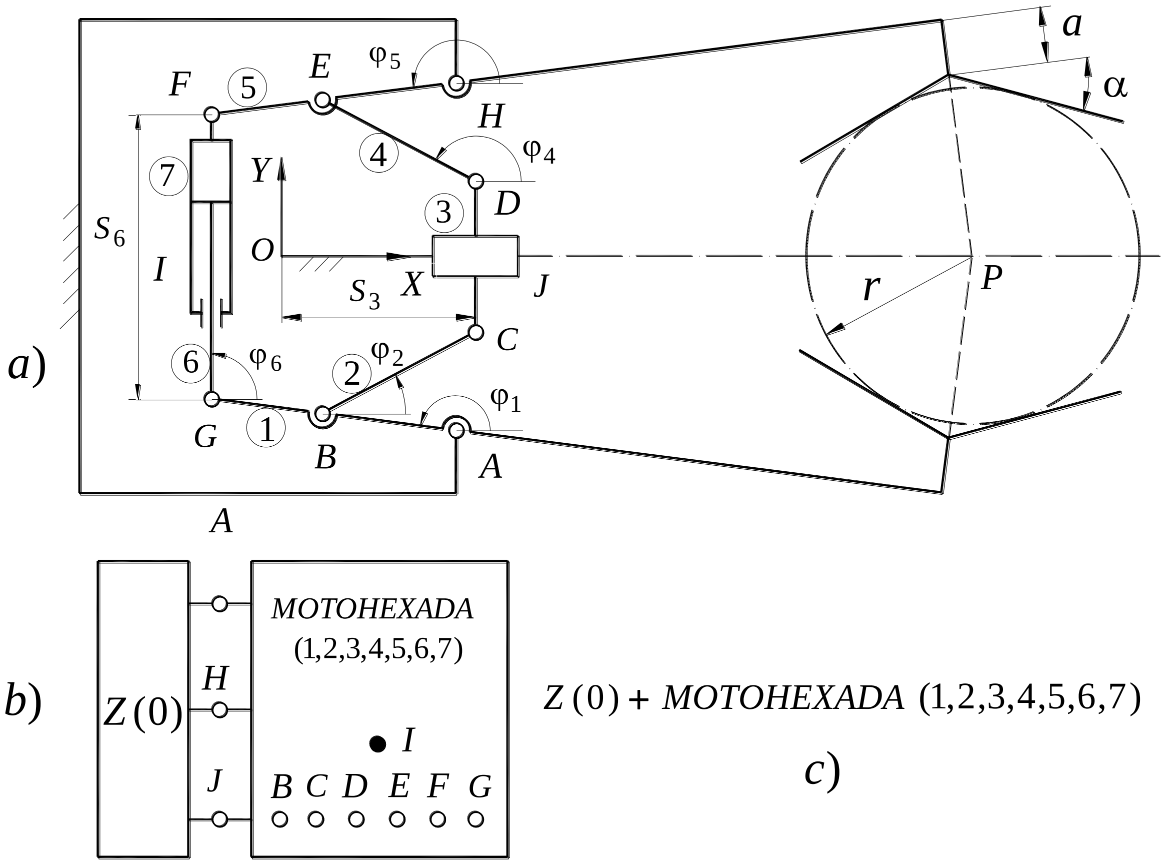

Fig.2 - Gripper with motor hexade

a) kinematic scheme, b) multipolar scheme, c) structural relation

Given data:

- $XA = 0.3$; $YA = 0.4$; $XH = 0.3$ [m]; $YH = 0.4$ [m]; $XP = 0$ [m]; $YP = 0$ [m] – the coordinates of the points *A*. *H* and *P*;
- $CPiston = 0.15$ [m] – the piston's stroke;
- $S_{60} = 0.75$ [m]- the initial distance between points *F* and *G*;
- S_6 - the independent parameter in the prismatic joint *B*;
- $\dot{S}_6 = -0.1$ [m/s] - the relative velocity between links 1 and 2;
- $\ddot{S}_6 = 0$ [m/s2] - the relative acceleration between links 1 and 2;
- $\theta = 0$ - the angle between the *OX* axis unit vector and the linear movement direction of the prismatic pair *J*;
- $\dot{\theta} = 0$ - the angular velocity of the linear movement direction of the prismatic pair *J*;
- $\ddot{\theta} = 0$ - the angular acceleration of the linear movement direction of the prismatic pair *J*;
- $AB = 0.3$ [m]; $BC = 0.4$ [m]; $DE = 0.53$ [m]; $HE = 0.3$ [m]; $HF = 0.5$ [m]; $EF = 0.2$ [m]; $AG = 0.5$ [m]; $BG = 0.2$ [m]; $CJ = 0.1$ [m]; $DJ = 0.1$ [m] – the kinematic dimensions of the mechanisms' links.

The kinematic parameters of the mechanism are required.

Using the authors' procedure for the motor hexade, the kinematic parameters of the gripper elements were calculated.

Tables 1, 2 and 3 show the position parameters, velocities and accelerations according to the independent parameter *S*6.

Table 1

poz	S6	fi1	fi2	fi4	fi5	fi6	s3
0	0.7500	3.0916	0.5677	2.5738	-3.0916	1.5708	0.4472
1	0.7200	3.0615	0.5477	2.5939	-3.0615	1.5708	0.4534
2	0.6900	3.0314	0.5280	2.6136	-3.0314	1.5708	0.4597
3	0.6600	3.0011	0.5084	2.6332	-3.0011	1.5708	0.4659
4	0.6300	2.9708	0.4891	2.6525	-2.9708	1.5708	0.4722
5	0.6000	2.9402	0.4699	2.6717	-2.9402	1.5708	0.4786

Table 2

poz	S6	om1	om2	om4	om5	om6	vs3
0	0.7500	-0.1001	-0.0671	0.0671	0.1001	-0.0000	0.0206
1	0.7200	-0.1003	-0.0663	0.0663	0.1003	-0.0000	0.0207
2	0.6900	-0.1006	-0.0655	0.0655	0.1006	-0.0000	0.0208
3	0.6600	-0.1010	-0.0648	0.0648	0.1010	-0.0000	0.0210
4	0.6300	-0.1015	-0.0641	0.0641	0.1015	-0.0000	0.0211
5	0.6000	-0.1021	-0.0635	0.0635	0.1021	-0.0000	0.0214

Table 3

poz	S6	eps1	eps2	eps4	eps5	eps6	as3
0	0.7500	0.0066	0.0076	0.0022	0.0076	-0.0005	-0.0013
1	0.7200	0.0061	0.0073	0.0024	0.0077	-0.0008	-0.0011
2	0.6900	0.0057	0.0069	0.0027	0.0079	-0.0011	-0.0010
3	0.6600	0.0053	0.0067	0.0029	0.0082	-0.0014	-0.0009
4	0.6300	0.0049	0.0064	0.0031	0.0084	-0.0018	-0.0007

CONCLUSIONS

Using the closed-loops method [Chr. Pelecudi] the kinematic analysis of the motor hexada has been accomplished. This motor modular group can be found in the composition of different mechanisms used in many areas of activity, such as: the actuation of some agricultural machinery, the actuation of some folding tables etc.

The computational procedure achieved using the MATLAB simplifies a lot the kinematic analysis of these mechanisms.

The results obtained in the presented example were verified in Turbo-Pascal. C++ and Matlab. In order to get a clearer picture of the considered mechanism, a simulation of its operation was made using the Matlab utility functions and the results were the same as those obtained from the numerical calculations.

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CALLING UPON THE SMART NETWORKS AND APPLYING THEM TO THE LEVEL OF THE ENERGY UNITS INTEGRATED INTO THE COMPETITIVE ENERGY MARKET
/
APELAREA LA REŢELELE SMART ŞI APLICAREA ACESTORA LA NIVELUL UNITĂŢILOR ENERGETICE INTEGRATE PIEŢEI CONCURENŢIALE DE ENERGIE

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Keywords: *Safe clean energy, SMART networks.*

ABSTRACT

The main issues developed in the communication include the following approaches: innovative approaching models of the energy efficiency at the level of the integrated production systems, the energy market based on the operational researches applied according to archemic-systemic concept and commenting the results of the new trends of increasing energy efficiency on the entire integrated structure of production-supplying both of the power and of the services archemicallycorresponding.

REZUMAT

Principalele probleme dezvoltate in comunicare se circumscriu urmatoarelor orientari inedite: modele de abordare inovativa a eficientei energetice la nivelul sistemelor integrate productiei, piata de energie cu recurs la cercetarile operationale aplicate in conceptie arhemo-sistemica si comentarea rezultatelor noilor directii de crestere a eficientei energiei pe intreaga structura integrata productie-furnizare atat a energiei cat si a serviciilor aferente sub aspect arhemic.

INTRODUCTION

Under the European Union's energy policy, energy is an essential element of development of the Union. This poses a challenge in terms of climate change impact of the energy sector, increasing dependence on energy imports and increasing energy prices [8].

Energy efficiency, as 2012/27/UE Directive of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC. is "the ratio of output of performance, service, goods or energy and the energy used for this purpose" [6].

Directive provides 2012/27/UE "a common framework of measures to promote energy efficiency within the Union in order to ensure the achievement of the primary objective of 20% energy efficiency by 2020 and pave the way for future growth energy efficiency beyond ".

Objective of reducing energy consumption by 20% by 2020 seems distant, for which the EU proposes new measures in the field. To this end, it is proposed to monitor the efficiency and the EU will propose, if applicable, performance improvement measures.

Romania faces long image of a country where energy is used with low efficiency, for example being used usually classic indicator "energy intensity". It is discussed frequently about high energy intensity of the Romanian economy compared to developed countries. The issue is addressed both by specialists and by politicians, journalists, representatives of public opinion [10].

The risk monitors installed on the entire production competitive market chain can ensure the economic operating state by generating savings of about 10°/o from the power distributed if we apply in practice the DSM and CRM (Demand Side Management and Customer Relationship Management) procedures, by calling upon the intelligent networks ensuring the voltage -frequency control of the power vehicled into the interconnected power systems.

Development of renewable energy by 2020 is determined by the European and global strategies on energy and environmental protection. Significant changes to the energy mix by increasing the share of natural gas and renewable energy, development of markets for energy and other major changes will pose challenges for energy suppliers [10].

These savings can be obtained based on power transmission and distribution computerization by calling upon software engineering based on risk anticipation monitors that allow reducing losses below 100/o of the power transmitted and distributed to the consumers.

The transformations are determined by the need to increase the share of renewable energy with reduced emission, ensuring the security of the power and energy by ensuring access to its affordable prices. Although coal is still a high proportion between energy carriers used in power plants but will reduce over time. In some developing countries the share of coal will continue to increase. The methane gas causing less pollution to the environment will also play an increasingly important in the production of electrical energy as opposed to oil weight which, in the production of electric energy will be reduced to zero. [10]

The cost of these risk anticipation monitors can be covered from the savings made based on the removal of real damage from the National Power System currently rising to at least 200/o.

An analysis of potential renewable resources in Romania should focus on understanding the complex geographic regions, both in terms of components and features of the natural and interpretation of complex spatial modelling maps. The potential of renewable resources (wind, solar, geothermal, hydropower, biomass and biogas) are closely related to the peculiarities of topography, climate, hydrography, soils and vegetation [9].

Energy intensity is addressed but usually in discussions / debates / official documents only when they have the theme of energy issues in general and energy efficiency in particular is considered by decision-sectorial index. Explicitly or implicitly, the institutions responsible for improving its value are often considered to be the state authorities responsible for energy.

These institutions have important attributions in the field of energy sector development, solving energy efficiency programs, but cannot be responsible for the development of national economy.Increasing energy efficiency in technical sense of the concept (reduce energy losses, increase yields) helps lower energy intensity, but the largest contribution to GDP growth should return.

Romania has the lowest amount of primary energy consumption per capital of the 28 EU Member States (1.568 tep/capital in 2015). almost twice lower than in the EU 28 in the same year (2997 tep / capital). Eurostat also shows the primary energy intensity expressed in tep /1000 Euro 2010. In this embodiment, the highest values of this indicator in 2016 were held by Bulgaria (0.449 tep/1000 EUR 2010) and Estonia (0.358 tep/1000 Euro 2010. Energy consumption in the domestic sector per capital recorded in 2015 (0.371 tep / capital) was 71.5% compared with the average UE28. Differences from the Nordic countries are normally given by the differences in climatic conditions. Differences are accounted for and against countries with similar geo-climatic conditions or mild climate (Italy, Slovenia, Croatia. etc.).

The differences will be emphasized and we shall reach more limited aspect if we analyze electricity consumption per capita in the domestic sector. Romania has the lowest power consumption per capita in the EU (0.05203 toe / capital in 2015). 2.6 times lower than the average UE28 (0.1340 tep / capital). In these circumstances, the aim should be not decrease but increase consumption for efficient use of energy, corresponding to economic development and higher living standards [4].

MATERIAL AND METHOD

This step pursues the optimization of the competitive sale prices of based on the correlations of the technological-managerial and economic-financial activities. In this perspective, the competitive prices have to be calculated as follows:

$$p_{power\,price}^{competitive} = \frac{C_{tac}}{g_i E_p}\frac{1}{dv} + t_{tax}^{network} + t_{supply\,tax}^{distribution} + t_{connection\,tax}^{market} + t_{profit}^{precalculated} \le p_{price}^{EPS} \quad (1)$$

where:

- ✓ Ctac = present total costs calculated by the models (9)
- ✓ gi = (0.8+0.9)
- ✓ Pi = power equipment loading degree;
- ✓ Ep= produced power, dv= life of energy aggregates.

The weighed national load curves are calculated starting from mathematical structure of the form:

$$p_{price}^{\substack{weighted\\average}} = p_{price\ for\ EPS}^{competitive} = \frac{p_{CTE}E_{CTE}+p_{CNE}E_{CNE}+p_{CHE}E_{CHE}+p_{CEE}E_{CEE}+p_{ccg}E_{ccg}}{E_{CTE}+E_{CNE}+E_{CEE}+E_{ccg}} \le p_{price\ for\ EPS}^{competitive} \quad (2)$$

where:

- ✓ p = power price at the level of each power plant producing energies (E) separately with various types of fuel. If we try the primary sources of renewable fuel to represent over 300/o of the current structure of the conventional fuels, then we can assist to a considerable increase in energy efficiency both at the level of the NPS and at the level of the competition with the European Power System.

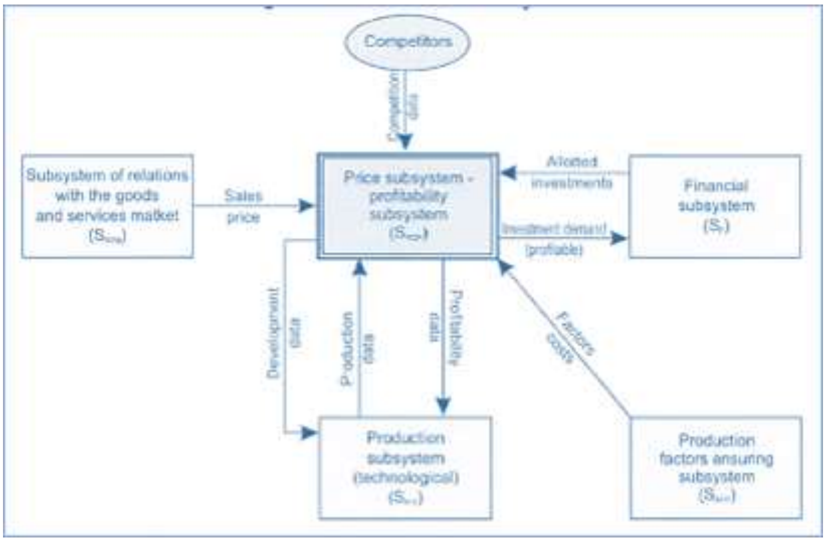

Fig.1 - Price subsystem-profitability costs (5)

The properties of intelligent agents of the SMART-GRIDS type are the following: infallibility that ensures the correct execution of tasks, the utility being given by the increase in the useful effect of power to consumer, the cost calculated by the relations 1, the automatic generation of goals; the engagement has to be fulfilled entirely, the conviction that a useful goal has been fulfilled pays off in the end the safety and profitability of the conducted actions, the aggregation of objectives, the fluency at the level of the interconnected agents. etc. From the combination of these properties one can outline four types of agents, namely: collaborating agents, trainable agents, interface agents and complex intelligent agents of the SMART-GRIDS type. In the energy field one appeals to the economic agents Buyer-Seller that attempt to find the most advantageous price for buying, respectively selling, energy products and installations.

The intelligent agents constitute assistents to the human factors at the level of the competitive market. Their collaboration leads to an increase in the efficiency as they learn mutually their preferences. To understand these collaborations we will define in short the intelligent agent concepts.

Use the intelligent technico-economic agents allowing the increase in energy efficiency produced and delivered to consumers with minimum risks can be presented synthetically as the first steps pf the SMART networks of rendering efficient the power units integrated into the competitive market.

Using the intelligent agents in calculating the efficiency of the interconnected systems is recommended as a solution for a correct administration of the optimum energy supply and demand.

In the consulted literature we cannot find calculating details both of the effects and efforts which prevent an accurate calculation of the economic profitability of the power systems on the products design-operation and sale chain. The changes in the model 1 in a first view are the following:

$$M_{gee} = \frac{E_{conomic\ effect}}{E_{conomic\ efort}} > 1 \left[\frac{saved\ lei}{spent\ leu}\right] \quad (3)$$

$$M_{gee1}^{P} = \frac{E_{conomic}^{P} \pm R_{risk}^{R} - C_{costs}^{information}}{I_t^P + C_{systems\ costs}^{intellingent}} > 1 \left[\frac{saved\ lei}{spent\ leu}\right] \quad (4)$$

$$M_{gee2}^{P} = \frac{E_{conomic}^{E} \pm R_{risk}^{E} - C_{costs}^{expert\ systems}}{turnover} > 1 \left[\frac{saved\ lei}{spent\ leu}\right]$$

The savings at the level of the design (EP) and those at the level of the operation (EE) can be determined starting from knowing the saving directions of the primary resources and of the efficient use of the human resources rightly integrated into the integrated design-operation processes of the new energy objectives.

$$E_{total\,saving}^{(P)} = E_{\substack{primary\\resources}}^{saved} + E_{used}^{refficiently} \pm E_{human\ resurces}^{riscks\ turned\ in\ to} - C_{\substack{saving\ operation\\costs\ in\ design}}^{expert\ systems} \tag{5}$$

$$E_{total\ saving}^{(E)} = E_{\substack{primary\\resources\\consuptions}}^{reducing} + E_{\substack{human\ resurces\\integrated\\in\ to\ operation}}^{reducing} \pm R_{risk}^{real} - C_{\substack{inteligent\ structures\\applied\ in\ practice}}^{operation\ costs\ of}$$

The technico - economic efforts at the level of the design and operation of the new energy equipment are determined as follows:

$$\begin{aligned} E_{\substack{design\\level}}^{efforts} &= \left[I_{investment}^{real} + C_{systems}^{expert}\right] I_{investment}^{real} = i_{sp} P_1 \\ E_{in\ operation}^{efforts} &= \left[turnpver + C_{\substack{expert\ systems\\operation\ costs}}^{cost\ commissioned}\right] \end{aligned} \tag{6}$$

The risks are included in the calculation of the energy efficiency with the sign (+) if the computerization installation detects incidents anticipatory and removes them by creating the possibility of turning the damage into savings.

If not, the risk decreases the real savings from the quantum. Another completion that should be done upon detailing the calculating elements of the Power Systems efficiency refers to approaching the problems in the concept of operational researches applied in the renewed archemo-systemic structure.

$$E_{saving}^{(P+E)} = \left(E_{saving}^{P} + E_{saving}^{E}\right)_{quantitative} + \left(E_{saving}^{P} + E_{saving}^{E}\right)_{\substack{arhemic\\qualitative}} \tag{7}$$

These changes of the general calculating models do not reflect in their structure, the influence of all the production factors the market modeled in the operational researches, a fact which leads us to the proposition of a new model in approaching the power systems efficiency.

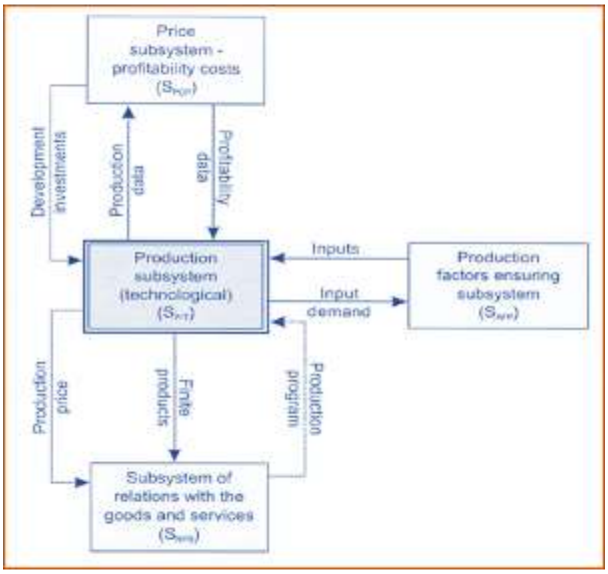

Fig. 2 - Production subsystem (5)

An important long-term aspect on electricity generation is the public acceptance of different generation technologies and fuels. An increase in climate change policies as a universal concern has an impact on the choice of energy production, often limiting the selection.

The European Commission has proposed a binding target of increasing the level of renewable energy in the EU's overall mix to 20 % by 2020. So, all EU should stimulate investment in production capacity using renewable fuels and reduced carbon emissions [5].

Mainframe forecasting is a complex problem that requires a lot of effort and time from the system engineers in order to define strategies and implement appropriate control algorithms [8].

To overcome these drawbacks in the grid of development and planning, several attention directions were proposed for the future and some measures to optimize the energy strategy. Optimization of planning and establishing a coherent energy strategy involves managing complex database which is regularly changed /supplemented [1].

The application of the SMART-GRIDS strategy at the level of national and international power systems is meant to modernize the entire technological – managerial structure and economic – financial structure of all equipment by appealing to vulnerability anticipation monitors, by carrying out a decentralized production resorting to renewable fuels, by implementing in the new power systems intelligent equipment (meters, substations and power plants equipped with virtual and agile transformers and separators), by activating at the level of the market the intelligent agents that allow consumers to take part in optimizing the operation of the whole system submitted to sustainable development, and by developing neuroinformatics that allows the valorization of current power informatics and makes the passage to neurofractal design workshops of the new high archemic resolution power structures (Fig.2).

The practical objectives of the SMART-GRIDS strategy that allow the delivery of safe clean power to consumer mainly refers to the following endeavors: designing a power transmission capacity produced so that to render flexible the production – consumption relation, minimizing losses based on resorting to the management of reactive power and voltage control equipment, online optimization of network monitoring starting from load management and control devices (SMART. Metering, Demand Side Management. predictive maintenance application and congestion management. etc); promoting SMART-GRIDS solution based on FACTS devices that might ensure the observing of the limits regarding power flow between the interconnection lines and 110 kV national networks; including the meeting of conditions regarding reactive power circulation imposed on interconnection lines; integrating the technology based on synchrophasors in the national power systems; the increase in the number of applications that should appeal to the correlated actions of the synchrophasors and factors applicable to the anticipatory monitoring of the entire system on the clean energy production – consumption chain.The reduction in power losses based on carrying out the SMART-GRIDS networks that require: developing lines with several phase conductors (3 x 300 mm^2 and 4 x 240 mm^2), correlated production control with clean power transport and distribution based on software engineering and reengineering suggested by the real facts research model that is based on the intelligent electronic control and resorts to the following program products (P.P.): sustainable development, commercial activity computerization, the production, human resources reconfiguring, decision elaboration in view of building up the entreprenorial concept of managing the new systems endowed with SMART-GRIDS equipment [7].

The preoccupations, capabilities and relevant interests of the specialists of Romanian energy sector focus on the following actions: extensive use of EMS/SCADA information systems; DMS/SCADA; HPMS/SCADA; PPM/SCADA implemented at the level of the National Power System management. respectively at the level of power plants, the metering system applied to the bulk energy market, electric power quality monitoring system, MIS (Management Information Systems), intelligent power consumption metering system, commissioning in the near future of new virtual and agile power production – transport – distribution equipment (optic transformers. FACTS information structures and phase shifters. etc).

Besides, the Institute for Studies and Power Engineering works at a Pilot-project SMART-Grids that covers the simulation of the NPS operation with advanced software tools and may assume the role of a strategic partner in a consortium with an external consultant in order to elaborate and apply a new SMART-GRIDS strategy at a national level [4].

CONCLUSIONS

1. The financial component is also important and implementation of all physical values of the cost components is beneficial to consumers in the context of the ongoing evolution of prices for primary energy used. In this way, any action that involves increasing the energy efficiency of the system can be quantified directly in a component of the economy and sustained before the decision-maker if the action involves an investment cost.

2. Energy efficiency measures are also means of promoting the competitiveness of European economies, not only by reaching sustainable energy supply, but also by reducing emissions of greenhouse gases, improving security of supply and reducing import costs.

3. The global energy sector needs to address many issues in the coming years, including decarbonisation of the electricity supply mix, increasing access to energy and affordable prices and improving energy efficiency.
All these will contribute to a change of paradigm shift from a carbon based economy to one based on the combustion new sources of energy and new ways of energy generation and distribution.

4. Since achievement of plants and facilities are planned by investor groups it is useful in the future to achieve a database (chart) on the new investment commissioning steps and development of legal activities for a more efficient running of projects by providing advice and working with law firms Romanian Energy Association.

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CONSIDERATIONS ON MECHANICALLY ACTIVE EQUIPMENT FOR OPENING INTERRUPTED FURROW USED IN TECHNOLOGY OF HOEING PLANT CULTURES, FRUIT AND VINE PLANTATIONS
/
CONSIDERAŢII PRIVIND ECHIPAMENTELE ACTIONATE MECANIC PENTRU DESCHIS BRAZDE INTRERUPTE UTILIZATE IN TEHNOLOGIA CULTURILOR DE PLANTE PRASITOARE SI PLANTATII VITIPOMICOLE

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Keywords: efficient *capitalization of water, technical equipment, interrupted furrow.*

ABSTRACT
Lately, there is a decrease in arable land surface while the population grows, therefore the need to increase agricultural production per unit of surface is a must to meet food needs.

Water resources are reduced and therefore it is important to promote techniques and technologies that efficiently utilize water from various sources with low energy consumption.

In sapling crops, directing water along the plant line or uniform storage is achieved with continuous or interrupted (compartmentalized) furrows.

The paper aims to analyze the construction and operation of several types of equipment for opening compartmentalized furrows and how they work.

REZUMAT
In ultima perioada se constata o scadere a suprafetei arabile in timp ce populatia creste fiind necesara cresterea productiei agricole pe unitatea de suprafata pentru acoperirea nevoilor de hrana. Resursele de apa sunt reduse si de aceea este importanta promovarea de tehnici si tehnologii care sa valorifice eficient apa provenita din diverse surse. cu consum redus de energie. La culturile prasitoare. dirijarea apei in lungul randului de plante sau stocarea uniforma se realizeaza cu ajutorul brazdelor continue sau intrerupte (compartimentate). Lucrarea isi propune sa analizeze construcţia şi funcţionarea mai multor tipuri de echipamente de deschis brazde compartimentate. precum şi modul de lucru al acestora.

INTRODUCTION
For soil supply with additional water to those naturally received by precipitation, quantities established according to the pedoclimatic conditions and plant requirements, it is necessary to establish additional works in the respective technologies.

Due to the fact that the arable area is decreasing as the population grows, the increase in agricultural production per unit of surface remains the main solution to meet the growing demands and better quality of food.

The achievement of large agricultural output is influenced by several factors (mechanization, fertilization, weed control, pests, biological soil potential, seed quality), each with its importance, but lack of soil water over periods overlapping the critical phases in plant development, diminishes the harvest even compromises it as a result of the drought.

In Romania, the area with economic irrigable potential is estimated at 3 million hectares, of out of which 1.5 million ha with high economic efficiency. In this context, irrigation will become the most important water consumer in agriculture and one of the main consumers nationwide, demanding on average 35-45% of the country's exploitable water resources.

Water resources in Romania are low with a value of about 1660m3 / inhabitant and in other countries in Europe they are 2.5 times bigger and, therefore, it is important to promote techniques and technologies that efficiently capitalize water from various sources with low energy consumption, soil water and its circulation. About 41% of our country's arable land is affected at some times of the year by excessive humidity on about half of the arable area and in the same year longer or shorter droughts are recorded and watering with variable rules is required; soil erosion phenomena are manifested on 35% of the total agricultural area. Water resources in Romania are modest compared to other countries in Europe (11th place for local resources and 21st place for the ones formed on its territory) [1]

Due to the fact that for the watering of the plants an important amount of fresh water is used and their needs are higher in dry periods, other sources of water (groundwater, drainage, wastewater, precipitation water etc.) are needed which by their chemical composition qualitatively corresponds to plant requirements.

The effects of the watering process are felt both economically and socially and in environment protection. Watering ensures the normal development of agricultural crops which leads to stable revenues, by increasing the photosynthesis process to enriching the atmosphere in oxygen and reducing the carbon dioxide content, allowing the development of microbial activity in the soil and increasing the humus content by producing a quantity of increased by vegetal debris, avoiding the deterioration of the ecological balance by improving the drought-affected microclimate. Gravitation is the oldest form of irrigation. The surface leakage consists in the fact that water is distributed on the ground by free flowing on the furrows or strips, while the drain and the infiltration of water into the soil, take place. In general, the lands for watering are modelled by shaping them to ensure a continuous slope imposed by the general characteristics of the leakage, the watering method or the requirements of the agricultural exploitation. The modelling of irrigable agricultural land is of particular importance because this work ensures a uniform distribution of water in the soil, whether it is conducted through furrows or strips on the surface of the land, or it is sprayed. Opening the interrupted furrows is necessary in the following situations:

- on landscaped lands for sprinkling with fixed or mobile installations and with uneven or sloping streams causing water leakage and pouring into microdepreses;
- on lands with kneaded microrelief with small slopes, not arranged for irrigation and in which rainwater flows rapidly downstream, being not used by the plant and producing the phenomenon of erosion [2].

MATERIAL AND METHOD

Watering is both an important technological sequence in the crop culture agro technology, as well as the most important technical means of eliminating the water of the soil, constituting the infrastructure of sustainable development. Technologies to combat the effects of climate change have evolved to reduce the water consumption of plants (dripping, micro-spraying). of the superior capitalization of water by reducing losses and associating with other works (fertilization, herbicides, etc.) and using other sources of water waste from animals or rural, urban and industrial environment).

To meet water requirements, it is necessary to adopt new technologies that reduce water consumption by associating with other works, storing water from other sources, distributing water near plant roots, increasing watering efficiency. etc. The rational use of water in agriculture implies prioritization of water use in critical situations (droughts. etc.), the adoption of measures to impose the application of reference models, the application of innovative solutions for reducing water losses, the quality control of water for the reduction of environment pollution. A superior valorisation of the water from the rainfall and also of the water obtained by the sprinkler irrigation method is obtained by modelling the soil surface.

In the case of continuous or interrupted furrows, it is intended to obtain as many sections of the furrow as necessary to carry and accumulate as much water as possible. Interrupted brasses are executed to reduce the erosion phenomenon resulting from rainfall, slope or creep. Depending on the sowing scheme, interrupted watering grooves can be performed on sowing crops between plant rows, alternately or on each interval.

Furrows used in agriculture are of great importance for agricultural production and are a major component of the agricultural ecosystem [3]. [4]. [5]. and [7].

It is estimated an increase in agricultural production per hectare by 20% in agricultural crops with broken furrows. This is explained by the infiltration of a larger amount of water at the plant roots and by the reduction of the soil erosion phenomenon [1]. Water management along the plant line or uniform storage is achieved with continuous or interrupted furrows (compartments). For the constructive and functional analysis of mechanically operated equipment for open furrows used in owing crops technology and viticol and fruit plantations, it is necessary to study the constructive characteristics of these equipments, the functioning of the working parts and the working process carried out by them so that at the end to be able to recommend the best constructive solution that can be considered.

RESULTS

The open furrow work is known as soil processing by ridgeplowing (soil modelling) and was initially made with the help of some trailed animals.

This operation is done with a machine that works in aggregate with a tractor, the machine on which is mounted equipment for continuous furrows or specialized equipment for making interrupted furrows.

The machine equipped for the execution of the continuous furrows is made up of ridgeplows which make the tringhiular section of the furrow and the modifiers that make the parabolic section and the finishing of the furrow; the machine equipped for the execution of the interrupted furrows is composed of the same ridgeplows, the rotors with blades and a mechanism for controlling the rotors for interruption of the furrows and the execution of some digestions (plugs); both equipment is mounted on a frame with supporting wheels. The number of workstations is selected based on the sowing pattern, the section spacing and the row between the processed rows (on each interval or at two intervals). The most commonly used seed sowing scheme is 6 or 8 rows and the maximum number of machined intervals is 5 and 7 respectively, which must coincide with the number of workstations.

In the case of continuous or interrupted furrows, it is important to obtain an enlarged section of the furrow. fig. 1. to transport and accumulate a larger volume of water respectively.

Fig.1 - Continuous compartmented furows after rain [2]

Fig 2 - Equipment for continuous open furrows [2]

Aspects during working with a broken open furrow are shown in fig, 3, fig. 4, fig. 5 and fig. 6.

Fig.3 - Open furrow machine compartmented into each row interval [6]

Fig.4 - The open-beam machine is divided into three ranges

Fig.5 - Open furrow machine divided over a single interval [8]

Fig. 6 - Open furrow machine compartimented over a single interval [9]

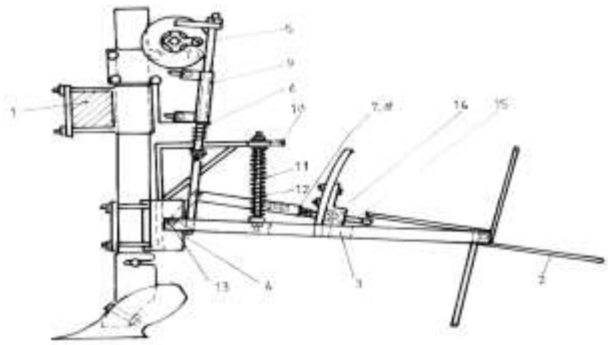

Fig. 7 - Work unit with splitting furrow equipment [10]:

1. Equipment frame for opening watering furrows; 2. Pallets rotor; 3. Support arm; 4. Lever system; 5. Roller cam; 6. Resort traction; 7. Adjusting pipe; 8. Adjustment nut; 9. Guide; 10. Surface support; 11.Rod; 12. Compression resort; 13. Joint; 14. Lock bolt guide; 15. Bolt lock

Fig. 8 - Driving mechanism [6]

The adriving mechanism aims to unlock the pallet rotor to form the ground plug on the furrow. It consists of the following main parts:

- camshaft support;
- camshaft;
- lever / cable and locking bolt.

The control mechanism of the rotor blades in order to interrupt the furrows on variable lengths correlated with the slope of the ground is driven by the rotating wheel (fig. 8). The rotation motion is transmitted by means of a chain transmission (fig. 9) to a cam shaft positioned next to each work section.

During the rotation movement, the camshaft will operate the lever / cable mechanism from each section in the direction of unlocking the blade by means of the locking bolt and by rotating the blade, the furrow plug will be made at predetermined distances. The rotors will have three or four pallets of trapezoidal shape being pressed on the bottom of the furrow by two spring-mounted bends or spring-loaded spring bends. The time when the rotation of one of the pallets will be blocked by a bolt it will scrape the bottom and the side walls of the furrow by mobilizing a quantity of soil in front of it.

When the eccentric cam is operating the lever mechanism, the bolt retracts. releases the rotor with the blades, which rotates one step leaving a ground plug with a base width between 20 and 40 cm and the height equal to the depth of the furrow . While the blade rotor rotates with a 90 ° bolt released by the camming action, it returns to the previous position blocking the next rotor blade and then repeating the cycle. The device provides for the modelling of the watering compartments on the intervals between the plant ranges in two ways: alternatively a range with a furrow and a furrow interval or consecutive interval, depending on the sowing pattern, the soil type and the root zone [6].

Fig.9 - Chain transmission for driving the rotor control mechanism [6]

Since lately. temperatures have been growing at increasing intervals, watering of trees and vines is becoming a necessity. In FIG. 10 is presented the equipment for modelling the soil in furrows divided into vineyard plantations, simultaneously in two furrows per interval PCMV2.2 + EMBC2-0. at a distance of 20-40 cm in order to accumulate water from precipitation in the soil on the surface to which the droplets fall, avoiding water leakage outside the cultivated perimeter or accumulation in depression areas on land with a slope of up to 5% on mild, medium or heavy texture, showing a depth of at least 250 mm at a near humidity by the minimum ceiling.

The equipment consists of the following main components: 2 plows (left. right), a device for making split compartments provided with a control mechanism and optionally with two knife arrows if the simultaneous carrying of the pigs is desired. The plows are mounted on the plow frame in the lateral sides corresponding to the plowing in the bellows with the furrow overhanging inside the row, having the support of the deformed bodies towards the inside of the frame.

The device for making compartmented furorows consists of the following main parts: the control mechanism, the rotor support. the blade rotor and the presser mechanism of the rocker blades. The adjustment of the swath compartmenting mechanism will allow the creation of soil plugs along the furrow at different distances (1.5. 3 or 6 m).

The driving mechanism consists of spur gear, transmission and drive mechanism. The spur gear is provided with steel spurs on the belt to increase the grip on the ground, avoiding skidding. For the transport position, the spur gear will be locked in a vertical position. The transmission is of the chain type and has the role of transmitting the movement from the spur gear to the camshaft. The driving mechanism is designed to block the blade rotor to form the ground plug on the furrow.

 

Fig 10 - Equipment for soil modelling in furrows compartmented on fruit and vineyard plantations. simultaneously in two furrows per interval. PCMV2.2 + EMBC2-0 [6]

CONCLUSIONS

In order to provide the soil with additional water to those naturally received by precipitation, it is necessary to develop technologies adapted to the new pedoclimatic conditions**.**

Technologies to combat the effects of climate change have evolved to reduce the plants water consumption (dripping, micro-spraying), high water utilization by reducing losses and associating with other works (fertilization, herbicides. etc.) and using other sources of water waste from animals or rural, urban and industrial).

A superior capitalization of water from precipitation, as well as of water obtained by sprinkler irrigation method is obtained by shaping the soil surface in the form of continuous or interrupted furrows. It is estimated an increase in agricultural production per hectare by 20% in agricultural crops with lands so shaped.

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NOISE MEASUREMENT AND DIRECTIONAL CURVE DETERMINATION FOR AN AGRICULTURAL TRACTOR
/
MĂSURAREA ZGOMOTULUI ŞI DETERMINAREA CURBEI DE DIRECTIVITATE A UNUI TRACTOR AGRICOL

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Keywords: *directional curve, acoustic pressure, tractor, noise.*

ABSTRACT
The paper presents some general notions about noise influence and effects on the human body as well as the effects of noise amplification due to meteorological conditions. The results of the study consist of measuring the noise around an agricultural tractor in order to represent the directivity curve at different distances. The use of tractors with a low level of pollution contributes to farmers' health, meeting the level of environmental protection and, implicitly, increasing the quality of marketed products.

REZUMAT
În lucrare se prezintă câteva noţiuni generale legate de influenţa şi efectele zgomotului asupra organismului uman. precum şi efectele de amplificare a zgomotului datorat condiţiilor meteorologice. Rezultatele lucrării constă măsurarea zgomotului în jurul unui tractor agricol in vedere reprezentării curbei de directivitate la diferite distanţe. Utilizarea unor tractoare cu un nivel de poluare cat mai redus conduce la sanatatea agricultorilor. satisfacerea nivelului de protecţie a mediului şi implicit la creşterea calităţii produselor comercializate.

INTRODUCTION
Noise and vibrations have a special influence on the workers' body, working capacity and the presence of accidents.

Noise can have a harmful effect on the human body and this depends on several factors, namely: the noise level, its spectral component, the duration and distribution of noise exposure during a working day, the total duration of exposure during life.

Noise is always a disruptive factor of the human body. Physically, noise has two essential features:

- frequency or number of oscillations per time unit
- sound strength, force or intensity

Research has shown that continuous noise repeated at close intervals is more disturbing than short momentary noise repeated at long periods of time. The noises in which high-frequency components predominate are more damaging than those in which low-frequency components predominate. Also, machine noise and the noise produced by some technological processes are more disturbing than natural noise with equal intensities.

Noise harmful effect can lead to: organ of hearing disorders; disorders of various body organs and systems; reducing labour productivity; reducing speech intelligibility. [1]

The human body records oscillations between 16 and 20.000 Hz in the hearing system. With time, as the age advances, the ear no longer captures the oscillations higher than 1.000-4.000 Hz; the higher the frequency, the bigger the noise harmfulness.

Under the influence of a loud noise, the blood pressure increases, the pulse accelerates, the intracranial vascular tension can increase three times, the eyesight agility decreases and the respiratory rate changes. Through the brain cortex, noise causes nerve irritation, the fatigue process becomes stronger attention and mental reactions weaken, asthenia or even nerve diseases may occur.

Noise affects physical work, but especially the intellectual one. Numerous researches show that labour productivity in a noisy environment can drop by half.

In a noisy environment. the danger of accidents increases because the possibility of acoustic signalling, orientation and speech intelligibility are reduced. This is due to the effect of sound masking generated by the disturbing environment.

It is often necessary to determine the effect of background noise on the intelligibility of speech. The level of speech intelligibility PSIL. [1] is defined to be used in such assessments, provided that no sound of the conversation is reflected toward the listener. Taking into account the decomposition of noise in octave bands, the Preferential Speech Interference Level (PSIL) was defined. This is the arithmetic mean of the noise level at 500 Hz. 1000 Hz and 2000 Hz.

$$\text{PSIL}=\frac{L_{p500}+L_{p1000}+L_{p2000}}{3}\ \text{[dB]} \tag{1}$$

The curves in Figure 1. drawn by Beranek [1]. show the voice level based on preferential speech interference level (PSIL). For women, the curves level is reduced by 5 dB.

The level of speech intelligibility can also be evaluated taking into account the background noise level in dB(a). Figure 2 curves evaluate the speech intelligibility according to the background noise level expressed in dB(a).

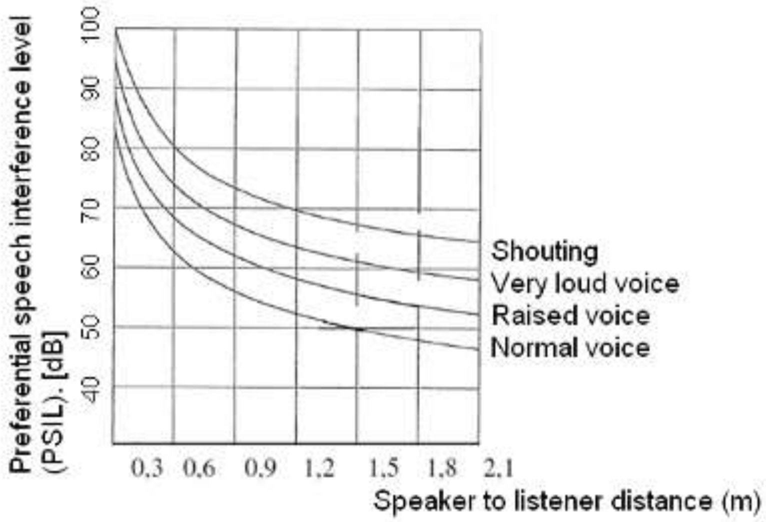

Fig. 1 – Voice level according to the preferential speech interference level (PSIL) [1]

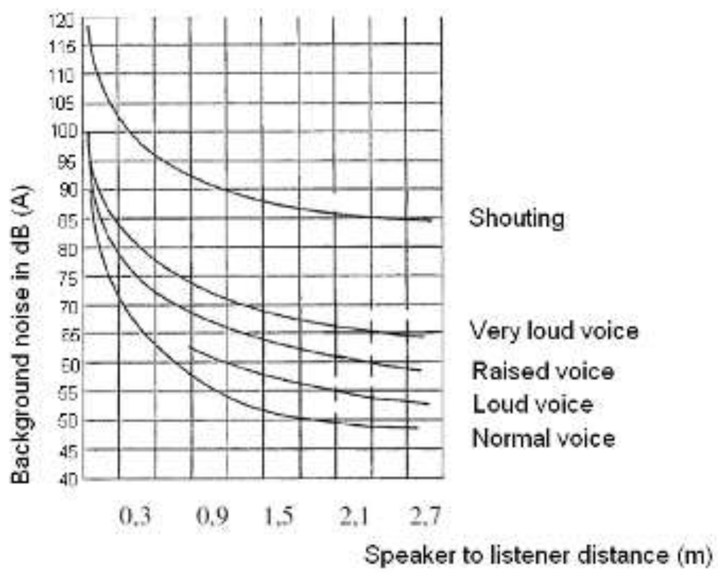

Fig. 2 – Voice level according to the background noise expressed in dB(a) [1]

The effects of noise amplification depend to a large extent on the specific conditions of the site, but also on the meteorological conditions, as it can register significant variations. Wind speed and temperature (depending on altitude) influence the propagation of the sound waves. Compared to a calm atmosphere, a constant light to moderate wind can generate an increase in the noise level in the direction of air currents movement and a decrease of it in the opposite direction relative to a certain source. It has been noticed that a light constant wind can generate an amplification of the noise level without increasing the acoustic background. On the other hand, winds with higher speeds tend to generate an increase in the acoustic background level due to turbulences or the movement of trees and shrubs, obliterating other sources of noise.

Low-speed winds can generate a rise in acoustic levels by a few decibels in relation to calm conditions, assuming the existence of topographical conditions without distortion between sources and receptors. Instead, the noise levels can be reduced in the opposite direction to the wind with a similar value. Temperature inversions are also known as factors for increasing noise levels at certain distances from the source. [4]

A big part of the noise pollution comes from machinery, cars, trucks and planes. Agricultural machinery, construction equipment and the equipment used outside the buildings can also be noisy.

The mechanized execution of agricultural works is accompanied by some negative effects of different magnitude. Agriculture mechanization has its share of blame in terms of environmental pollution by the specificity of the activity itself, but also in combination with other factors of agricultural production. Many of the polluting effects are produced directly by using technical means, tractors and agricultural machinery for the mechanization of agricultural works, including the noise they produce.

The noise from agricultural machinery is due to the engine, hydraulic units and pistons or working parts that come in contact with the soil or materials that are processed. [5]

An important aspect that should be considered in the sound pollution study should be that to determine the acoustic power level of the source and, if necessary, its characteristic of directivity.

The notion of directivity can be introduced where only a distinct part of the machine, for example the engine, is the actual source of noise.

MATERIAL AND METHOD

According to the provisions of the procedures in force within DI – INMA, metrologically verified equipment was used and also within the verification validity term, the measuring accuracy being within the limits imposed by the metrological norms in force. In table no. 1 are presented the measuring devices used:

Table 1

No.	Name of instrument or device	Measuring range	Measurement uncertainty/ Permissible error
1.	Measuring tape	0÷8 m	$\pm$0.5+10 $^{-4}$mm
2.	Integrating Sound Level Meter type 2237	20÷20000 Hz	0.3 dB
3.	Anemometer Testovent 4000 type	0.4÷40m/s	measurement uncertainty 0.35m/s
4.	Thermohygrometer DH 50	humidity: 5÷95% temperature: - 20÷80°C	± 0.1 % measurement uncertainty 0.5ºC

The Integrating Sound Level Meter type 2237 is shown in Figure 3 and is used to measure A-weighted sound pressure:

Fig. 3 - Integrating Sound Level Meter for measuring A-weighted sound pressure [6]

Figure 4 shows the *anemometer Testovent 4000 type* used to measure wind speed, while Figure 5 shows *thermohygrometer DH 50* used for measuring air temperature and humidity:

Fig. 4 - Anemometer Testovent 4000 type [7] **Fig. 5 – Digital thermohygrometer DH 50**

The sketch of the measurement sector in which the measurement positions at each 30^0 are marked is shown in Figure 6:

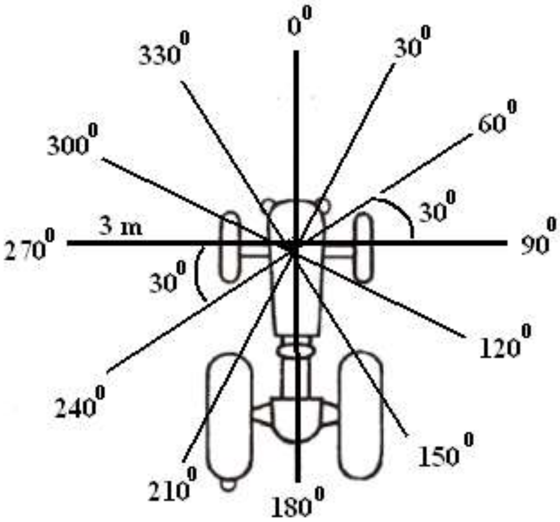

Fig. 6 - Sketch of the measurement sector

RESULTS

Experiments to determine the directivity curve of an agricultural tractor with installed power P = 150 hp were carried out at INMA Bucharest - Testing Department.

Noise measurements must be made on a horizontal surface (preferably concrete or asphalt) in a clear and sufficiently quiet area (ambient noise and wind noise shall be at least 10 dB less than the noise to be measured). Before starting the measurements, bring the engine to its normal operating temperature. [2]

To determine the directivity curve of an agricultural tractor, the following operations are carried out:

- the approximate position of the main noise source shall be determined as being situated on the longitudinal axis of the tractor in the middle area of the engine assembly;

- a radius is conveniently chosen so that the agricultural tractor is fully comprised in an imaginary circle having the centre coincident with the position of the main noise source previously determined;

- on the previously established imaginary circle, the measuring positions at each 30^0 are chalked clockwise;

- the determinations are made at a height of 1.2 m above the ground at each of the set measurement points;[3]

- based on the results obtained, the directivity curve is drawn using the graphic design software programs.

Measurements are made with the agricultural tractor in running order, stationary, at least two series of appropriate determination being carried out for two different radii of the imaginary circle.

Weather conditions:

- temperature: 27°C;
- humidity: 42.6%;
- wind speed: 0.8 m/s

Fig. 7 - Aspects of measuring the pressure level with the sound level meter

Measurement results

Table 2 shows the results of the measurements for each position:

Table 2

Measurement angle [degrees]	0^0	30^0	60^0	90^0	120^0	150^0	180^0	210^0	240^0	270^0	300^0	330^0
Sound pressure level [dB(a)] at a distance of 3 m	60	61	59	60	62.5	62	61	61	58	59	59.5	61.5
Sound pressure level [dB(a)] at a distance of 5 m	56	55.6	55.5	56	58	57.8	57.7	56	54	55	56	57
Background noise [dB(a)]	42.2÷43.1											

Based on the results obtained above, figure 8 shows the directivity curve of an agricultural tractor at a distance of 3 m, respectively 5 m. from the main noise source:

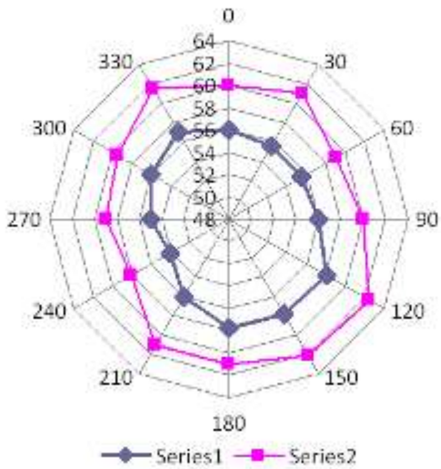

Fig. 8 - Determination of the directivity curve of an agricultural tractor at a distance of 3 m. respectively 5 m. from the source

CONCLUSIONS

Noises can have a harmful effect on the human body action depending on several factors, namely: the noise intensity level, its spectral component, the duration and distribution of noise exposure during a working day, the total duration of exposure during life.

Noise harmful effect can lead to: hearing disorders; disorders of various body organs and systems; reducing labour productivity; reducing speech intelligibility.

The effect of background noise on speech intelligibility can be estimated using the preferential speech interference level (PSIL)

It has been noticed that a light constant wind can generate an amplification of the noise level without increasing the acoustic background. On the other hand, winds with higher speeds tend to generate an increase in the acoustic background level due to turbulences or the movement of trees and shrubs, obliterating other sources of noise.

The noise from agricultural machinery is due to the engine, hydraulic units and pistons or working parts that come in contact with the soil or materials that are processed.

The use of tractors with a low level of pollution leads to farmers' health, meeting the level of environmental protection and, implicitly, increasing the quality of marketed products.

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OPERATOR PROTECTION DURING APPLYING THE PLANT PROTECTION PRODUCTS – PROTECTIVE ROLE OF CABINS
/
PROTECŢIA OPERATORULUI ÎN TIMPUL APLICĂRII PRODUSELOR PENTRU PROTECŢIA PLANTELOR - ROLUL PROTECTOR AL CABINELOR

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Keywords: pesticides, cab, sprayer, tractor.

ABSTRACT
Applying the plant protection products is safely performed nowadays due to harmonized legal regulations applicable to plant protection products, self-propelled sprayers, tractors and users. The cabin protection function contributes both to the operator's safety and comfort.

REZUMAT
Aplicarea produselor de protecție a plantelor se desfășoară astăzi în siguranță datorită reglementărilor legislative armonizate aplicabile produselor fitosanitare. maşinilor de stropit autopropulsate. tractoarelor şi utilizatorilor. Funcţia de protecţie a cabinelor contribuie atât la securitatea operatorului cât şi la comfortul acestuia.

INTRODUCTION
Plant protection products have the role of protecting plants against harmful organisms, which means a significant contribution to ensuring sufficient and quality food.

Regarding the possible effects on the environment and human health, plant protection measures are the most demanding operations in agriculture and forestry, as evidenced by the extent of the legislation on plant protection.

The legal basis for the implementation of plant protection measures is laid down in the Framework Directive 2009/128 / EC on the sustainable use of pesticides and Regulation 2009/1107 concerning the placing of plant protection products on the market of the phitosanitary products.

These regulations also address important aspects regarding the operator protection because they include provisions on:

- good spraying practice;
- requirements for operators, dealers and manufacturers of plant protection products;
- applying the plant protection products.

Operator security during the application of plant protection products is influenced by:

- operator expertise (training, skills);
- choosing the plant protection application equipment;
- choosing the plant protection product;
- pesticides storage;
- transport;
- pesticides applying (preparing, filling, spraying, omission of cleaning, waste storage, cans/tanks storage. equipment cleaning. filling place cleaning);
- maintenance;
- sprayed equipment inspection.

MATERIAL AND METHOD
The most common forms of contamination with plant protection products are due to contact with the respiratory tract or skin.

Plants Protection Products (PPP) are used in a variety of activities related to spraying. In figure 1 are explained the different operations, the related measures and the sprayer technology measures per operation. These measures complement one another and together facilitate the protection of the operator and the environment.

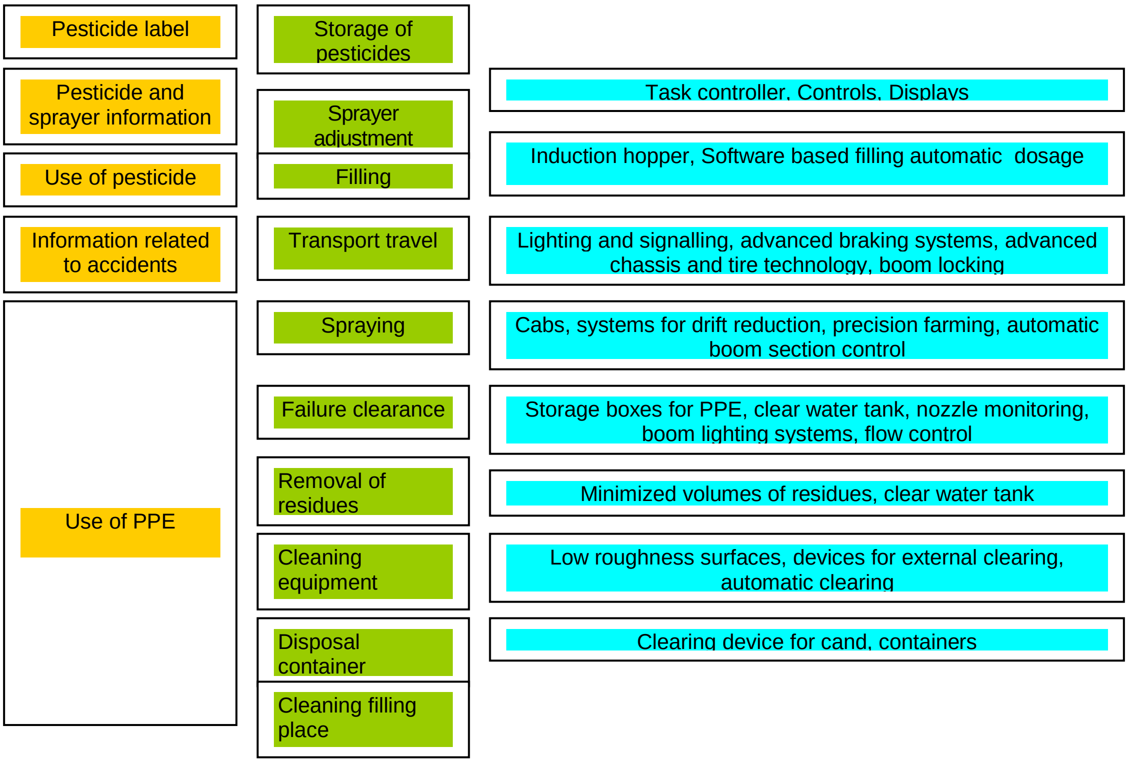

Fig. 1 - Application of plant protection products [1]

At present, plant protection is carried on at a very high level, including in terms of operator protection. An important fact was the publication of standard EN 15695 (Agricultural tractors and self-propelled sprayers;. Operator protection against dangerous substances - Part 1: Classification of cabins, requirements and test methods and Part 2: Filters. requirements and test methods) providing additional possibilities for optimizing operator protection. The operator's safety is determined by a combination of the plant protection product, the spraying technology used and the operator's behaviour.

Part 1 of the standard addresses cabin manufacturers for self-propelled sprayers and tractors and defines four categories of cabins:

- category 1: Cab which does not provide a specified level of protection against hazardous substances;
- category 2: Cab which provides protection against dust(s);
- category 3: Cab which provides protection against dust(s) and aerosols;
- category 4: Cab which provides protection against dust(s), aerosols and vapours.

Protects against		Cabin classification	Minimum requirements	
Dust	✓ YES	Category 4	Fresh air flow	30 m3/h
Aerosol	✓ YES		Pressurization	20Pa
Vapour	✓ YES		Pressure indicator	Mandatory
Dust	✓ YES	Category 3	Fresh air flow	30 m3/h
Aerosol	✓ YES		Pressurization	20Pa
Vapour	✗ NO		Pressure indicator	Mandatory
Dust	✓ YES	Category 2	Fresh air flow	30 m3/h
Aerosol	✗ NO		Pressurization	20Pa
Vapour	✗ NO		Pressure indicator	Optional
Dust	✗ NO	Category 1	Fresh air flow	No requirement
Aerosol	✗ NO		Pressurization	No requirement
Vapour	✗ NO		Pressure indicator	No requirement

Fig. 2 - Cabins classification [7]

According to [4]:

- **cabins in category** 2 have to be equipped with an external air and filtration system designed to reduce the amount of dust. The external air supply system must create a positive pressure difference inside the cabin of at least 50 Pa or at least 20 Pa if a manometer is provided. The external air supply system shall provide at least a fresh air filtration rate of 30 m^3 / h;

- **cabins in category 3** must be equipped with an external air and filter system to reduce the amount of dust and aerosols. The external air supply system must create a positive pressure difference inside the cabin of at least 20 Pa and there must be a manometer. The flow of fresh and filtered air must be 30 m^3/h;
- **cabins in category 4** shall be equipped with an external air and filter air supply system designed to reduce the amount of dust, aerosols and vapours. The external air supply system must create a positive pressure difference inside the cabin of at least 20 Pa and there must be a manometer. The fresh and filtered air flow rate must be 30 m^3/h.

Part 2 is addressed to the manufacturers of filters and specifies requirements and test procedures for these.

With regard to filters, the requirements are [5]:

- the air supply system filter shall have a gravimetric efficiency ≥ 99%;
- the maximum penetration rate of aerosols must be ≤ 0.05%;
- at the bottom of the filter the test vapour concentration must not exceed the threshold of 10 μg / g.

The cabs of tractors and self-propelled sprayers play an important role in ensuring operator protection against contamination with plant protection products during spraying.

The cabin protection function contributes both to operator safety and comfort, but the following considerations need to be considered:

- it represents a risk mitigation measure in the authorization process of plant protection products;
- provides the user with adequate information;
- maintains the filters and the cabin.

The cabin must meet the requirements of the category to which it belongs and must allow the operator to mount the appropriate filters. The need for a certain type of filter must be specified by the plant protection product manufacturer on the product label so that the operator operates safely, for example to select the appropriate filter and install it in the cabin.

RESULTS

To ensure operator protection, manufactures of self-propelled sprayers and tractors must pay attention to the following:

1. The manufactures of self-propelled sprayers

According to the Machinery Directive 2006/42/ EC. in the context of a risk assessment the manufacturer is obliged to determine the risks to the operator and the environment that may be caused by the use of the self-propelled machinery and to reduce them to an acceptable level through appropriate measures. Such risks may result from application, leakage and spillage or from the contamination of water sources during filling, emptying, cleaning. The risks during use arise from the release of pesticides in unintended quantities or at an unintended rate and from the unintended release of pesticide to areas other than the target areas during application [6].

By applying harmonized European standards EN ISO 4254-6 "Agricultural machinery. Safety. Part 6: Sprayers and liquid fertilizer distributors"; EN ISO 16119-1 "Agricultural and forestry machinery. Environmental requirements for sprayers. Part 1: General"; EN ISO 16119-2 "Agricultural and forestry machinery. Environmental requirements for sprayers. Part 2: Horizontal boom sprayers". EN ISO 16119-3 "Agricultural and forestry machinery. Environmental requirements for sprayers. Part 3: Sprayers for bush and tree crops " and EN ISO 16119-4 "Agricultural and forestry machinery. Environmental requirements for sprayers. Part 4: Fixed and semi-mobile sprayers":

– the risk assessment process is considerably simplified because the risk reduction measures stipulated are sufficient for the risks covered by these standards;

– there is a presumption of conformity that sprinklers comply with legal provisions and are sufficiently safe for people and the environment.

When assessing risks, it is assumed that:

- the machine is only used for applications defined by the manufacturer and in the manner described by the manufacturer;
- the operator has the necessary expertise;
- the operator uses only products for the protection of authorized plants;
- the operator respects the manufacturer's instructions for plant protection.

2. The tractors manufacture

Directive 2010/52/EC on certain components and characteristics of wheeled agricultural or forestry tractors includes additional safety requirements for special applications [3]:

- if there is a risk of contact with plant protection products, the cabin must meet the requirements of categories 2,3 or 4 according to EN 15695. The criteria determining the choice of one level or another must be described and comply with those indicated in the owner's manual. For spraying pesticides, the cabins must be of category 4;

- the level of protection (cabin category) for handling of dangerous substances must be described in the user manual.

However, cabins in cat. 3 and 4 are expensive and their choice to improve comfort is only justified for:

- farms where the application of plant protection products is the main activity;
- farms with special crops such as shrubs or trees;
- employers and employees who have sufficient experience to ensure proper use.

However, when the operator has to leave the cabin (for example,. to eliminate malfunctions), he must wear the personal protective equipment recommended by the manufacturer of the plant protection product (safety gloves and goggles). The correct use is indicated in the respective documents (application, packaging, cleaning of equipment, precautionary measures, transport, storage etc) [2].

3. Additional measures for preventing contact with plant protection products

In addition to the protective function of the cab other measures can be useful in order to reduce the probability of operator contact with plant protection products. The following examples of measures and technical equipment increase the safety for the operator and the environment and in particular allow additional gains in convenience and efficiency in the professional use of plant protection technology [1]:

- Planning, performance and documentation of plant protection measures by task controllers (series standards ISO 11783 "Tractors and machinery for agriculture and forestry - Serial control and communications data network");
- Automated sprayer filling to eliminate tank mix residues;
- Dosing devices for extracting plant protection products from canisters;
- Closed transfer systems;
- Direct injection of plant protection products;
- Drift-reducing technology;
- Monitoring of nozzles;
- Sensors for detecting places within the crop area that do not require treatment;
- Facilities for exterior cleaning of sprayers;
- Electronically stored product and safe information on the plant protection product package

CONCLUSIONS

Current European legislation protects the environment and the operator when working with plant protection products.

Operator security is determined by a combination of plant protection product, spraying technology used, operator behaviour and machine construction.

Manufacturers of self-propelled sprayers and tractors should determine the risks to the operator and the environment that may be caused by their use and reduce them to an acceptable level by appropriate measures.

With regard to tractors cabs or self-propelled sprayers, four categories are defined:

- category 1: Cab which does not provide a specified level of protection against hazardous substances;
- category 2: Cab which provides protection against dust(s);
- category 3: Cab which provides protection against dust(s) and aerosols;
- category 4: Cab which provides protection against dust(s). aerosols and vapours.

For spraying pesticides. the cab must be of category 4.

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RESEARCH ON OPEN-AIR NOISE EMISSIONS LEVEL OF A UNIVERSAL HAMMER MILL / *CERCETĂRI PRIVIND NIVELULUI EMISIILOR DE ZGOMOT ÎN AER LIBER AL UNEI MORII CU CIOCANE UNIVERSALE*

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Keywords: *universal hammer mill, acoustic power level, acoustic pressure level.*

ABSTRACT

The acoustic power level is a measure that must be specified on open-air equipment and its determination depends on several factors: microphones location for its determination, the shape of the measuring surface as well as the operation of the equipment. This work consists in determining the acoustic power levels by measuring the acoustic pressure in free field conditions according to EN ISO 3744:2011. in order to ensure the users' health and, implicitly, to increase the quality of this marketed equipment.

REZUMAT

Nivelul de puterea acustica este o marime ce trebuie specificata pe echipamentele cu functionare in aer liber, iar determinarea acesteia depinde de mai multi factori: modul de amplasare a microfoanelor pentru determinarea acesteia, forma suprafetei de masurare precum şi functionarea echipamentului. Lucrarea constă în determinarea nivelurilor de putere acustică prin măsurarea presiunii acustice în condiţii de câmp liber conform cu SR EN ISO 3744:2011. în vederea asigurării sănătătii utilizatorilor şi implicit la creşterea calităţii acestor echipamente comercializate.

INTRODUCTION

EN ISO 3744:2011 establishes the method for measuring acoustic pressure levels on a measuring surface that includes a noise source under conditions close to those of a free field near one or more reflecting planes, in order to calculate the acoustic power level produced by the noise source. The standard contains conditions for test environment and equipment, as well as procedures for obtaining the level of acoustic pressure on the surface from which the acoustic power level of the source is calculated.

Indicating the guaranteed acoustic power level will allow consumers and users to make informed product choices. In this respect, the paper consists in determining the acoustic power level by measuring the acoustic pressure in free field conditions according to the standard EN ISO 3744:2010. Measurements are made under operating conditions, at a distance of 1 m.

MATERIAL AND METHOD

Experimental research was carried out on a universal hammer mill (Fig. 1) used to grind cereal grains (wheat, barley, maize, oat etc.). corn cobs, trifolium, etc.

Fig. 1 – Universal hammer mill [1]

The universal hammer mill consists of the actual mill, fan, cyclone with supporting structure and dust bag, electric motor, transmission, electric panel.

The actual mill consists of a support frame on which the two-part housing is mounted: the lower fixed housing with outlet and the upper hinged housing with the feed hopper, concave and an evacuation flap chamber. The mill rotor consists of a disk axle on which 28 hammers are hinged by bolts.

The fan consists of housing and a 6-blade rotor that rests on bearing housings.

Table 1 presents the main technical characteristics of the mill:

Table 1 [1]

No.	Characteristic	UM	Values
1.	Electric motor power	kW	22
2.	Electric motor speed	rev/min	3000
3.	Supply voltage	V	380
4.	Gear ratio	-	1:1
5.	Number of hammers	pc.	28
6.	Maximum discharge height	m	28
7.	Sieve hole size are: for grains: for cobs: for trifoliums:	mm	 ø3 ø4 ø5
8.	Overall dimensions: length width height	mm	 3000 1000 1900

According to the provisions of the procedures in force at the Testing Department (DI) - INMA., metrologically verified equipment was used and within the validity term of the verification, the measuring accuracy being within the limits imposed by the metrological norms in force. Table 2 shows the measuring devices used:

Table 2

No.	Name of instrument or device	Measuring range	Measurement uncertainty/ Permissible error
1.	Measuring tape	0÷8 m	$\pm$0.5+10 $^{-4}$mm
2.	PULSE system with microphones	100÷10000 Hz	0.3 dB
3.	Anemometer Testovent 4000 type	0.4÷40m/s	measurement uncertainty 0.35m/s
4.	Thermohygrometer DH 50	humidity: 5÷95% temperature: - 20÷80°C	$\pm$ 0.1 % measurement uncertainty 0.5°C

The equipment used to determine the acoustic power level is a measurement and analysis system based on PC - "System Type 3569 C PULSE multi-analysis" (fig. 2) produced by Bruel & Kjaer, which consists in 12 microphones with preamplifier, amplifier and signal conditioning module with 12 measuring channels, assisted by a notebook computer and software required for the acquisition, processing, interpretation and presentation of data in tabular form. [5] Also, it includes a calibration module type 4231 which generates on the frequency of 1 kHz, a noise level of 94 dB or 114 dB. The calibration value of 114 dB is used when measurements are made in a noisy environment (noise level> 50 dB). [4]. [5]. [7]

Calibration of measuring channels is performed at the beginning of each set of measurements required to measure a noise source. [6]

Fig. 2 - PULSE Multi-analyser System Type 3560 to determine the acoustic power level

Figure 3 shows the *anemometer Testovent 4000 type* used to measure wind speed, while figure 4 shows *thermohygrometer DH 50.* used for measuring air temperature and humidity:

Fig. 3 - Anemometer Testovent 4000 type **Fig. 4 - Digital thermohygrometer DH 50**

RESULTS

The atmospheric conditions are presented below:

- temperature: 24.2°C;
- humidity: 48%;
- wind speed: 0.7÷1 m/s;

The acoustic power level was determined by a Pulse system equipped with 9 microphones disposed according to the parallelepipedal scheme of EN ISO 3744:2011 [2]. The tests of the universal hammer mill were carried out at INMA Bucharest, on the concrete platform of the Testing Department - DI. (See fig. 5).

Considering that the tests were made outside, an anti-wind screen was used to avoid affecting the measuring accuracy.

Fig. 5 – Determining the acoustic power level of the universal hammer mill (in the laden condition) by using Pulse system (9 microphones)

The results of the acoustic power level measurements of the universal hammer mill are shown in table 3.

Table 3

Probe	Acoustic pressure level per microphone									Acoustic pressure level averaged over the measurement surface	Acoustic power level L_w [dB]
	L_{p1} [dB]	L_{p2} [dB]	L_{p3} [dB]	L_{p4} [dB]	L_{p5} [dB]	L_{p6} [dB]	L_{p7} [dB]	L_{p8} [dB]	L_{p9} [dB]		
Probe 1	97.1	105.3	101.5	99.3	100.0	99.7	99.0	96.4	95.8	100.33	116.4
Probe 2	98.5	104.9	101.4	98.8	100.0	99.6	98.9	96.1	96.3	100.22	116.3
Probe 3	99.9	105.9	102.8	100.0	101.6	100.6	99.7	97.5	98.7	101.39	117.5
Average acoustic pressure level per microphone	98.5	105.4	101.9	99.4	100.2	100.0	99.2	96.7	96.9	-	

L_{p1}. L_{p2}. L_{p3}. L_{p4}. L_{p5}. L_{p6}. L_{p7}. L_{p8} and L_{p9} - represent the determined acoustic pressure level in each of the 9 measurement points

L_w – represents the acoustic power level that is calculated by the PULSE system

The uncertainty of measuring the acoustic power level of the universal hammer mill is 0.74 dB, a range established with a probability of approximately 95%.

The uncertainty of measurement has been estimated according to GUIDE ISO-IEC 98-3:2010: *Uncertainty of measurement. Guide to the expression of uncertainty in measurement.* [3]

CONCLUSIONS

The lowest recorded value of average acoustic pressure level per microphone was 98.5 dB and the average acoustic power level (rounded to the full value) was 116 dB. According to the Directive 2006/42/EC on Machinery, the equipment instruction manual shall specify the A-weighted sound pressure determined in the working position, if it exceeds 70 dB(A) and for the acoustic pressure values higher than 80 dB(A) the A-weighted sound power shall also be specified. The fact that this information is specified in the product's technical data will allows users to compare both the technical performance and the level of protection against airborne noise, creating prerequisites for informed product choices. Considering the high level of acoustic power, implicitly of acoustic pressure, it is recommended that the operator wears safety headphones as indicated in the technical manual of the equipment.

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STUDIES AND RESEARCHES REGARDING THE OPTIMIZATION OF WATER QUALITY FROM A RECIRCULATING AQUACULTURE SISTEM USING A WATER DENITRIFICATION INSTALLATION
/
STUDII ŞI CERCETĂRI PRIVIND OPTIMIZAREA CALITĂŢII APEI DINTR- UN SISTEM ACVACOL RECIRCULANT UTILIZÂND O INSTALAŢIE PENTRU DENITRIFICAREA APEI

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Keywords: aquaponic systems, *aquaculture, hydroponic, water denitrification.*

ABSTRACT
Aquaponics is defined as a combination of aquaculture and hydroponic systems, where the waste water rich in nutrients from the aquaculture system is introduced into a hydroponic system.

Plants absorb nutrients from residual water and thus improve or purify water in the aquaculture system. This method provides an ecological and sustainable system.

Aquaponics integrates a hydroponic subsystem and an aquaculture subsystem constituting the optimal practice for obtaining superior yields both quantitatively and qualitatively through the use of effluents from fish as a natural fertilizer for plants,. the plants giving the fish filtered and reconditioned water.

REZUMAT
Acvaponia este definită ca fiind o combinaţie între acvacultură şi sistemele hidroponice. prin care apa reziduală bogată în nutrienţi din sistemul de acvacultură este introdusă într-un sistem hidroponic.

Plantele absorb nutrienţi din apa reziduală şi astfel îmbunătăţesc sau purifică apa din sistemul acvacol. Aceasta metodă oferă un sistem ecologic şi durabil.

Acvaponia integrează un subsistem hidroponic și un subsistem de acvacultură. constituind practica optimă pentru obţinerea de producţii superioare din punct de vedere cantitativ cât şi calitativ prin folosirea efluenţilor de la peşti ca fertilizant natural pentru plante. plantele redând peştilor apa filtrată şi recondiţionată.

INTRODUCTION
Aquaponics is an intensive production system where several cultures are produced with reduced inputs of water and fertilizers and it is very suitable for small agricultural producers targeting local markets and agritourism opportunities (*Blidariu F.. 2013; Cristea F.. Radulov I.. Lato F..2011; Francis-Floyd. R.. C. Watson. D. Petty D. Pouder. 2012; Hughey T.W. 2005; Martan E. 2008*).

Aquaponic systems are more complex than the systems designed only for growing plants or fish breedin, because optimum conditions for each group of active organisms participanting in the production process – plants, fish and nitrifying bacteria are not identical. (*Blidariu F.. 2013; Francis-Floyd. R.. C. Watson. D. Petty D. Pouder. 2012; Hughey T.W. 2005; Martan E. 2008*).

For practicing efficient aquaponics an increased attention is necessary regarding consumer demands, food security and economic efficiency through continuous development of new technologies (*Blidariu F.. 2013; Cristea F.. Radulov I.. Lato F..2011; Francis-Floyd. R.. C. Watson. D. Petty D. Pouder. 2012; Hughey T.W. 2005; Martan E. 2008*)

The fact that nutrients in the water are consumed by vegetable "layers" makes the water become usable again for fish, so it is pumped or directed by free flowing back to the fish basin and the recirculation process continues (*Blidariu F.. 2013; Cristea F.. Radulov I.. Lato F..2011; Hughey T.W. 2005; Şumălan R.2009*).

Waste water from fish basins directed through pipes. irrigates the plants placed above another basin with their roots in the water, on a bed of gravel (or other materials), then returns to the fish basin in a continuous flow. In hydroponic cultures, plants are seeded either on floating artificial substrates or in sterile, porous, high water permeability substrate (*Blidariu F.. 2013; Cristea F.. Radulov I.. Lato F..2011; Hughey T.W. 2005*).

This way plants receive nutrients and fish water is naturally filtered. Fish effluents contain nitrates and bacteria that favor vegetables natural and organic growth (*Blidariu F.. 2013; Cristea F.. Radulov I.. Lato F..2011; Şumălan R. 2009*).

In fish tanks, ammonia exists in two forms, which together are called total ammoniacal nitrogen [3]. The nitrification process is the two-step biological oxidation of ammonia to nitrate. The process is carried out by autotrophic bacteria that use ammonia and nitrites as a growth substrate to generate energy for the cellular activity and reproduction (*Blidariu F.. 2013; Cristea F.. Radulov I.. Lato F..2011; Francis-Floyd. R.. C. Watson. D. Petty D. Pouder. 2012; Şumălan R. 2009*).

The efficiency of the nitrification process depends on the oxygen concentration, temperature, biomass retention time, alkalinity and pH. Nitrifying bacteria are strictly aerobic and they can nitrify only in the presence of dissolved oxygen (DO) (*Blidariu F.. 2013; Francis-Floyd. R.. C. Watson. D. Petty D. Pouder. 2012*).

Biological denitrification process is the conversion of nitrates to gaseous nitrogen in the absence of oxygen. This process is carried out by a part of heterotrophic bacteria, called denitrifying heterotrophic bacteria, having the ability to use nitrates and nitrites as electron acceptor in organic matter oxidation process (*Blidariu F.. 2013; Hughey T.W. 2005*).

The efficiency of the denitrification process is affected by the absence of dissolved oxygen, the presence of a suitable and active population of denitrifying bacteria, pH., temperature, nutrients and redox potential (*Francis-Floyd. R.. C. Watson. D. Petty and D. Pouder. 2012; Martan E. 2008; Şumălan R. 2009*).

MATERIAL AND METHOD

The hydroponic subsystem have the following main components:

- Two hydroponic tanks (Fig.1) placed on two metal supports. The water coming from aquaculture subsystem supplies in parallel each of the two tanks, being introduced at one of their ends and then removed at the opposite end;
- Floating supports for plants made of expanded polystyrene, presenting holes where the lettuce seedlings are planted;
- Devices for regulating water level in hydroponic tanks;
- Taps for regulating water flow rate in hydroponic tanks;
- Plant lighting panels placed over the hydroponic tanks, so that the distance to plants be adjustable, have the role to ensure the light necessary for photosynthesis.

Fig.1- Hydroponic tanks

Lighting panels will be placed above the hydroponic tank so that the distance can be adjustable and are intended to provide the light necessary to photosynthesis, thereby ensuring a good development of the plants (Fig.2).

Fig.2 -Lighting panels placed above the hydroponic tank

Connecting the hydroponic system to the aquaponic one is made using fittings and fixtures so that water supply for hydroponic basins can be ensured either through the outlet pipe or the supply pipe of the biological filter. Water removal from hydroponic basins will be made through the supply pipe of the mechanical filter.

Determining water quality in different phases of the technological process will be made by taking periodical samples and their analysis in laboratory.

The denitrifying installation from aquaponic cultures that will be used during the experiment has the following main characteristics:

- Type of culture .... aquaponic
- Fish species bred in recirculating acvacole systems (RAS)............. sturgeons and pike-perch
- Hydroponic culture vegetables .... lettuce
- Hydroponic culture surface………...... ………………………………….. 8 m2
- Culture density (lettuce) ………………………………………………. 14 piece/m2
- Average water need for lettuce growing 1.5 m3/day
- Lighting type ………….........…... LED lamps
- Energy source ……………..…………………………………………… photovoltaic panels.

For the determination of chemical parameters of the water there will be compared the results of the chemical analyzes of the samples taken from the water at the inlet and outlet of the water denitrification system.

Water samples subjected to chemical analyzes were taken from the basin feed pipe. In order to eliminate reading errors before chemical testing, they were filtered with filter paper to retain any solids. A 10 ml pipette, a 2 ml capacity pipette, an Erlenmayer glass, a glass funnel, a filter paper, a multiparameter HANNA C200 HI83200. reagents were used.

Determination of ammonium ion. nitrite. phosphorus and phosphate was performmed with an multiparameter photocolorimet.

Dissolved oxygen level and water temperature were recorded with a dissolved oxygen probe and temperature; this probe recorded the dissolved oxygen level and water temperature 24h of 24. 7 days out of 7 within 15 minutes.

The pH was recorded with a pH probe which will register 24h of 24, 7 days out of 7, at an interval of 10 minutes.

The organic compounds were recorded with a probe for organic compounds; this probe recorded the level of organic compounds 24h of 24, 7 days out of 7, within 5 minutes.

The water was tested for quantitative determination of chemical elements in the culture water (total nitrogen (N), phosphorus (P), potassium (K), sodium (Na), calcium (Ca), magnesium (Mg) , Zinc (Zn) by periodic sampling of water samples both from the system supply and from the discharges of the twoplants cultivation tanks.

For the water filtration in the aquaponic module were introduced green lettuce seedlings (latuca sativa). Daily water consumption and water temperature was measured, the average daily water quantity and average daily temperature was made.

The relative air temperature and humidity inside the aquaponic module was measured with a thermo-hygrometer both in the morning and in the evening.

The illumination period was 12 hours a day; the light intensity was measured with a luxmeter 30 minutes after the lighting fixtures went into operation, 30 minutes before light was spotted and somewhere in the middle. These measurements were performed on the median part of the aquaponic module on the leaf foliage of the lettuce.

RESULTS

In the experimental period, the average daily water quantity used was 690L / day with a minimum amount of 430 L / day and a maximum of 950 L / day and the average recorded temperature was 26.45 ° C recording a minimum of 24.7 ° C and a maximum of 27.5 ° C (Tab.1).

Regarding the relative humidity values, it was observed that in the repetition 2 there was a higher average level compared to the repetition 1.The average daily light intensity for repetition 1 was 10.288 lucsi. and for second repeat the average value was 10.316 lucsi. The maximum for repetition 1 was 10.467 lucsi and for repetition 2 it was 10.500 lucsi. The minimum value for light intensity repetition 1 was 10.110 lucsi and for repetition 2 it was 10.133 lucsi (Tab. 2).

Table 1

Daily water consumption and water temperature

	Water consumption L/zi	Water temperature °C
Minimum value	430	24.42
Maximum value	950	26.30
Medium value	690.00	24.81

Table 2

Microclimate parameters at aquaponic module level

	Repetition 1			Repetition 2		
	Temperature °C	Relative humidity %	Light intensity lux	Temperature °C	Relative humidity %	Light intensity lux
Minimum value	25.8	62.2	10.110	24.7	65.8	10.133
Maximum value	27.8	76.6	10.467	27.5	79.3	10.500
Medium value	26.8	69.4	10.288	26.1	72.55	10.316

The results of the measurements from the chemical analyzes made are shown in Table 3.

Table 3

Results obtained from chemical analyzes on chemical elements in water

No.crt	Chemical element	Water supply	Water evacuation
1.	Total nitrogen (N)	22.95	17.88
2.	Phosphorus (P)	3.60	3.53
3.	Potassium (K)	1.85	1.81
4.	Sodium (Na)	17.82	16.67
5.	Calcium (Ca)	19.92	19.80
6.	Magnesium (Mg)	2.86	2.63
7.	Cooper (Cu)	0.020	0.019
8.	Zinc (Zn)	0.054	0.046

CONCLUSIONS

Modern Aquaponics, a branch still at the beginning, which combines aquaculture with hydroponics judiciously applied, can sum up the benefits and even more, can mutually neutralize some major problems of the two such as the use as nutrients, by plants, of noxious products fish generated.

Concerning the results obtained from chemical analyzes on chemical elements in water, it was found that the amount of nitrogen decreased from 22.95 mg / L to 17.88 mg / L. ;also a progressive decrease was observed of the amount of nitrogen at a level of 22.95 mg / L at the introduction of the green lettuce crop to a level of 17.88 mg / L at the time of salad harvesting.

It was noticed that when the seedlings were introduced into the aquaponic module, the amount of potassium was similar in both the supply water of the aquaponic module and the water discharged from the aquaponic basins. In the following samples it was observed that the potassium level decreased progressively from the introduction of the plants into culture, but it was noticed that the potassium level was higher at the time of harvesting of the plants than in the samples taken when the plants were introduced into the system.

In the samples taken periodically it was observed that the level of phosphorus in the water discharged from aquaponic system basins is lower than in the sample drawn from the supply pipe.

Regarding the calcium, it was observed that at 10 days after the introduction of the seedlings into the aquaplaning module,the amount of calcium was similar in the feed water of the module aquaponic as well as in the discharged water, there was little difference between the amount of calcium in the sample taken from the supply water and the amount of calcium in the samples taken from the water drained from the module, which coincides with the harvest.

In samples taken periodically, the amount of sodium in the water was similar in both the supply water and the water taken from the introduction of green lettuce seedlings into the aquaponic module. During plant development small differences in the amount of sodium between samples in feeds and samples from discharges were observed, slightly lower.

The amount of magnesium was similar in both samples during the development of the plants, with slight differences in the magnesium concentration.

The amount of copper in the initial samples taken from the aquaponic water supply and from the drained water from the pools of the aquaponic module is similar. On the day of harvesting of the plants it was observed that the level of copper is slightly lower.

The level of zinc was maintained similarly, but a slight decrease was observed in the sample taken at the time of harvesting.

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ENERGETIC CAPITALIZATION OF BIOMASS RESIDUES RESULTED AFTER EXTRACTING FIBERS FROM *CANNABIS SATIVA L.*
/
VALORIFICAREA ENERGETICĂ A REZIDUURILOR DE BIOMASĂ REZULTATE DE LA EXTRAGEREA FIBRELOR DE CANNABIS SATIVA L.

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Keywords: *hemp residues, energetic capitalization, calorific value, ash content.*

ABSTRACT

Cannabis sativa L (hemp) is grown for its natural fiber content in a high percentage and also for its seeds rich in siccative oil. Hemp fibers are longer than flax ones, are very durable, quite strong and are used for confectioning a large range of textile product that are resistant to rotting even immersed in water. Short fibers (oakum) are used to confection mattresses, also as insulating material. Secondary products – oils, hemp cakes are used for obtaining different food supplements used for human nutrition, but also as animal feed,especially cakes. Another by product obtained from processing hemp is represented by hemp plant residues derived from the woody core of industrial hemp after being processed. The paper presents a characterization of hemp residues in terms of ash content, calorific value, in the view of capitalizing them as biofuel (briquettes / pellets).

REZUMAT

Cannabis sativa L (cânepa) se cultivă pentru conţinutul său în fibre naturale în procent relativ ridicat şi pentru seminţele bogate în ulei sicativ. Fibrele de cânepă sunt mai lungi decât cele de in. foarte durabile şi destul de rezistente și se utilizează la confecţionarea unei game largi de produse textile. rezistente la putrezire chiar şi aflate în apă. Fibrele scurte (câlţii) se folosesc la confecţionarea saltelelor precum şi ca material izolator. Produsele secundare - uleiuri. turtele sunt utilizate pentru obținerea diferitelor suplimente alimentare utilizate în hrana omului dar și în alimentația animalelor. in special turtele. Un alt produs secundar obținut de la procesarea cânepei o reprezintă reziduurile de biomasă - acestea sunt derivate din miezul lemnos al cânepei industriale prin procesarea paielor cânepei. În cadrul articolului aceasta puzderie de cânepa va fi caracterizată din punct de vedere al conținutului de cenușă. putere calorifică pentru a fi valorificate energetic sub forma de biocombustibil (brichete/pelete).

INTRODUCTION

Hemp is one of the oldest plants grown in our country (over 2000 years), being used mainly for obtaining fibers used to confection clothing. Stems of local species and those of wild hemp contain 10-12% fibers and those of improved varieties, 26-32%. Fiber content in stems is influenced by the variety and technological and pedoclimatic conditions. Fibers have a series of particularly valuable resistance characteristics (to traction, torsion, friction, rotting), extension (elastic and plastic), spinning capacity, bigger length than sisal, jute, manila or cotton making them usable in various fields: textile industry, manufacturing industry, automobile industry, etc. Hemp seeds contain 36% oil, 28% protein, 14-27% non-nitrate extractives, 17.8-26.3% cellulose and 2.5-6.8 ash. (*www.revista-ferma.ro/articole/tehnologii-agricole/canepa-cannabis-sativa-l*)

Due to this composition, hemp seeds can be used to extract oil, directly in human nutrition and also for producing margarine. Unrefined oil is used to obtain varnishes, paints, linoleum, soap and waxed cloths. Seeds are also used widely directly or in concentrated fodder in bird feed. Cakes resulted after oil extraction are used to feed birds, calves, horses, sheep, fish. etc. 600 g of hemp cakes are the nutritional equivalent of 1000 h of cereal seeds. (*www.fortasigratie.ro/realitati-contemporane/canepa-canabis.htm*)

Hemp wood represents about 55% of the stem weight and contains over 50% cellulose. The biomass residue resulted after extracting fibers or the entire plant can be used for: obtaining paper, phono insulating fiberboards, the furniture industry, artificial silk, soundproofing lining between plasterboards. The chaff resulting in seed crops is a particularly valuable fertilizer: 10 tons of hemp chaff are equivalent to 40 tons of manure. [2]

Fig.1 - *Cannabis sativa L* (plant and residues from extracting fibers). [14.15]

The energetic capitalization of hemp biomass residues deriving from processing the stems of industrial hemp allow the full recovery of this very valuable plant.

The use of conventional energy sources releases an important quantity of greenhouse gases into the atmosphere, among them the most important being carbon dioxide (CO_2) (*Hahn. 2011*). The excessive use of non-renewable resources has negative consequences on the environment, increasing the greenhouse effect, acid rains and the concentration of dust in the atmosphere. Climate changes are a characteristic of our planets history, the Earth undergoing during its history a series of major climate changes and a progressive warming process.. (*Komlajeva et al.. 2016; Matúš. Križan.. 2010*) As regard to the renewable energy, the European Council imposes for the EU a mandatory target for these resources in a share of 20% before 2020. Also, it is mandatory for member states to use at least 10 % bio-fuels for transportation before 2020. [10]. In the last 10 years, in the developed countries were finalized the technologies and equipment necessary for the efficient production and burning of briquettes from sawdust, straws, miscanthus, herbs and other forms of biomass (being possible to include biomass residues resulted from hemp processing). *(Prade et al.. 2016)*

In the current European context, energy is related to the limitation of global warming phenomenon because the Integrated European Policy for Energy that was based in Bruxelles, comprises three objectives: the safety of providing energy for EU member states, increasing the competitivity of the energy sector and stopping global warming. The European Commission proposed and the European Council accepted the target of limiting global warming by 2050 at 2 degrees Celsius above the levels in the pre-industrial era. Thus, the European Union assumes a world leading role concerning measures regarding climate changes. *(Prade et al.. 2016; Shaw. 2008). The conclusions of the European Council established for EU member states a commitment, independent from other world countries to reduce greenhouse gas emissions by at least 20% by 2020.*

The national legislative framework for the energy and environment sectors imposes according to the concept of sustainable development the promotion of obtaining energy from renewable sources, so that the ratio of electrical energy produced from these sources in total gross electric energy consumption to be 33% in 2010. 35% in 2015 and 38% in 2020.

The paper presents a series of experimental researches conducted on biomass residues resulted from the processing of hemp stems, in order to determine the possibility of using these residues in energetic purposes, thus ensuring the complete use of the plant in a sustainable manner.

MATERIAL AND METHOD

The first characteristic investigated was moisture content. Moisture influences the suitability of woody biomass to be used as solid biofuel, as a moisture content that is too big, has a negative impact on combustion, storage and also on the possibility to transform biomass into densified products.

Moisture content was determined by drying a test sample of hemp biomass residue in an oven. The content is reported based on the total mass of the test sample (on wet basis). Moisture content was determined according to the method described in standard SR EN ISO 18134-1:2015. Solid biofuels -

Determination of moisture content - Oven dry method - Part 1: Total moisture -- Reference method [10]. Aspects during the determinations are shown in figure 2.

Fig. 2 – Determining the moisture content

In order to **determine the lower calorific value**, according to the method described in [8], a calorimetric system type CAL 2K was used, figure 3, formed of: the calorimeter itself; bomb calorimeter; nacelle; combustion adapter; oxygen station; analytical balance with a precision of 0.1 mg.

Fig. 3 - Determining the lower calorific value for hemp samples

Operating manner: the material sample for determining the calorific power is introduced in the nacelle and it is weighed. A cotton thread is introduced in the center of the ignition wire and the other end is introduced in the sample. to propagate the combustion inside it. The nacelle situated in its support is introduced into bomb calorimeter and is hermetically sealed. The bomb is then filled with oxygen at the pressure of 20-30 bars from the oxygen station, connected to an oxygen tank. The ignition adapter is attached and then is introduced the interior vessel of the calorimeter, following the level indicator. In order to prepare the measurements, the following were introduced in the measuring menu: the measured sample weight, the type of operation that will be conducted (calibration or actual measuring), the type of bomb calorimeter and the correction values the heat generated from burning the cotton thread (implicit value is 50 J) or from other sources.

When everything is ready, the lid of the calorimeter is closed and the equipment starts the measuring operating. First, the interior vessel is filled with water and then the combustion takes place, the final stage consisting in equalizing the temperatures of the interior and the exterior vessels.by transferring the heat from the interior vessel to the exterior one. After that is completed, the measuring process ends and the value of the measured calorific power is displayed.

There are two types of calorific power: higher calorific value (Q_s) where the water vapors formed during combustion are condensed, giving their latent heat of vaporization, lower calorific value (Q_i) where the water vapors formed during combustion remain in a gaseous state and, as a result, they do not give their latent heat of vaporization. Lower calorific value at a constant pressure of an initial sample of a fuel is represented by the number of heat units which can be released by complete combustion of a mass unit of fuel in the initial state in an atmosphere of oxygen at constant pressure. The calorific value of solid fuels relates to 1 kg of fuel and is expressed in MJ/kg. [8.13]

Ash content determination: ash content for hemp residue samples was determined according to the method described in SR EN ISO 18122:2015 “Solid biofuels - Determination of ash content” [11], using a calcination oven. The samples were subjected to the calcination process. following the stages:

- Weighing the samples using an analytical balance (the mass of the samples has to be bigger than 1 gram);
- Placing the sample in the cold furnace;
- Setting the parameters of the ashing program on the furnace interface as follows: Raise the furnace temperature to 250 ^oC over a period of 30-50 min, maintain the temperature at this level for 60 minutes (in order to allow volatiles to leave the sample). Raise the temperature in the furnace to 550 (±10) ^oC over a period of 30 min, maintain the temperature for at least 120 minutes with the samples inside;
- Removing the samples from the furnaces and allowing them to cool to ambient temperature in a desiccator;
- Weighing the samples and calculating the ash content.

The stages above are represented in figure 4.,as follows:

Fig.4. – Representative stages for determining the ash content of hemp residues samples

Determining the volatile matter content – The volatile matter content is determined as the loss in mass, less that due to moisture when a solid biofuel is heated out of contact with air under standardized conditions, according to standard SR EN ISO 18123:2015 "Solid biofuels - Determination of the content of volatile matter" [12]. The method for determining volatile matter content is the following one:

- Fill a crucible with 1 g ± 0.1 g using an analytical balance;
- Heat the furnace at 900 ± 10 ^oC;
- Place the crucibles with the samples in the heated furnace for 7 minutes;
- Remove the crucibles and let them cool down to ambient temperature in a desiccator;
- Weigh the samples and calculate the volatile matter content.

RESULTS

Based on the methodology described above for the hemp residues the following parameters were determined: moisture content, lower calorific value, ash content and volatile matter content, the results being shown in table 1.

Table 1

Sample number	Moisture content [%]	Lower calorific value [MJ/kg]	Ash content [%]	Volatile matter content [%]
1.	9.73	17.522	4.53	75.34
2.	9.66	17.614	3.00	77.87
3.	9.69	17.568	3.77	76.23
4.	9.75	17.975	4.28	75.49
Average value	***9.71***	***17.670***	***3.89***	***76.23***

By processing the experimental data obtained and presented in table 1 using Excel program, the following graphs resulted (fig. 5):

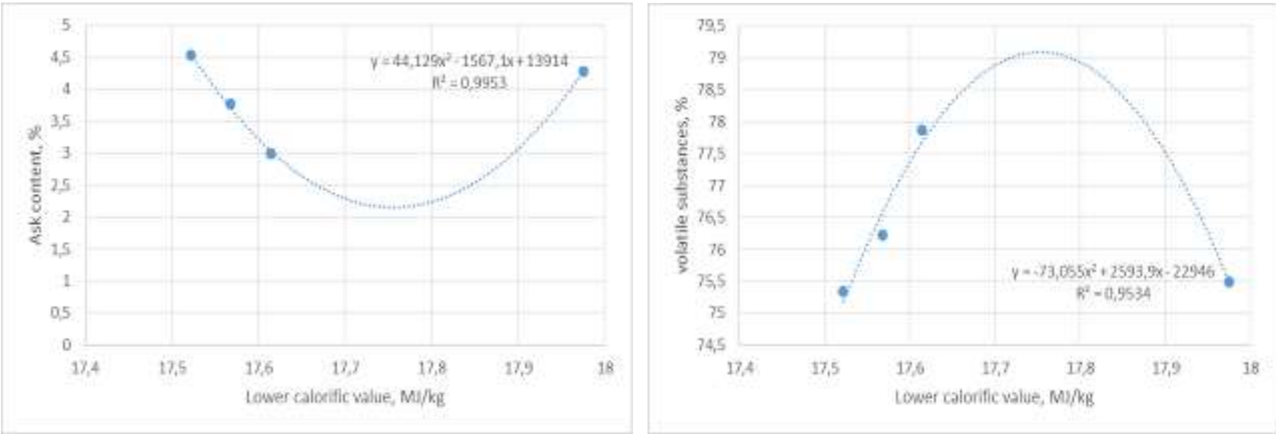

Fig. 5 – Graphic representation of experimental data

CONCLUSIONS

After conducting the experiments using the calorimeter, it was obtained for the inferior calorific value an average value of 17.670 MJ/kg for the hemp biomass residues. The variation in the inferior calorific value related to ash content shows a coefficient of determination of 0.99, obtained using a second-degree polynomial equation.

The variation of the lower calorific power relative to the resulting volatile substances has a coefficient of determination of 0.95. obtained by means of a using a second-degree polynomial equation.

The relatively high calorific value obtained for hemp biomass residues offers a high perspective for these plant residues to be used as alternative energy source, being possible to use them for obtaining fossil biofuel (briquettes, pellets. etc.).

The ash obtained after burning hemp residues can be used as natural fertilizer for gardening soils, as it contains a multitude of nutritive substances that can fill the deficiencies of vitamins and minerals. Ash is an important source of calcium, potassium, phosphorus and due to the fact that it is alkaline, it can also be used to balance the level of acidity in the soil.

The high volatile matter content of hemp biomass residues indicated its property to easily maintain combustion without adding binders.

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CONSIDERATIONS ON THE IMPORTANCE OF LIQUORICE ACTIVE PRINCIPLES / *CONSIDERATII PRIVIND IMPORTANTA PRINCIPIILOR ACTIVE ALE LEMNULUI DULCE*

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Keywords: *liquorice, flavonoids, saponins, glycyrrhizin, active principles.*

ABSTRACT

In this article we want to make an analysis of liquorice (Glycyrrhiza glabra L.) active principles, a plant that is part of Fabaceae family. Due to its very complex structure, the roots and stolons are widely used in the treatment of bronchitis and pharyngitis. Macro and micro-elements are found in the root such as Ca. P. Na. Mn. etc, but also active principles such triterpenoid saponins and flavonoids.

REZUMAT

În prezentul articol se doreşte a se realiza o analiză a principiilor active ale Lemnului dulce. Datorită compoziţiei foarte complexe. rădăcinile şi stolonii se utilizează pe scară largă în tratamentul bronşitelor şi faringitelor. În radacină se găsesc macro şi microelemente precum Ca. P. Na. Mn. etc.. dar şi principii active precum saponine triterpenice şi flavonoide.

INTRODUCTION

Liquorice (Glycyrrhiza glabra L.) (Fig.1) is part of Fabaceae family and is an old medicinal plant described in the paper “Erbolario Bergomense”, in 1441 by Guarnerinus de Padua [1].

Fig.1 – Liquorice [8]

It is used in food, cosmetic, pharmaceutical and textile industries. The main active element in liquorice is glycyrrhizin, a triterpenoid saponin which has a sweet taste, 30–50 times the sweetness of sucrose. Flavonoids have a mild diuretic and hypotensive action. In terms of physiological and pharmacodynamic action, in general, saponins are toxic and irritating to the cells due to reduced superficial tensioactivity, resulting in haemolysis processes. Irritating sternutatory action, reducing blood coagulation and increasing bronchial, stomach and intestinal secretions confers them emetic or expectorant therapeutic properties. In the gastrointestinal tract, due to the fact that they give colloidal solutions, they are very difficult to resorb, which is a therapeutic advantage.

MATERIAL AND METHOD

Liquorice main active element is glycyrrhizin, a triterpenoid saponin which has a sweet taste, 30–50 times the sweetness of sucrose. The sweetness is very different from sugar, being less instant, but lasting longer. Moreover, it is considered that liquorice “quenches thirst”, so its use in warm climate areas is very popular. Glycyrrhizin has, besides its organoleptic effects also pharmaceutical ones [9].

This perennial undergrowth is a powerful anti-inflammatory that is very efficient in treating arthritis and aphathae. In ancient times, Theophrastus recommended it against breast disease. Used for millennia in phytotherapy, liquorice is grown also in our country, especially in the southern area [7].

It is cultivated in spring, by planting divided roots. It vegetates in light or medium soils, sandy or clayey, wet non-waterlogged soils. Liquorice prefers full sun, but it can also grows in penumbra. It needs high temperature and places protected from strong winds.

It blooms from June to July. The rhizome and roots are harvested in spring, before blossoming and in autumn after leaf fall, only from plants over three years.

They are washed under water jet not to lose the active substances, then dried and covered with straw or reeds. Every 2-3 days they are winnowed, not to get mouldy and then covered again. They are kept for 10-15 days, then cut into pieces and dried in the sun in thin layers [7].

The dynamics of medicinal plants use is great. Thus, if in 1958 were isolated and studied 2,669 active substances in plants, in 1979 were isolated approx. 50,000. The number of flavonoids known increased in only two decades over five-fold from 295 in 1958 to 1,445 in 1978 [3].

Liquorice root (Fig.2) contains triterpenoid saponins (4-20%), particularly glycyrrhizin, a mixture of potassium and calcium salts of the glycyrrhizic acid, about 1% flavonoids, particularly flavones liquiritin, isoliquiritin and liquiritigenin, chalcones isoliquiritin, isoliquiritigenin and formononetin (isoflavonoid), 1-2% amine, asparagines, betaine and choline, amino acids, 3-15% glucose and sucrose, starch (2-25%). polysaccharides (arabinolactan), beta-sitosterol, coumarins, resins, essential oils (0.05%) [6].

Fig. 2 – Liquorice root [8]

RESULTS

Depending on the type of pyran or furan heterocycle condensed with a benzene ring and on the number and position of hydroxyl and methoxyl groups, the following types of **flavonoids** are known: flavans, flavones, anthocyanidins, flavanones, chalcones and aurones. These flavonoids (Fig.3). through biochemical reactions may develop into plants, depending on the needs, some into others or, by polymerization, into other substances. Thus, flavans form by polymerization catechins, that are part of catechin tannins of medicinal plants.

Flavones and isoflavones are the yellow pigments in leaves, flowers and fruits, derivatives of 2-phenyl and 3-phenyl-benzopyrone, being found in nature, especially as glycosides. Flavones have the property of absorbing UV radiation protecting the cytoplasm and chlorophyll. This physiological role for the plant explains their presence in larger quantities in tropical and equatorial species and in the alpine area species.

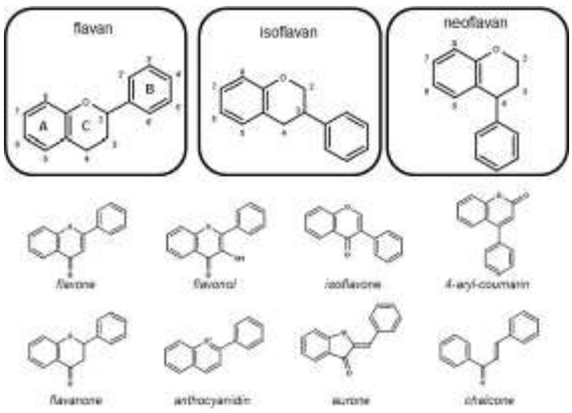

Fig. 3 - Structure of the structural backbones of the main flavonoid groups (flavan, isoflavan and neoflavan) and of relevant flavonoid classes. Atom numbering and ring nomenclature are also included [4]

Flavones are crystalline yellow substances soluble in hot water, alcohol, acetone, ethyl acetate and insoluble in chloroform and benzene.

In the past, flavones were assigned the role to protect capillaries which led some authors to assign them a vitamin role (vitamins P. C). The role to protect capillaries is assigned today to leucoantocians and epicatechin, which are more stable as dimers – considered precursors of vitamin C.

Flavonoids have a mild hypotensive and diuretic action.

In Romania, among the species richer in flavones there are: *Sophora japonica* (Japanese pagoda tree). *Fagopyrum* sp. (Buckwheat). *Polygonum* species. *Carduus marianus*. *Crcitaegus* species etc.

Flavones are accompanied by flavanones - colourless pigments that, by oxidation, are converted into golden-yellow aurones. Aurones and chalcones are usually present in flowers while flavanones are present both in flowers and leaves, bark and wood [3].

Saponins (Fig.4) are active substances of plant origin with sterol or triterpenoid amorphous structure, soluble in water, producing, by stirring persistent foam, from here also deriving their name.

Most of them make red blood cells haemolysis. They are toxic to cold-blooded animals.

Saponins, by enzymatic or acidic hydrolysis pass in monosaccharides (first are released hexoses, then pentoses, and then uronic acids) and in genins or sapogenols which, unlike the saponins, are insoluble in water and soluble in organic solvents.

According to the basic ring, saponins were classified in sterol or steroidal (27 C atoms) and triterpenoid (30 C atoms).

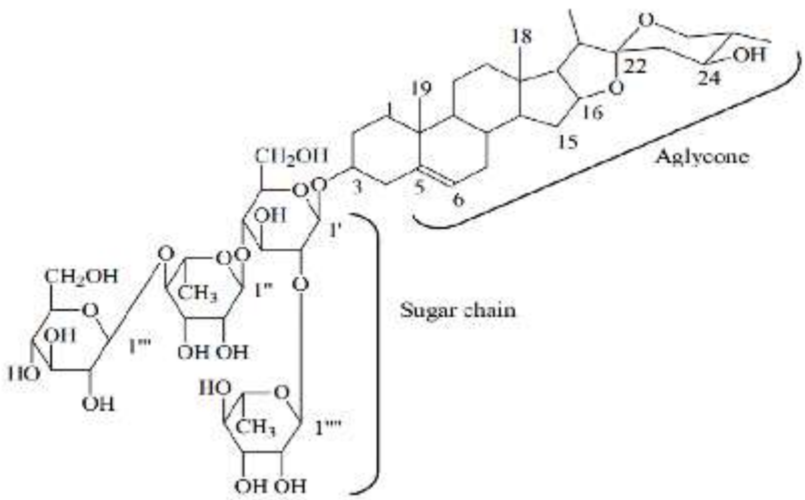

Fig.4 - Structure of saponin [5]

Steroidal saponosides have high therapeutic relevance because by acetylation, oxidation with CrO3 and hydrogenation in the presence of Pd may pass to hormones (progesterone, cortisone etc.). This group of saponins prevails in some tropical species wild or cultivated in our country (*Dioscorea. Agave*) and in some species of Solanaceae family.

The most widespread in nature are triterpenoid saponins, among which hederagenol (from *Hedera helix*),gipsogenol (from *Gypsophila paniculata*), glycyrrhizic acid (from *Glycyrrhiza glabra*), quinic acid, etc.

In terms of physiological and pharmacodynamic action, in general, saponins are toxic and irritating to the cells due to reduced superficial tensioactivity, resulting in haemolysis processes. Irritating sternutatory action, reducing blood coagulation and increasing bronchial, stomach and intestinal secretions, confers them emetic or expectorant therapeutic properties. In the gastrointestinal tract, due to the fact that they give colloidal solutions, they are very difficult to resorb, which is a therapeutic advantage.

Through the local irritating action they facilitate drugs resorption in the body via the gastrointestinal tract. Local irritating action on renal epithelial cells gives them diuretic properties.

In the pharmaceutical industry they are used in preparing emulsions and suspensions. They are also used in food, cosmetics and textile industries.

Sterol saponosides have great importance in the pharmaceutical industry for the production of steroid hormones [3].

CONCLUSIONS

The main active element in liquorice is glycyrrhizin, a triterpenoid saponin, which has a sweet taste, 30–50 times the sweetness of sucrose. Glycyrrhizin is a mixture of magnesium and potassium-calcium salts of glycyrrhizic acid. Depending on the variety, the concentration of glycyrrhizin in liquorice root can vary between 2 and 25%.

In the pharmaceutical industry it is used in preparing emulsions and suspensions. The roots and stolons are widely used in the treatment of bronchitis and pharyngitis, having anti-inflammatory and anticancer properties. In 1991, the European Union has proposed that the maximum dose of glycyrrhizin ingestion per day to be 100 mg (equivalent of 60-70 grams of liquorice). In April 2003. the Scientific Committee on Food of the European Commission confirmed this limit. To treat patients with chronic hepatitis B. glycyrrhizin was used in Japan by intravenous administration, often with positive results, being noticed a substantial improvement of liver functions.

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THE INFLUENCE OF APPLYING CHEMICAL AMENDMENTS AND FERTILIZERS ON SOIL AND PRODUCTION OF CORN CULTURE FOR SC PROGRESUL SRL - DOLJ /
INFLUENȚA ADMINISTRĂRII DE AMENDAMENTE ȘI ÎNGRĂȘĂMINTE CHIMICE ASUPRA SOLULUI ȘI PRODUCȚIEI LA CULTURA DE PORUMB PENTRU SC PROGRESUL SRL – DOLJ

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Keywords: *amendments, acidification, mineral fertilization, agro food.*

ABSTRACT
Since large areas of field crops are cultivated in Romania with cereals and legumes, corn crops find a favorable environment in almost all regions of the country for development and obtaining important production of grains and green matter.

The purpose of this paper is to explain the importance of knowing the physica,. hydro -physical and chemical properties of the soils studied in order to obtain the desired productions. The researches take place in the locality of Leu in Dolj Count at SC Progresul SRL, where the amendments with $CaCO_3$ and mineral fertilization with NPK were applied in different quantities aiming at their effect on the agrochemical properties of soil and implicitely on production. Soil fertility and changes occurring due to the application of $CaCO_3$ and NPK and the production of corn obtained, are also being studied.

REZUMAT
Deoarece în România se cultivă mari suprafeţe de teren cu cereale şi leguminoase de câmp. cultura porumbului găseşte mediu prielnic aproape în toate regiunile ţării pentru dezvoltare şi obţinerea de producţii boabe şi masă verde record.

Scopul acestei lucrări vine să argumenteze importanţa cunoaşterii proprietăţilor fizice. hidrofizice şi chimice ale solurilor luate în studiu. pentru obţinerea de producţii dorite. Cercetările au loc în comuna Leu din judeţul Dolj. la societatea SC Progresul SRL. unde s-au aplicat amendamente cu $CaCO_3$ şi fertilizare minerală cu NPK în diferite cantităţi. urmărindu-se şi efectul asupra proprietăţilor agrochimice ale solului cu efect asupra producţiei. De asemenea. se are în studiu şi fertilitatea solului şi modificările care au loc datorită aplicării de $CaCO_3$ şi NPK şi producţia de boabe de porumb obţinută.

INTRODUCTION
Continuing the underestimation of the soil, as it does not bring an immediate profit and the effects of its degradation that are felt slower than the degradation of water and air, represent a serious concern not only for Romania but also for the whole contemporary society (*Munteanu I. 2006*).

In the market economy, land valuation is very complex. In addition to the quality of the land on the basis of its intrinsic attributes (ecotourism), other economic, infrastructure and social elements influence the economic value (*Mihalache M.. Ilie L.. 2009*).

Since 1962, the effect of different types of nitrogen fertilizers, complex fertilizers, organo-mineral fertilizers and slow release of nitrogen has been studied on the production of wheat, maize, sunflower and sugar beet, the results demonstrating that there are no differences in production between assortments to the equivalent of the active substance (*Coculescu et al.. 1968. Hera et al.. 1978*). Culture plants react differently to fertilizer application. Thus, wheat has consumed nitrogen and phosphorus fertilizers better than corn in both the first and subsequent years of application (*Coculescu et al.. 1968*).

Corn, sugar beet, potato, sunflower are highly potassium-consuming and react better to the application of potassium fertilizers, to nitrogen and phosphorus agglomerates.

In addition to the direct effect of increasing the production of maize produced by the separate application of fertilizers with a certain element, an important role has the interaction between them when applied together.

The combined influence of cultivar and crop technology (application of irrigation and administration of appropriate fertilizer doses) leads to changes in the main physiological processes that can lead to optimization of technologies in order to obtain maximum yields at doses of rationally applied fertilizers (*Pandia Olimpia 2006 and Saracin I. 2010*).

Generally speaking, it is necessary to know the specific problems that may arise in different geographical areas due to the soil and climate conditions, the biological particularities of the cultivated plants, as well as the cultivation technologies used.

MATERIAL AND METHOD

SC PROGRUSUL SRL owns 37 ha of agricultural land in the locality of Leu, Dolj county, which is cultivated with: corn, wheat, rape, lucerne and sunflower. The studied years were 2014-2015 and included a number of 12 soil samples randomly harvested per hectare of cultivated agricultural land and we kept a batch for the blank sample that did not intervene. The characteristic soil of this area is luvic reddish brown which has a lower natural potential and therefore requires a correction of its acidity by fine-tuning or by applying different doses of NPK.

The experience was located in the autumn of 2014, when land finishing was done with 4 t / ha with $CaCO_3$. Being a polyfactorial experience with three factors, it was followed:

Factor A - Fertilization level with N with four graduations:

a1 - N_0

a2-N_{80}

a3-N_{120}

a4-N_{160}

Factor B - Fertilization with phosphorus and potassium with four graduations:

b1 - P_0

b2- P_{40}

b3- $P_{80}K_{60}$

b4-$P_{120}K_{80}$

Factor C - Amendments with two graduations:

c1-unamended

c2-$CaCO_3$ - 4 t / ha.

The soil chemical, physical and hydrophysical analyzes (*ICPA 1987; ICPA 1980*) were performed by methods known as:

The pH of the soil was measured by the potentiometric method, which is based on the determination of hydrogen ions according to the potential difference between the two electrodes introduced into the soil suspension and the results are read on the scale of the measuring apparatus that is graduated in pH units.

The Ah was determined by treating the soil with the solution of an alkaline hydrolysis salt with 0.1 N sodium hydroxide in the presence of phenolphthalein.

Sb. The method of determination is to treat the soil with an excess of 0.05 HCl 0.005 n and the sum of the bases being equivalent to the amount of HCl consumed in the reaction is determined by titration with NaOH in the presence of the methyl red used as an indicator.

Phosphorus was determined by the Engner-Riehm-Domingo method and was carried out by removing the mobile phosphorus with a solution of ammonium lactate acetate. The concentration in the phosphorus thus obtained is determined by colorimetry.

Potassium was determined by the same method as phosphorus and its dosing was carried out on a flame photometer.

For the determination of Humus, the Walkle and Black method was used and was made by oxidizing the organic substance in the soil with potassium dichromate in the presence of sulfuric acid and titrating excess potassium dichromate with a Mohr's salt solution.

Nt was obtained by applying the Kjeldahl method, which was done by soil mineralization with concentrated sulfuric acid and by measuring the excess sulfuric acid with 0.1N NaOH; the nitrogen content of the sample to be analyzed can be calculated.

Also the exchangeable hydrogen was made by percolation with a solution of 1n potassium acetate. For the hydroscopicity coefficient the Mitescherlich method was used; the wicking coefficient was determined by the Kacinscki NA method; the penetration resistance was determined by a laboratory penetrometer, the soil moisture determined by drying in the laboratory oven at 110^{0}C. Volumetric weight was determined by harvesting soil samples, weighing them before and after drying and making the calculation.

RESULTS

Following chemical, physical and hydro physical determinations of soil samples taken before the establishment of maize crops and chemical treatments in the soil and application of amendments, the following results were obtained.

Table 1

Physical and hydro physical characteristics of the 12 red luvic red soil samples harvested on SC Progresul SRL's agricultural land in September – 2014

Ground test	Depth	Porosity		Yes	Resistance to penetration	Hydrophysical indicators			
		Total	Of air			CH	CO	CC	I.U.A.
	cm	%	%	g/cm^2	Kg/cm^2	%	%	%	%
P1	0-25	49	18	1.37	49.11	6.81	12.1	22.3	11.03
P2	0-25	50	24.1	1.31	40.30	6.47	12.0	21.6	11.0
P3	0-25	48	17	1.42	57.67	7.42	13.0	23.1	12.17
P4	0-25	48	17.5	1.43	58.18	7.65	13.02	23.6	12.24
P5	0-25	50	24	1.30	39.60	6.46	12.01	21.2	11.1
P6	0-25	50	23.3	1.32	40.31	6.48	12.0	21.7	11.1
P7	0-25	50	23.2	1.32	40.31	6.48	12.0	21.7	11.1
P8	0-25	49	18.1	1.38	50.16	7.02	13.85	22.4	11.15
P9	0-25	50	22.7	1.33	43.32	6.53	12.8	21.5	11.02
P10	0-25	49	18.5	1.39	52.85	7.12	13.87	22.8	11.25
P11	0-25	49	18	1.37	49.11	6.81	12.1	22.3	11.03
P12	0-25	49	18	1.37	49.11	6.81	12.1	22.3	11.03

Source: Author

At depths of 0-25 cm, the total porosity is close to the minimum limit with slightly different values; this is also due to agricultural works, whereas aeration porosity has values of 24.1% and is satisfactory for this depth threshold. Apparent density has lower surface values but slightly increased progressively, but penetration resistance varies from 40.30 g / cm^3 to 58.18 g / cm^3.

The hydroscopicity coefficient ranges from 6-47% to 7-65%, as the determinations on many places are constant. The wicking coefficient values show a small variation on this profile, the water field capacity ranges from 21.2% to 23.6% of the dry soil weight to 25 cm depth. The range of active humidity ranged between 11.0% and 12.24% at the surface and at a depth of 25 cm.

To demonstrate the chemical composition of the soil studied, numerous chemical, physical and hydro physical determinations were performed:

Table 2

The chemical properties of the 12 red luvic red soil samples harvested on the agricultural land of SC Progresul SRL in September – 2014

Ground test	Depth	pH	Humus	N total	NO_3	P_2O_5 total	P mobile	K mobile	Ah	S.B.	S.H	T	V
	cm	H_2O	%	%	mg/100 g sol	%	ppm.	ppm.	me/100 g sol				%
P1	0-25	5.4	2.20	0.106	5.71	0.109	13.51	105	3.05	21.5	7.7	20.71	66.43
P2	0-25	5.4	2.20	0.106	5.71	0.109	13.51	105	3.05	21.5	7.7	20.71	66.43
P3	0-25	5.2	2.22	0.107	4.12	0.084	13.18	106	2.94	21.2	7.5	21.83	67.18
P4	0-25	5.3	2.24	0.108	3.14	0.085	13.05	107	2.93	20.9	7.4	22.87	69.45
P5	0-25	5.4	2.20	0.106	5.71	0.109	13.51	105	3.05	21.5	7.7	20.71	66.43
P6	0-25	5.3	2.24	0.108	3.14	0.085	13.05	107	2.93	20.9	7.4	22.87	69.45
P7	0-25	5.5	2.27	0.109	2.18	0.086	12.10	110	2.67	20.8	7.3	24.76	71.48

P8	0-25	5.4	2.20	0.106	5.71	0.109	13.51	105	3.05	21.5	7.7	20.71	66.43
P9	0-25	5.5	2.27	0.109	2.18	0.086	12.10	110	2.67	20.8	7.3	24.76	71.48
P10	0-25	5.5	2.27	0.109	2.18	0.086	12.10	110	2.67	20.8	7.3	24.76	71.48
P11	0-25	5.4	2.20	0.106	5.71	0.109	13.51	105	3.05	21.5	7.7	20.71	66.43
P12	0-25	5.4	2.20	0.106	5.71	0.109	13.51	105	3.05	21.5	7.7	20.71	66.43

Source: Author

Based on these results of the chemical determinations on the studied soil, they fall within the limits of characterization of red luvic red soil. The soil reaction is moderately acidic and the pH value at the 12 samples collected was between 5.2-5.5. The humus content for all 12 samples is low with values between 2.20-2.27%. But, as well as total nitrogen as supply, it has low values ranging from 0.106-0.109%, these results being correlated with the values of the humus content. Mobile phosphorus existing in the arable layer is poorly supplied, medium supplied with mobile potassium. Nitric nitrogen has a higher concentration in samples 1, 2, 5, 8, 11 and 12 with slight decrease for soil samples 3, 4, 6, 7, 9 and 10.

The hydrolytic acidity is higher in the arable layer and has values ranging from 3.05 me / 100g soil with a slight decrease to 2.67me / 100g soil. The total cationic exchange capacity has average values increasing depending on the increase in the amount of clay from 20.71 to 24.76%. The degree of saturation in the bases is small and has values ranging from 66.43 to 71.48%, being stable for this depth.

In the autumn of 2015, more precisely in October, after the soil was subjected to the application of chemical amendments and fertilizers according to the work plan, followed their effect on the improvement of soil quality and the production of grain trying to collect the samples in approximately the same places as in 2014. Following the physical determinations, the following results were obtained:

Table 3

The physical and hydro physical characteristics of the twelve red luvic red soil samples harvested on the agricultural land of SC Progresul SRL in October – 2014

Ground test	Depth	Porosity Total	Yes	Resistance to penetration	Conductivity hydraulics
	cm	%	g/cm^2	Kgf/cm^2	mm/h
P1	0-25	51	1.37	37.18	9.8
P2	0-25	56	1.27	32.40	9.48
P3	0-25	49	1.42	38.17	10.12
P4	0-25	49	1.43	34.16	10.12
P5	0-25	56	1.30	39.60	12.87
P6	0-25	56	1.35	32.40	12.87
P7	0-25	56	1.35	32.40	12.87
P8	0-25	51	1.38	36.14	11.56
P9	0-25	56	1.36	33.85	12.87
P10	0-25	51	1.38	36.14	11.56
P11	0-25	50	1.35	37.18	10.92
P12	0-25	51	1.35	37.18	11.56

Source: Author

After chemical, physical and hydro physical determinations, it can be noticed that on the fined agro fond, but also on the background of $N_{160}P_{120}K_{80}$. there was a slight increase compared to the unmodified land and without treatments to the maize crop until the harvest. Thus, total porosity increased 49 to 51% and apparent density ranged from 1.27 to 1.43.

Table 4

The chemical properties of the 12 red luvic red soil samples harvested from SC Progresul SRL's agricultural land in October – 2014

Ground test	Depth	pH	Humus	N total	NO_3	P mobile	K mobile
	cm	H_2O	%	%	mg/100g sol	ppm.	ppm.
P1	0-25	6.4	2.31	0.136	5.71	15.50	112
P2	0-25	6.4	2.31	0.136	5.71	15.52	112
P3	0-25	6.2	2.34	0.147	4.12	16.19	113
P4	0-25	6.3	2.36	0.138	3.14	16.07	114
P5	0-25	6.3	2.31	0.136	5.71	15.56	112
P6	0-25	6.3	2.36	0.138	3.14	14.06	114
P7	0-25	6.3	2.39	0.139	2.18	16.13	117
P8	0-25	6.4	2.31	0.136	5.71	17.59	113
P9	0-25	6.2	2.39	0.139	2.18	15.13	116
P10	0-25	6.2	2.39	0.139	2.18	15.12	116
P11	0-25	6.4	2.31	0.136	5.71	16.54	113
P12	0-25	6.4	2.31	0.136	5.71	16.54	114

Source: Author

After application of chemical amendments and fertilizers, the soil pH improved with minor modifications due to fined agro fond, having a positive influence on the establishment of corn crops and a great contribution to the physical properties of the soil.

Soil humus content does not undergo any major changes except in combination with chemical fertilizers, with increases of 2.20 on unimpeded agro fond and 2.39% on agrofonds treated.

Soil nitrogen has also had a similar evolution to humus and phosphorus and potassium have significant increases in all variants on chemically-treated and fined agrofonds.

Table 5

Production of grain maize obtained in 2015

Factor	Average production q/ha	
A	76.3	
B	78.6	
C	unamended	68.3
	$CaCO_3$ -4 t/ha	79.5

Source: Author

Due to these improvements in chemical and biochemical soil content, the established corn culture has capitalized well in terms of quantity and quality of production over the unmodified agrofonds, knowing that maize assimilates both low doses of NPK and high doses.

CONCLUSIONS

Due to the application of calcium-based modifications and the application of variable doses of NP, an improved acid reaction of the soil and a better supply of plants with fertilizing elements and water are achieved.

Analyzing the interaction between the three factors, it can be concluded that all three have contributed positively to the production of grain maize compared to the unmodified and untreated control.

From the results obtained, it is clearly obvious the necessity of chemical and mineral fertilization, the treatment of slightly acidic soil with amendments before the establishment of the culture, in order to obtain planned results.

Of the above, it is clear that apparent density is positively influenced by agrofond and applied fertilizer doses.

The total porosity, hydraulic conductivity has remarkable improvements on the fertilized agrofond and the penetration resistance is significantly diminished.

In conclusion, soil reaction has been improved and it is recommended that treatments and appropriate use of amendments be made to obtain production increases in the established crop.

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TECHNICAL EQUIPMENT FOR WORKING THE SOIL IN THE ROW OF FRUIT TREES SIMULTANEOUSLY WITH ROOT CUTTING TO MODERATE SHOOTS GROWTH AND PRECISION FOLIAR FERTILISATION
/
ECHIPAMENT TEHNIC PENTRU LUCRAREA SOLULUI PE RÂNDUL DE POMI FRUCTIFERI. CONCOMITENT CU TĂIERILE DE RĂDĂCINĂ PENTRU MODERAREA CREȘTERII DE LĂSTARI ȘI FERTILIZAREA FOLIARĂ DE PRECIZIE

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Keywords: *soil working, root cutting, fruit trees.*

ABSTRACT
INMA Bucharest designed, produced and tested an experimental model of technical equipment for working the soil in the row of fruit trees along with root cutting to moderate shoots growth and precision foliar fertilization, within the innovative technology of fruit plantation maintenance in the rural areas. The paper presents experimental research with the aggregate of the TD 80D New Holland tractor and the ETR technical equipment for determining the qualitative working indexes of soil working and root cutting. The results obtained generate valid solutions for the achievement of a significantly improved product within the fruit plantation maintenance technology and offer to the interested economic agents an efficient product, adapted to the specific heavy conditions in the country.

REZUMAT
INMA București a proiectat. realizat și testat un model experimental de echipament tehnic pentru lucrarea solului pe rândul de pomi fructiferi. concomitent cu tăierile de rădăcină pentru moderarea creșterii de lăstari și fertilizarea foliară de precizie în cadrul tehnologiei inovatoare de întreținere a plantațiilor pomicole aflate în zonele rurale. Lucrarea prezintă cercetări experimentale cu agregatul format din tractorul TD 80D New Holland și echipamentul tehnic ETR pentru determinarea indicilor calitativi de lucru la lucrarea solului și tăierile de rădăcină. Rezultatele obținute generează soluții valide pentru realizarea unui produs semnificativ îmbunătățit în cadrul tehnologiei de întreținere a plantațiilor pomicole și oferă agenților economici interesați un produs performant. adaptat condițiilor grele specifice din țară.

INTRODUCTION
The objectives of world fruit growing in general and in Europe, in particular, are directed to reduce the growing vigour of cultivated fruit species (apple, pear, cherry, sour cherry and walnut) by mechanical interventions on the root system in order to establish intensive and super-intensive fruit plantations with high tree density per area unit (ha). On these small-scale plantations, technological works such as cuttings, phytosanitary treatments, fruit harvesting etc, can be made easier, with greater efficiency, less workforce and maintaining the same production (Hoying. 2017).

Worldwide research in fruit growing has shown that cutting a part of the tree root system, correlated with crown cutting, is beneficial, helping to keep trees down and maintaining root growth within the nutritional space of each tree.

The area of nutrition may be a field with herbicide applied and/or worked on a 1-1.4 m band under the tree rows where one can apply norms of localized irrigation (drip, micro-spraying) and fertilization (fertigation) of which only trees can benefit (Dorais et Ehret. 2008).

A root cutting equipment at a distance of 50-60-cm from the trees trunk (row axis) with high quality working indexes maintains root growth only in the nutrition space and is a control operation of fruit trees growth.

Root cuttings must be made in the side of the row by mechanically reducing their length during vegetation, on both sides of the row, alternatively, one year on one side and in the second year on the other side, in order not to compromise the stability of the fruit trees. The cut of a root should be like that of a branch, be straight, without fringes and keeps the required distance.

MATERIAL AND METHOD

The experimental researches were carried out with a technical equipment for soil working on the row of fruit trees. together with root cuttings to moderate shoots growth and precision foliar fertilization. ETR (figure 1) was made by INMA and intended for the maintenance of fruit plantations in order to increase fructification efficiency by performing a single-pass ploughing on a strip at a distance from the trunk to maintain loose soil to the surface, cutting the root at a distance from the trunk to moderate the shoots growth and foliar fertilization.

Fig. 1 - Technical equipment for working the soil in the row of fruit trees along with root cutting to moderate shoots growth and precision foliar fertilization, ETR

ETR technical equipment is designed to perform proper root cutting works in all soil types where fruit plantations are located, ranging from mild to hard and with a stony structure soil, specific to plantations located on hill areas; it is robust and has stability in the working direction by maintaining the same distance from the tree axis (Marinela Mateescu et al.. 2016).

It performs the following works in the same time:
- ploughing on a strip at a distance from the trunk to maintain a loose soil to the surface;
- root cutting at a distance from the trunk to moderate shoots growth;
- precision foliar fertilization.

The ETR technical equipment consists of a metal frame fitted with a coupling system at the three-point suspension mechanism of a wheeled tractor, a wheel for copying the soil and adjusting the working depth of a right plough body for ploughing, a support for an articulated guide and means for adjusting the cutting depth and blocking in the vertical cutting direction of a disc-type working part with a large diameter for root cutting (Marin E. et al.. 2015) and a device for precision foliar fertilization.

The main technical characteristics of the ETR technical equipment are:

- Power source:	80 HP wheeled tractor
- Strip width, mm	250
- Strip depth, mm	150..200
- Working depth of the large diameter disc knife, mm	10...250
- Cutting distance from the trunk, mm	500...600

The experiments made in laboratory-field conditions to determine the qualitative and energetic indices of ETR technical equipment, were performed on the INMA Bucharest experimental plot according to the specific test procedure made for this purpose. The following measuring and control equipment and instruments were used to test the ETR equipment: metallic tape, mechanical timer, device for measuring plow depth, rulers, set squares, poles, stakes. etc.

The following qualitative working indexes were determined under laboratory conditions:
- root cutting depth;
- distance from the trunk to the root cutting disc;
- soil working depth;
- distance from the trunk to the soil working plough body.

RESULTS

The root cutting depth was determined using the measuring tape by measuring the distance between the surface of the non-worked field and the rim of the large diameter disc knife active part (Figure 2). Measurements were made in 5 points at intervals of 2 m between them, for three working speeds (small, medium and maximum) of the ETR technical equipment. Based on the measurements, the *average depth of root cutting* was calculated. Table 1 shows the average values of root cutting depth. The coefficient of variation is defined as the ratio between the value of the standard deviation and the average value and is given as percentage (Marin E. et al.. 2012).

Table 1

Average values of root cutting depth

Repetition	*a*	a_m	*S – standard deviation*	*Cv- variation coefficient*
	cm	cm	cm	%
Working speed: 3 km/h				
1	19.6	19.42	0.29	1.49
2	19.4			
3	19.4			
4	19.2			
5	19.5			
Working speed: 5 km/h				
1	19.4	19.36	0.27	1.39
2	19.3			
3	19.6			
4	19.3			
5	19.2			
Working speed: 7 km/h				
1	19.2	19.20	0.37	1.95
2	19.3			
3	19.4			
4	18.9			
5	19.2			

Fig. 2 - Measuring root cutting depth

- *The Distance from the trunk to the root cutting disc* was determined by means of measuring tape by measuring the distance between the trunk and the rim of the large diameter disc knife active part (Figure 3). Measurements were made in 5 points at intervals of 4 meters between trees for three working speeds (small, medium and maximum) of the ETR technical equipment. Based on the measurements, the *average distance from the trunk to the root cutting disc* was calculated.

Table 2 shows the average values of the distance from the trunk to the root cutting disc.

Table 2

Average values of the distance from the trunk to the root cutting disc

Repetition	*d*	*d_m*	*S-standard deviation*	*Cv- variation coefficient*
	cm	cm	cm	%
Working speed: 3 km/h				
1	58	56.4	3.33	5.90
2	56			
3	54			
4	58			
5	56			
Working speed: 5 km/h				
1	60	59.3	4.51	7.61
2	58			
3	56			
4	62			
5	60			
Working speed: 7 km/h				
1	54	53.5	4.51	8.47
2	52			
3	50			
4	56			
5	54			

Fig. 3 - Measuring the distance from the trunk to the root cutting disc

- *Soil working depth* was determined by means of measuring tape by measuring the distance from the level of the soil resulting from the work to the bottom of the furrow (Figure 4). Measurements were made in 5 points at intervals of 2 m between them for three working speeds (small, medium and maximum) of the ETR technical equipment. Based on the measurements, the *average soil working depth* was calculated. Table 3 shows the average values of the soil working depth.

Table 3

Average values of soil working depth

Repetition	*a_l*	*a_{lm}*	*S-standard deviation*	*Cv-variation coefficient*
	cm	cm	cm	%
Working speed: 3 km/h				
1	16.2	16.12	0.45	2.80
2	16.0			
3	15.8			
4	16.4			
5	16.2			
Working speed: 5 km/h				
1	16.0	16.02	0.33	2.10
2	15.8			
3	15.6			
4	16.0			
5	15.8			
Working speed: 7 km/h				

Repetition	a_l	a_{lm}	S-standard deviation	Cv-variation coefficient
	cm	cm	cm	%
1	15.6	15.44	0.36	2.33
2	15.4			
3	15.8			
4	15.6			
5	15.2			

Fig. 4 - Measuring soil working depth

- *The distance from the trunk to the soil working plough body* was determined by means of measuring tape by measuring the distance between the trunk and the furrow wall made by the soil working plough body. Measurements were made in 5 points at intervals of 4 m between trees for three working speeds (small, medium and maximum) of the ETR technical equipment. Based on the measurements, the *average distance from the trunk to the soil working plough body* was calculated.

Table 4 shows the average values of the distance from the trunk to the soil working plough body.

Table 4

Average values of the distance from the trunk to the soil working plough body

Repetition	d_t	d_{tm}	S-standard deviation	Cv-variation coefficient
	cm	cm	cm	%
Working speed: 3 km/h				
1	130	126.4	5.03	3.98
2	124			
3	124			
4	126			
5	128			
Working speed: 5 km/h				
1	128	126	3.61	2.86
2	126			
3	124			
4	128			
5	124			
Working speed: 7 km/h				
1	126	125.2	4.51	3.60
2	128			
3	124			
4	122			
5	126			

The energetic indexes determined were:

- *Effective working speed* V_e. in km/h

A linear space *s* was measured by means of measuring tape on the test field and the beginning and end of this space was marked with 2 stakes. When the aggregate became operational in the test field, the timer was switched on and at the exit of that respective space it was stopped and the time *t* for passing the space *s* was read out on the timer. Determinations for three working speeds were made. The operation was repeated 5 times for each working speed and based on this, the arithmetic mean was calculated.

With recorded data, the travel speed *v* was calculated with the following relation (*Tecusan et Ionescu. 1982*):

$$V_e = \frac{3.6 \times s}{t}\ \textbf{. km/h}$$

- *The theoretical working capacity $W_{ef.}$* in ha/h

The theoretical working capacity was calculated with the relation (Caba et al. 2013):

$$W_{ef} = 0.1 \times B_l \times V_e\ \textbf{. ha/h}$$

where

- B_l is the working width of the technical equipment, in m
- V_e – working speed, in km/h.

Energetic indexes for the aggregate TD 80D New Holland tractor (http://agriculture.newholland.com. 2011) + ETR technical equipment are shown in Table 5.

Table 5

Energetic indexes for the aggregate TD 80D New Holland tractor + ETR technical equipment

Parameters determined	Value				
Travel speed, km/h	3.0	3.1	3.2	4.9	5.0
Theoretical working capacity W_{ef}. ha/h	0.66	0.68	0.70	1.0 7	1.1

Figure 5 shows an aspect during the determination of energetic indexes for the aggregate TD 80D New Holland tractor + ETR technical equipment.

Fig. 5 - Aspect during the determination of energetic indexes for the aggregate TD 80D New Holland tractor + ETR technical equipment during root cutting and soil processing works

CONCLUSIONS

- The qualitative working indexes achieved during the experimentation of the ETR technical equipment fall within the agrotechnical requirements corresponding to each individual work. The values of the variation coefficients were below 10%. which is admitted by the agrotechnical requirement, as follows:

- Variation coefficient values of root cutting depth depending on the working speed are graphically represented in Figure 6;

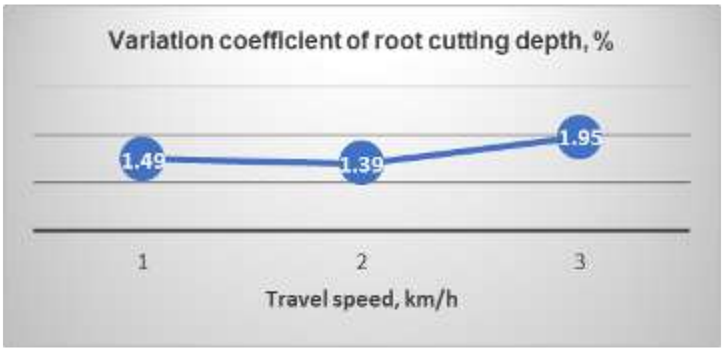

Fig. 6 - Variation coefficient of root cutting depth depending on the working speed

- Variation coefficient values of the distance from the trunk to the root cutting disc, depending on the working speed, are graphically represented in Figure 7;

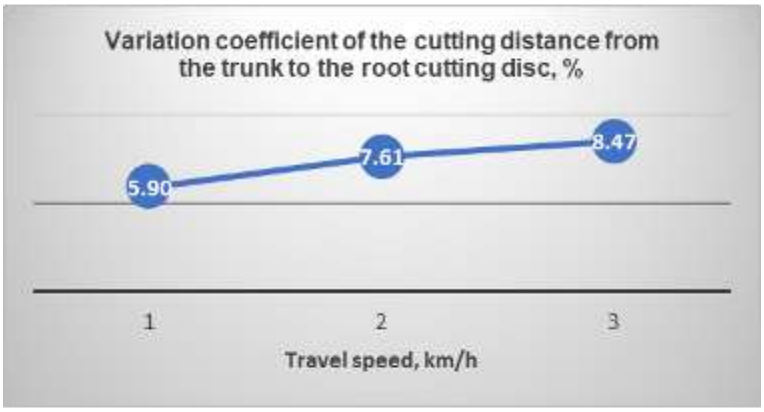

Fig. 7 -Variation coefficient of the distance from the trunk to the root cutting disc depending on the working speed

- Variation coefficient values of soil working depth depending on the working speed are graphically represented in Figure 8;

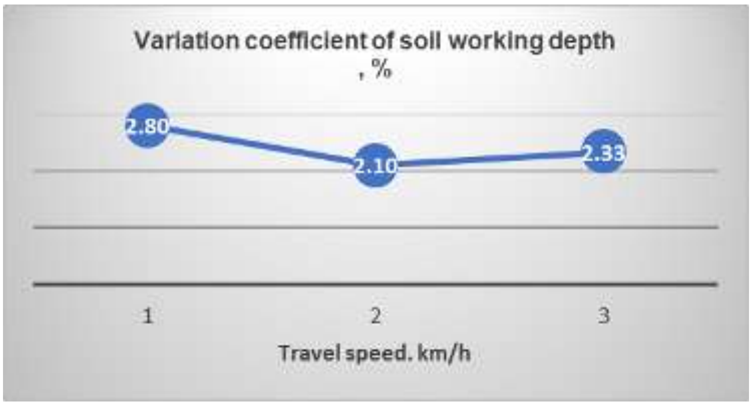

Fig. 8 - Variation coefficient of soil working depth depending on the working speed

- Variation coefficient values of the distance from the trunk to the soil working plough body depending on the working speed, are graphically represented in Figure 9.

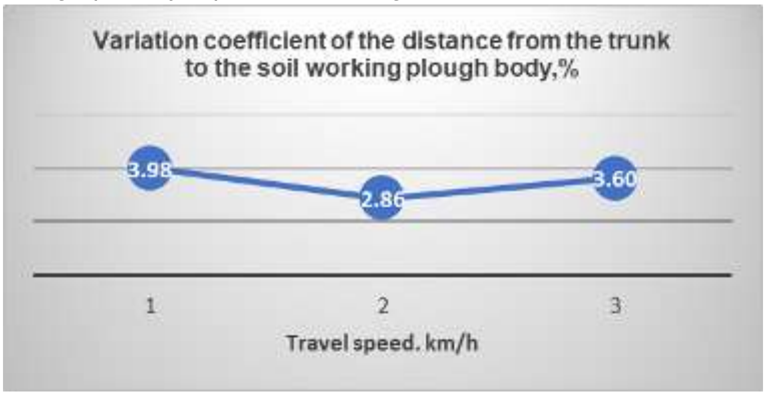

Fig. 9 - Variation coefficient of the distance from the trunk to the soil working plough body depending on the working speed

- The energetic indexes achieved during the experimentation of the ETR technical equipment fall within the agrotechnical requirements corresponding to each individual work.
- Experimental research has enabled the technical and technological validation of the solutions addressed when designing the components of the ETR technical equipment;
- Experimental results make it possible to develop a useful recommendation for farmers applying innovative maintenance technology for fruit plantations.

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CONSIDERATIONS ON THE TECHNOLOGY OF MINT CULTURE AND ESSENTIAL OILS OBTAINING
/
CONSIDERATII PRIVIND TEHNOLOGIA DE CULTURĂ A MENTEI SI OBTINEREA DE ULEIURI ESSENTIAL

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Keywords: *mint, essential oil, technology, methods, distillation.*

ABSTRACT

The article contains aspects on all agro-technical works necessary for the production process for the establishment, maintenance and harvesting of mint culture, as well as for obtaining essential oils from this plant using the water vapour distillation method, which is most often used for the extraction of essential oils from plants.

The article also presents the importance of cultivating this plant for the pharmaceutical. cosmetic and food industries.

REZUMAT

Articolul cuprinde aspecte privind totalitatea lucrărilor agrotehnice necesare procesului de producţie pentru înfiinţarea. întreţinerea şi recoltarea culturii de menta. precum şi obtinerea uleiurilor essential din aceasta planta aplicand metoda distilarii cu vapori de apa. metoda ce este cel mai des utilizata pentru extractia de uleiuri esntiale din plante.

De asemenea. se prezintă importanţa cultivării acestei plante pentru industria farmaceutică. industria cosmetică precum şi în industria alimentară.

INTRODUCTION

Mentha piperita (fig.1) is an annual herbaceous plant. nevertheless considered by many authors to be perennial. Mint culture is of particular importance for the pharmaceutical, toothpaste, food.,soap, perfume industries.

Mint is one of the oldest known medicinal plants. “Papyrus Ebers” mentions that the mint was used 1550 years BC in Egypt. In Europe it was cultivated for the first time in England (1760), where the first quantities of essential oil were obtained. [8] The largest essential oil production (3/4 of the world production) is provided by the United States, England, France, Italy, Bulgaria; Russia and Japan compete for the world production of mint essential oil.

Fig. 1 - Mentha piperita

Mint is an adjuvant in hepatic and digestive disorders due to gastric and gallbladder secretion; it combats hepatic colic, pyloric and gastrointestinal spasms, spastic and intestinal fermentation colitis, gastrointestinal infections, nausea, vomiting, aerophagia, lazy digestion, abdominal bloating, chronic diarrhea, dysentery and indigestion; it cleans the intestines having beneficial effects in the case of intoxication and pinworm infection. [5]

Mint is a sterile hybrid, which in agricultural practice is multiplied exclusively by vegetative reproduction using the underground stolons. Sometimes, for scientific purposes, mint is multiplied by aerial stolons, by rooting the stems or even the leaves. [6]

Underground stolons used as propagation material must be white and free from the traces of disease and pest attack. Of particular importance to the quality of the underground stolons is the way of maintaining the culture, its fertilization and exploitation, as well as the age of the plantation. [3]

Perennial species with rhizomes and stolons, in the first year develops a main root that is replaced in autumn by the adventitious roots of the inner part of the stem, which will become the plant rhizome. From the nodules of the rhizome start underground and aerial stolons. The stem is up to 100 cm and has 4 edges; it is green, reddish-violet or violet-brown. The leaves have a short petiole up to 1 cm long. 3-8 cm long and 1.5-2.5 cm wide limb. Flowers are grouped at the top of the stems and have violet or pink colour and they bloom in July. [2]

The fruit consists of 4 small nuts covered with persistent calyx. The weight of 1000 seeds is 0.065 g. [3] Mint begins to vegetate in the early spring when the average temperature is around 3 to 5^0 C. The optimum temperature for mint growth during summer is 18-20^0 C. maximum 22-25^0 C. The temperature influences the essential oil content.

Mint special needs for soil humidity are explained by the particular extension of the leaf surface and the presence of a relatively weak and superficial root system.

The lack of humidity is very harmful to mint cultures because it reduces the plant's height by 1.5 times and decreases its weight by about 4 times. Also, soil humidity is the factor that can decide the optimum planting time. It is very important to know that at soil humidity below 30% the mint must not be planted because most of the stolons dry, regardless of their initial water content.

For normal growth and development, mint needs continuous illumination for at least 12 hours. Essential oil obtained from shady plants has enhanced menthone content and low menthol content. [3]

Mint culture technology:

Crop rotation: For mint culture, good preplants are: hay maslins, grain legumes, autumn cereals, hoeing crops, early vegetable plants. etc. Lucerne, clover, perennial grass crops and grain corn are not indicated. [1]

Fertilization: The effect of organic or mineral fertilizers on increasing the mint production is unanimously recognized. [3] Phosphorus and potassium are applied annually in the autumn, while nitrogen in spring at the start of vegetation. Recommended doses are: phosphorus: 50-80 kg / ha active substance, nitrogen: 50-70 kg / ha active substance, potassium: 35 - 60 kg / ha active substance. Well-fermented manure, as a complex fertilizer, applied under the basic tillage, has a particular effect on the production of mint green mass. [3] The manure in doses of 20 - 40 t / ha. is applied well fermented. In this case, mineral fertilizer doses are halved.

Increasing the amount of fertilizer increases production continuously, but economically only to a certain level; nevertheless, the fertilizer quantities do not affect the level of essential oil content. [3]

Tillage: Basic soil preparation is based on its humidity at release. When the soil is dry and deep ploughing perfectly ground cannot be performed, after cereals or legumes, first will be performed a coarse mulch work at 8-10 cm deep, then, when the soil has sufficient humidity, ploughing will be executed at 28-30 cm deep; the preparation of the land for the planting is done by passing the disc harrow in aggregate with the adjustable tooth harrow and the levelling bar at the depth of 15-18 cm by 2 successive passes. Soil preparation does not influence the essential oil content.

Planting: To obtain large mint crops it is absolutely necessary to execute the planting in autumn and only in exceptional cases in very early spring. The optimum period is set according to soil humidity, generally in October.

Stolons are not planted in dry soil because they dehydrate very quickly, the planting standard is: 1000-1400 pieces / ha, planting distance 70 cm between rows, planting depth 12-15 cm., optimum density 20-26 plants / m2.

Planting on small surfaces is done manually, the stolons being placed on the bottom of the furrow opened by ridge plough, 2-3 pieces in continuous row, taking care to overlap with ¼ of their length.

On large surfaces, the planting is semi-mechanized by opening the furrow using ridge plough, the manual planting, the covering being done with machines adapted to the model of those used in vegetable gardening or with the stolons planting machine. [1]

Maintenance works: In spring, as soon as the conditions allow entry the field, the mint culture is harrowed perpendicularly to the rows direction to a depth where the stolons are not removed from the ground.

During the vegetation period, mechanical hoeing is performed 2-3 times, manual hoeing is performed 2-3 times and 1-2 weeding works. In the second year of vegetation, in spring, it will be hoed and rows will be cut with the cultivator at a distance of 50 cm.

Mentha piperita as a plant cultivated for medicinal purposes was known late in 1760 in England, when the first quantities of essential oil were obtained, being mentioned in the British Pharmacopoeia. [8] From a historical point of view, the plant was appreciated for its medicinal uses, being a natural medicine used since ancient times. Unlike many other plants and essential oils, the benefits of mint oil and mint have been studied and confirmed by the scientific community. Mint oil contains many minerals and nutrients including iron, manganese, magnesium, calcium, folic acid, potassium and copper. It also contains omega-3 fatty acids, vitamin A and C. [7]

The therapeutic results of mint essential oil are well known. Researchers know that this extract, especially because of its main active ingredient, menthol, has analgesic effect when applied to the skin. Looking for an alternative to synthetic anti-inflammatory drugs, they started from the premise that mint oil could work effectively. After a series of preliminary tests, the experts at the Clinic of Neurology with Christian-Albrecht University of Kiel. Germany, presented the first information on the positive results of applying mint oil on the forehead, proving effective in relieving stress-induced headache - the effect being the same as the administration of a 1000 mg dose of acetaminophen (paracetamol). [9]

Before using mint oil, tell the doctor or pharmacist if you are allergic to mint or anything else, because the product may contain active ingredients that may cause allergic reactions or other problems.

MATERIAL AND METHOD

Water vapour distillation is the most widespread method and is currently used for essential oil extraction in most aromatic plants; it is frequently used for industrial-scale extraction, but also has widespread use in the laboratory. The process consists in the passage of water vapors obtained in certain steam production installations, in special boilers at quite high temperatures and pressures, through the vegetative mass (flowers, grass. etc.). placed in special baskets.

The distillation installation is made of the following elements: steam source, the vessel for raw material (1000 l), cooling vessel (500 l) and Florentine vessel for separating essential oil and flower water.

The steam source can be an electric generator to produce steam under pressure, a boiler operating with gas/diesel, wood (pellets) or an electric boiler.

The distillation vessel (tank) must be made of stainless steel the same as the steam input and output pipes and the sieve inside on which the plants are placed. The cover must be made of the same material and it must be provided at the top with inside temperature indicator display and safety valves that open if there is overpressure in the vessel. The cooling vessel and coil should also be made of stainless steel.

The last component of the installation and perhaps the most important one is the essences separator (Florentine vessel). It serves to separate the essential oils from flower water.
The plant material, in this case. is supported by a grate or a perforated plate placed at a suitable distance from the bottom of the still. Its bottom is empty.

The grate level allows avoiding any contact between the water and the plant. The steam pipe is connected to the bottom of the tank: steam will be injected under the grate. Load the plant mass in the tank.

By this method, water vapour enters the plant mass subjected to distillation, destroy the cover of the oil glands, volatilize oil and then mix with it. The mixture of water vapour and oil vapour passes into the condenser (condensing vessel), where it turns into a liquid that is nothing but the mixture of water and essential oil. This mixture reaches the Florentine vessel (separation vessel) where the separation takes place, namely, the volatile oil being lighter will be deposited in layer above the water. [4]

Figure 2 shows the technological scheme of the equipment for obtaining essential oils:

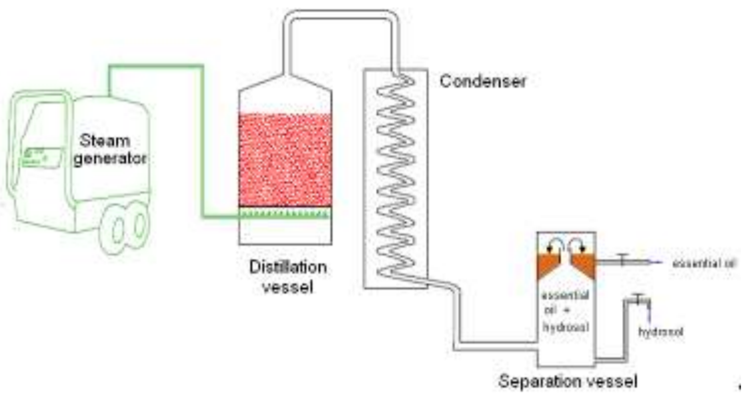

Fig. 2 - Technological scheme of the equipment for obtaining essential oils

The main technical characteristics of the installation for obtaining essential oils through distillation are presented in Table 1:

Table 1

No.	Characteristics	Values
1.	Vessel working capacity	approx. 700 l (80kg - 100kg)
2.	Working pressure	0.18 – 0.2 bar
3.	Working temperature	103 - 105°C

RESULTS

In order to conduct experimental research, freshly harvested plants of Mentha piperita variety were used and we obtained the following results presented in Table 2:

Table 2

Charge weight	Distillation time	Oil obtained (litres)	Flower water (litres)
80 kg	70 min.	0.45	28
90 kg	75 min	0.50	30
100 kg	85 min	0.65	35

CONCLUSIONS

Mint culture is of particular importance for the pharmaceutical, cosmetic and food industries. As active principles, Herba Menthae and Folium Menthae contain: volatile oil 1.5-3.5%. The oil is rich in menthol 50-60% and menthone 9-12%. They also contain methyl and valerian acetate, tannins, flavonoids, polyphenols and a bitter principle. The pharmacological action consists in the fact that mint leaves have stimulatory, stomachic, antiseptic and antispasmodic, cholagogic and spasmolytic, anti-inflammatory, antiemetic. antidiarrheic and antitussive properties.

Oils extracted at low pressures contain only essential components, while wax, essential resins and other colour compounds are not found in oils. Distillation is a simple and economical method of extracting essential oils.

The optimum temperature for mint growth during summer is 18-20^0 C. maximum 22-25^0 C. The temperature influences the essential oil content. Fertilizer amount and soil preparation do not influence the level of essential oil content.

The lack of humidity is very harmful to mint cultures because it reduces the plant's height by 1.5 times and decreases its weight by about 4 times.

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CONSIDERATIONS ON MAINTAINING THE SEEDING DEPTH FOR MODERN PLANTING MACHINES FOR HOEING PLANTS
/
CONSIDERAŢII PRIVIND MENŢINEREA ADÂNCIMII DE SEMĂNAT LA SEMĂNĂTORILE MODERNE DE PLANTE PRĂŞITOARE

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keywords: *seeding, precision planting, gauge wheel, downforce.*

ABSTRACT

Seeding depth represents an important factor in achieving a quality seeding work. The lack of maintaining a constant seeding depth leads to obtaining productions smaller than those provided by agrotechnical norms, which in the end translates in financials loses for farmers. Placing seeds at the optimal depth requires an adequate downforce on each planting unit throughout the entire period of developing the work. In the paper are presented a series of considerations on the additional means of maintaining the seeding depth, used by the producers of precision planters.

REZUMAT

Adâncimea de semănat reprezintă un factor important în realizarea unei lucrări de semănat de calitate. Nemenţinerea constantă a adâncimii de semănat conduce la obţinerea de producţii mai mici decât cele prevăzute de normele agrotehnice. ceea ce. în final reprezintă pierderi financiare pentru fermieri. Plasarea seminţelor la adâncimea oprimă necesită o fortă de apăsare adecvată pe fiecare secţie de semănat. pe toată perioada desfăşurării lucrării. În lucrare sunt prezentate consideraţii în privinţa mijloacelor suplimentare de menţinere a adâncimii de semănat utilizate de producătorii de semănători de precizie.

INTRODUCTION

Through the importance and sensitivity of the work, seeding plays a special role within the technologies for establishing crops.

The seeding of hoeing plants represents an important link in the technology of cultivating plants, being performed mechanized, using precision planting machines. Seeding works need to answer the following basic requirements (*Brencu and Marin. 2010; Popescu S. et al.. 2007; Uceanu et al.. 2008*):

- To ensure constant distances between rows;
- To ensure high collinearity between plants on row;
- To ensure the maintenance of a constant distance between seeds on a row;
- To ensure that seed breakages do not occurs in the seed distribution process;
- To ensure the maintenance of a constant seed burying in the soil and to compact the soil within the limits provided by the agrotechnical requirements of the respective plant variety;
- In the case of equipment performing the seeding of multiple seeds in the pocket, it is necessary to ensure that the number of seeds in the pocket is maintained constant.

Seeding depth is distinctive for each crop, but it also depends on soil texture, moisture degree and the level where it is found in the soil, germination type, seed size (quantity of reserve substances in the seed) etc. (*Gangu et al.. 2006*) The depth of burying the seeds is determined both during the seeding work, as well as after seed germination.

The working process of precision seeding includes the following operations (*Gratoon et al.. 2003; Paunescu. 2009*):

- opening the trench by the coulter;
- distributing and directing the seed (or seeds) towards the bottom of the trench by the distribution device;
- pressing seeds in the soil on the bottom of the trench (optional);

- covering seeds with damp soil by the compaction wheel of the unit.

High quality seeding ensures good seed germination, explosive and even emergence, normal plant growth and development through the early land covering with the possibility to win the competition against weeds. (*Marin et al.. 2010*)

MATERIAL AND METHOD

The working process of a precision planter includes a very important stage in achieving a quality seeding work: opening the trench by the coulter.

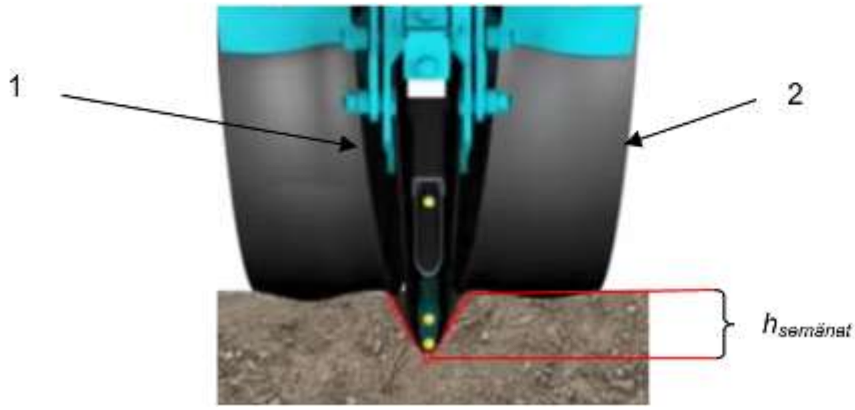

Fig.1 – Opening the trench where the seeds will fall from the distribution device [12] **through the means of the leading tube**
1 – double disc coulter; 2 – gauge wheels

Seeding depth depends on: soil type, seeding period, seedbed preparation and the seed's germinative energy. For modern planters, seeding depth is given by the difference in level between gauge wheels and the double disk for opening the trench where the seeds will fall from the distribution device through the means of the leading tube.

Fig.2 – Precision planter planting unit [12]
1 – double disc coulter; 2 – gauge wheels; 3 – damper

The wheels for maintaining the depth (gauge wheels) allow soil displacement upward and towards the exterior on the sides of the trench for a lighter compaction on its side wall. Also, gauge wheels transfer the weight of the planting unit in the lateral part of the trench wall to avoid the compaction of roots and robust plants at its base.

By placing the seeds at a smaller depth than the one given by agrotechnical norms, risks that can lead to uneven crops or to problems related to plant sustaining, can appear. A strong root system is capable to help the plant in difficult situations during the vegetation period and sustains a vigorous stem on which the foliar apparatus and production elements are developed. The depth of burying seeds is determined both during the seeding work as well as after plant germination.

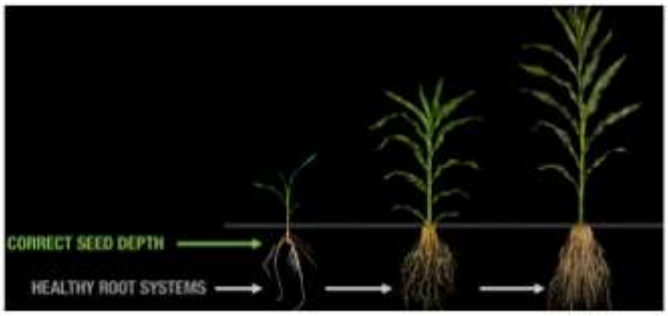

Fig.3 – Correct planting depth [13]

Different seedbed preparation conditions have imposed the use of additional means of maintaining the contact between the planting unit and the soil.

Fig.4 – Different planting conditions [15]

Classification of additional means of maintaining the contact of planting units with the soil, depending on their operation manner:

- mechanical;

a b

Fig.4 – Mechanical drive for adjusting seeding depth [12]

a – "Front depth control" concept (the adjustment of seeding depth is made from the front wheel);
b – "Balancing system" concept (the adjustment of seeding depth is made by driving both the front and rear wheels)

- hydraulic (hydraulic pressing cylinders automatically controlled from a distributor of the tractor's hydraulic system).

Fig.5 – Hydraulic drive for adjusting the seeding depth [11]

Fig.6 – Correct seeding depth maintenance on the entire working width using additional loading (pressing) systems fitted on each planting unit [13]

In the case of a modern planting machine, seeding depth is mainly ensured by the coulter and the gauge wheels. The coulter has the role of opening the trench where the seeds will fall into through the means of the leading tube. The gauge wheel is provided with an oscillating arm, thus allowing the balancing of this wheel in relation to the coulter. This way occurs the depth adjustment of the trench where the seeds will fall.

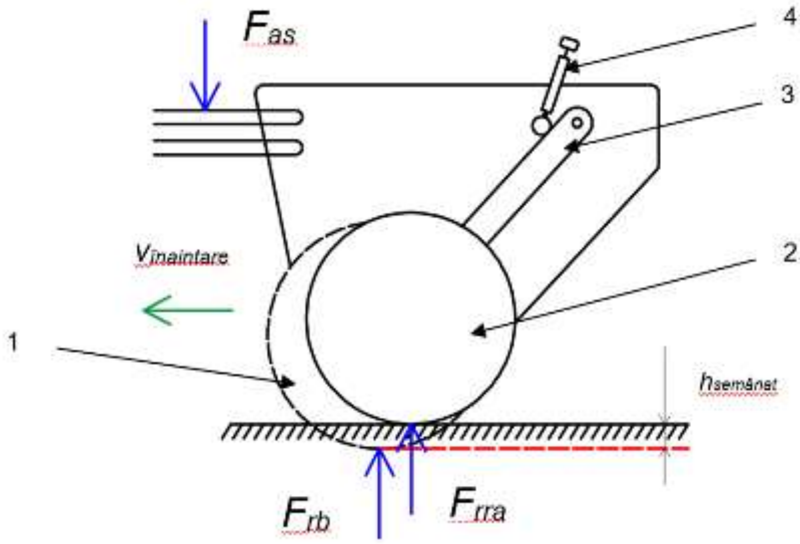

Fig.7 – Static analysis of the forces involved in maintaining the seeding depth
1 – double disc coulter; 2 – gauge wheels; 3 – depth adjustment arm; 4 – damper
F_{as} – downforce on the planting unit; F_{rb} – reaction force on the coulter;
F_{rra} – reaction force on the gauge wheel

To achieve the correct penetration of the coulter as safely as possible, it is necessary that:

$$F_{as} > F_{rb} + F_{rra} \tag{1}$$

Fig.8 – Optimal seeding depth with ferm, but uncompacted furrow walls [14]

If the additional mechanism for maintaining the depth presses with too little force of the gauge wheels, the latter will detach intermittently from the ground thus leading to the collapsing of furrow walls.

Fig.9 – Collapsed furrow sidewalls due to a force too small on the gauge wheels [14]

If the additional mechanism for maintaining the depth presses with too much force of the gauge wheels, furrow walls will be too compacted.

Fig.10 – Compacted furrow sidewalls collapsed due to too much force on the gauge wheels [14]

RESULTS

In order to obtain a maximum depth of the seeding trench (7-12 *cm*), studies and experimental researches have demonstrated that a planting unit should exert a downforce between 900 – 1600 *N*. (*Karayel D.. Šarauskis E. 2011; Gratton et al.. 2003; [10]*)

The force for opening the trench by the coulter needs to have a certain value so that the depth is maximum. This force, determined experimentally, has values of at least 200 *N* and depends on: (*Karayel D.. Šarauskis E. 2011; Gratton et al.. 2003; [10]*)

- type of soil;
- degree of soil processing;
- soil moisture;
- planting machine forwarding speed;
- the force of opening the trench by the coulter;

The force transmitted to the mechanism for maintaining the depth is determined through the means a force transducer fitted on the cylinder of the additional mechanism for maintaining the depth.

CONCLUSIONS

Seeding depth is an important factor in achieving a quality seeding work and depends on:

- additional loading (pressing) systems fitted on each planting unit;

- when the coulter penetrates the soil easily, a high penetration force is not required and, therefore, gauge wheels take the largest part of the planting machine's weight;
- in the situations when the coulter encounters areas with high compaction, it will require an increased penetration force and thus, the force pressing on gauge wheels is reduced.

The advantages of using additional pressing systems fitted on each planting unit are:
- maintaining an adequate seeding depth;
- maintaining the stability of the planting unit during the seeding work;
- obtaining adequate seed germination and plant development.

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EXPERIMENTAL RESEARCHES ON ESTABLISHING THE WORKING QUALITY INDICATORS OF EQUIPMENT FOR APPLYING SOLID CHEMICAL AMENDMENTS IN ORCHARDS AS CLOSE AS POSSIBLE OF TREES ROOT
/
CERCETĂRI EXPERIMENTALE PRIVIND DETERMINAREA INDICILOR CALITATIVI DE LUCRU AI ECHIPAMENTULUI PENTRU ADMINISTRAT AMENDAMENTE CHIMICE SOLIDE IN LIVEZI CÂT MAI APROAPE DE RĂDĂCINA POMILOR

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Keywords: *amendments, strips, working quality indicators.*

ABSTRACT

The applying of solid chemical amendments aims at enriching the soil with nutrients (phosphorus, nitrogen, potassium etc.). indispensable for the growth and development of future fruits. The paper presents the evaluation of performances of equipment for applying solid chemical granulated, crystallized or powdered amendments in strips located in the tree rows of area of the maximum root development.

REZUMAT

Administrarea amendamentelor chimice solide are ca scop îmbogăţirea solului cu elemente nutritive (fosfor, azot, potasiu etc). indispensabile creşterii şi dezvoltării viitoarelor fructe. In lucrare se prezinta evaluarea performanţelor unui echipament pentru administrat amendamente chimice solide destinat pentru transportul şi administrarea îngrăşămintelor chimice solide, granulate, cristalizate sau pulverulente în benzi situate pe rândurile dintre pomi in zona de dezvoltare maximă a rădăcinilor.

INTRODUCTION

The ultra-intensive agriculture practiced due to the technological level reached has led to the degradation of the environment and human life, requiring the introduction of a sustainable agriculture concept, where conservation is a fundamental condition.

Increasing the competitiveness of farms through better use of human resources and production factors and the fulfilment of national standards and community standards is an objective that can be achieved by endowing the fruit farm with new performing machinery that is necessary for the establishment and maintenance of fruit plantations [2].

The development of an organic fertilization technology in fruit growing and appropriate equipment for applying this technology will help to protect the environment by gradually replacing chemical fertilizers with organic fertilizers [3].

Fertilization in fruit growing is a maintenance work that is done both before planting and after setting up to ensure nutrient intake necessary for the development of fruit trees and the production of qualitative and quantitative fruit. [7.8]

In general, the equipment for applying solid chemical amendments must meet the following requirements [4.5]:

- needs a small number of workers;
- has great mobility during work and has high safety in operation;
- keeps the adjustments made while working;
- has multiple rigorous adjustment possibilities and can achieve the usual minimum and maximum norm provided for in agro-technical requirements;
- is easy to handle and adjust, has good work protection;
- has low manufacturing costs;
- allows high productivity;
- has pleasant design and mounting and demounting facilities;
- has low energy consumption and high yields [1]

MATERIAL AND METHOD

The equipment for applying solid chemical amendments used for research purposes consists of: frame, bunker, spreading device, conveyor belt, transmission, cardan shaft, support leg. The kinematic scheme of conveyor belt transmission is shown in figure 1.

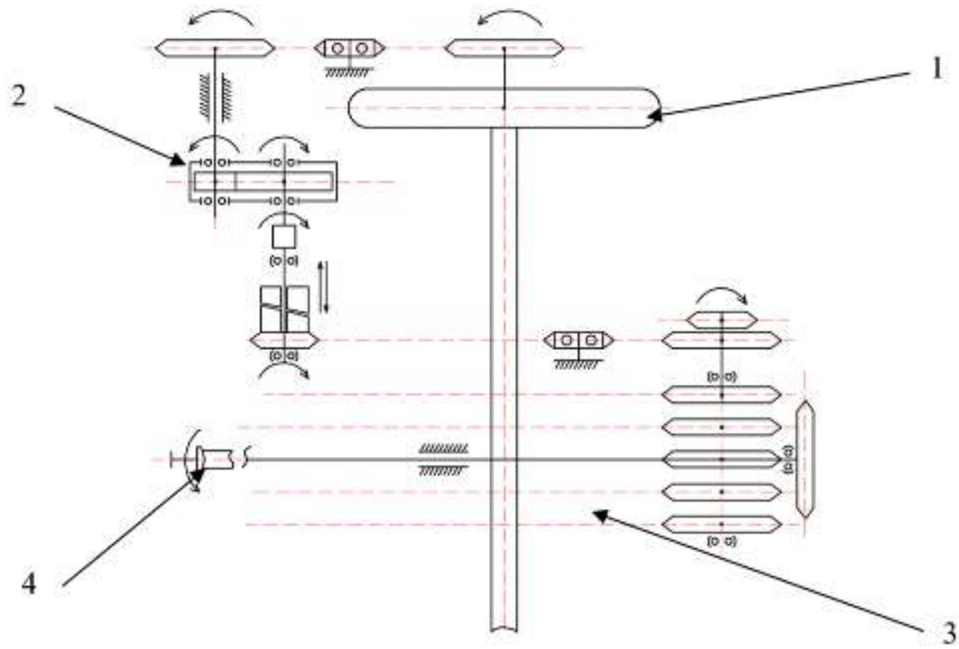

Fig.1 - The kinematic scheme of transportation conveyor
1 –drive wheel; 2 – reducing; 3 – conveyor belt; 4 – cardan shaft

Within experiments, the following qualitative working indices were determined (the distribution unevenness of the fertilizer on the working width, the width of the spreading, the instability of the distribution norm, the symmetry of the fertilizer spread over the longitudinal axis of the aggregate, the average quantities of fertilizers can distribute per hectare) and energy indices.

The physical-mechanical characteristics of the solid chemical fertilizers used are shown in table 1.

Table 1

Physical-mechanical characteristics of solid chemical fertilizers used for performing experimental researches

Current no.	Name of fertilizer	Humidity (%)	Chemical content of fertilizer according to particles diameter (%)				
			Ø < 1 mm	Ø=1-3 mm	Ø= 3-5 mm	Ø= 5-7 mm	Ø > 7 mm
1.	Granular ammonium nitrate	1.5	3.8	79.3	16.2	0.7	-
2.	Granular urea	1.2	3.6	79.5	16.1	0.8	-
3.	Granular superphosphate	2.5	30	19	17	34	-
4.	Potassium salt	2.7	78	19	3	-	-
5.	Complex fertilizers	2.2	5.6	79.5	14.1	0.8	-

When conducting the tests, the 45-HP tractor unit and solid chemical modification equipment shifted at 8.23 km/h. Each sample has been done in three repetitions.

For determination of the qualitative working indices for the "wide spread" work, a sufficient number of square boxes with a surface area of 0.25 m^2 and a height of 30 mm walls made of sheet metal were used, being placed on three rows at a distance of 15 m from each other perpendicular to the direction of displacement of the aggregate.

After the aggregate passes into operation, the chemical fertilizers fell into each box where, are weighed to a precision of 0.1 grams.

In the case of the "spreading in strips" as close to the tree root as possible, the test method is similar to the one described above, differing only in dimensions of the fertilizer collection boxes, measuring 500 mm in length, 200 mm in width and 20 mm in height.

The qualitative working indexes determined were:

1. The effective spreading width was determined by summing the width of the boxes in each row from which a quantity of chemical fertilizer was collected equal to at least half the average amount of the corresponding box per row.

2. Uniformity of distribution is the qualitative working index showing the distribution of the working width of the granular chemical fertilizer. The distributional non-uniformity was determined by the relationship:

$$e = \frac{\sqrt{\dfrac{\sum_{1}^{n}(|q_m| - |q_i|)^2}{n-1}}}{q_m} * 100 \quad (1)$$

were:

e – represents the distribution irregularity on the actual working width (%);

q_m – represents the average amount of fertilizer per pack in each row (g);

q_i – represents the average amount of fertilizer actually collected from each box in the row (g);

n – represents the number of boxes placed on the actual work width, in each row.

$$q_m = \frac{\sum_{1}^{n} q_i}{n} \quad (2)$$

where:

q_m represents the number of boxes placed on the actual work width, in each row (g);

q_i – represents the average amount of fertilizer actually collected from each box in the row (g), the average amount of fertilizer actually collected from each box in that row;

n – represents the number of boxes placed on the actual work width, in each row.

1. The instability of the distribution norm was determined by the relationship:

$$i = \frac{\sqrt{\dfrac{\sum_{1}^{r}(|q_m| - |q_i|)^2}{r}}}{q_m} * 100 \quad (3)$$

Where:

i – represents the instability of the distribution norm (%);

q_m - the average amount of fertilizer per unit of surface area under rehearsals under the same conditions (g);

q_i - the amount of fertilizer distributed at each repetitions (g);

r – the number of repetitions performed under the same conditions.

3. The spreading symmetry was determined by comparing the quantities of manure collected from the left with those collected from the right side of the longitudinal axis of the aggregate as well as comparing the spreading widths from which these fertilizers were collected. The average values of the qualitative working indices for the "spread over the whole surface" work are presented in table no. 2. and for the "spreading in strips" version are presented in table no. 3.

4. Quantities of chemical fertilizers that can be distributed per hectare were determined at an average displacement speed of 8.23 km / h at two transmission ratios and at two openings of the fertilizer dispenser.

To determine the quantities (s) of fertilizers that can be distributed per hectare, the following relationship has been used:

$$N = \frac{10000 * q}{b * l} \tag{4}$$

where:

N – is the distributed quantity (kg / ha);
q - is the amount of fertilizer collected in a sample (kg);
b – is the actual spreading width (m);
l – is the distance travelled during the test (m).

RESULTS

The average values of the qualitative working indices for the "spread across the surface" work are shown in Table 2.

Table 2

The average values of the qualitative working indices for "all-surface"

Den. No.	Names of fertilizers	Drive speed at work. (km/h)	Drive speed at work (kg/ha)	Working width (m)	Average values of qualitative work index					
					Non-uniformity of distribution (%)	Uncertainty of distribution (%)	Symmetry of spreading to the aggregate axis			
							left		right	
							Width effective (m)	Quantity (%)	Width effective (m)	Quantity (%)
1.	Granular ammonium nitrate	8.23	200	17	20	1.44	8.5	53	8.5	47
2.	Complex fertilizer	8.23	125	18	18	3.69	9	48.8	9	31.2
3.	Granular urea	8.23	90	16	16	2.18	8	52.4	8	47.6
4.	Granular superphosphate	8.23	100	14	18	1.0	7	48.5	7	51.5
5.	Potassium salt	8.23	300	6	30	9.4	3	47.4	3	52.6

The average values of qualitative working indices for the "band spread" work are shown in table 3.

Table 3

The average values of the qualitative working indices for "spreading in strips"

Crt. no.	Name of fertilizers	Drive speed at work. (km/h)	Set norms (kg/ha)	Trees raw width (m)	Average values of qualitative work index					
					Non-uniformity of distribution (%)	Uncertainty of distribution (%)	Symmetry of spreading to the aggregate axis			
							Left		Right	
							Width Effective (m)	Quantity (%)	Width Effective (m)	Quantity (%)
1.	Granular ammonium nitrate	8.23	528	3.5	9	4.81	1.75	46.2	1.75	53.8
2.	Complex fertilizers	8.23	430	3.5	1.1	3.64	1.75	50.8	1.75	49.2
3.	Granulated urea	8.23	175	3.5	9.4	5.3	1.75	47.6	1.75	52.4
4.	Granular superphosphat	8.23	440	3.5	6.3	6.19	1.75	52	1.75	48
5.	Potassium salt	8.23	780	3.5	3	10	1.75	46	1.75	54

The average values of the chemical fertilizer standards that the equipment can distribute are shown in Table 4.

Table 4

Average values of the chemical fertilizer standards that the equipment can distribute

Den. no.	Name of fertilizers	Norms performed (kg/ha)	The height of the slot evacuation (mm)	Working width (m)	Report of transmission	Angle of tilt deflectors
1.	Granular ammonium nitrate	100	33	17	0.151	15°
			55	17	0.107	15°
		200	70	17	0.151	15°
			110	17	0.107	15°
2.	Granulated urea	100	55	15	0.107	17°
			37	15	0.151	17°
		200	73	15	0.107	17°
			57	15	0.151	17°
3.	Salt potassium	100	4	6	0.151	25°
			11	6	0.107	25°
		300	41	6	0.151	25°
			56	6	0.107	25°
4.	Complex fertilizers	500	100	18	0.229	13°
			72	18	0.229	13°
		1000	39	3.5	0.229	13°
			20	3.5	0.229	13°
5.	Granular superphosphate	300	88	14	0.107	16°
			64	14	0.151	16°
		500	35	3.5	0.107	16°
			23	3.5	0.151	16°

Figure 2 shows the variation of the non-uniformity on the effective ammonium nitrate working width for the "spread across the surface".

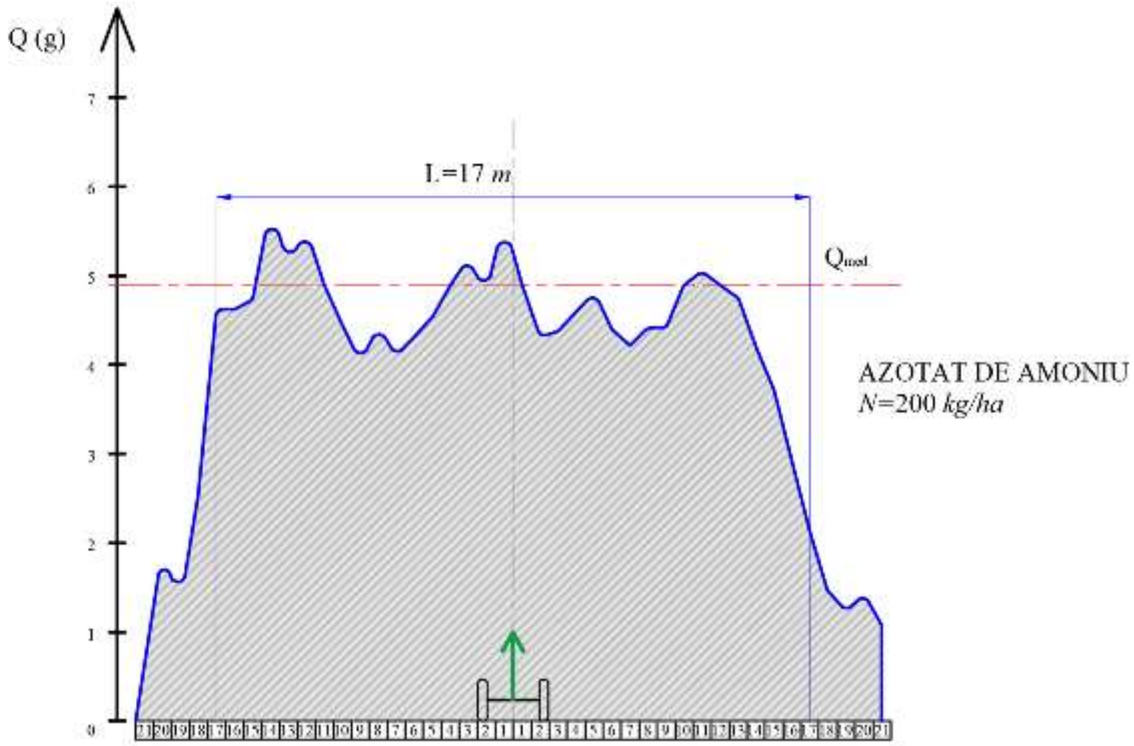

Fig.2 Variation of non-uniformity on effective work width for "spread across the surface"

Energy indices were determined and the results are shown in Table 5.

Table 5

Energy indices values

Crt.	Name	UM	Value of determined

no.			indices
1.	The mass of the loaded granulated superphosphate equipment	kg	2995
2.	Fertilizer mass in bunker	kg	1835
3.	Average force of depression of the fork on the coupling eye on the tractor: - static - at work	daN	495 640
4.	Effective travel speed at work	km/h	8.23
5.	The tensile strength of the machine	daN	340
6.	Drive power to the power outlet of the machine	CP	2.8

CONCLUSIONS

Analyzing the results of the determinations in tables no. 2; 3 and 4 the following are found:
With the equipment in aggregate with a tractor of 45 HP. solid chemical fertilizers with the physical-mechanical characteristics presented in table 1. with the norm between 100-1000 kg can be spread in orchards and other crops in strips and on the whole surface.

The main qualitative working indices obtained from solid chemical fertilizers applying are appropriate, namely:

- the "wide spreading" work width is 14-18 m for solid chemical fertilizers and 6 m for pulverulent fertilizers, and for the "spreading in strips" version there are 3-5 m;
- the unevenness of the distribution on the actual working width of the granulated chemical fertilizers was 16-20% for the "spread over the whole surface" and 1.1-9.4% for the "strip spread" work and for pulverulent fertilizers 2-3% between bands and 30% for the whole surface;
- the instability of the distribution norm in the direction of advancement to the granulated chemical fertilizers was 1-3.7% for spreading over the whole surface and 3.64-6.19% for spreading in strips, and for the pulverulent fertilizers 9.4% to spread across the surface and 10% for spreading in strips;
- the scattering symmetry of the aggregate axis had deviations of 2.4-6% on spreading across the surface and 1.4-8% for spreading in strips.

The main Energy Indices determined had the following values:
- the tensile strength of the machine was 340 daN;
- the mean fork of the fork on the coupling eye on the tractor was 495 static and 640 daN dynamic;
- the power output at the machine's power outlet was 2.8 HP.

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SEPARATION OF CEREAL SEEDS AND TECHNICAL PLANTS ACCORDING TO LENGTH IN ORDER TO IMPROVE SEEDS QUALITY
/
SEPARAREA SEMINŢELOR DE CEREALE SI PLANTE TEHNICE DUPĂ LUNGIME ÎN SCOPUL ÎMBUNĂTĂŢIRII CALITĂŢII SEMINŢELOR

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Keywords: separator, cylindrical, separation, seeds, length, cereals.

ABSTRACT

The paper presents the results obtained at separation of seeds on an universal cylindrical sieve, using separation method according to size, respectively length. It is a concept in a compact carcass system, which can be connected to the dust removal facility in the flux, having a positive impact on environment and quality of life. The sieve assures separation of cereal seeds from technical plants underpinning a new technology, in accordance with EU requirements.

REZUMAT

Lucrarea prezintă rezultatele obţinute la separarea seminţelor pe un trior cilindric universal. utilizând metoda de separare dupa dimensiuni. respectiv după lungime. Este o concepţie în sistem compact. carcasat ce poate fi racordat la instalaţia de desprafuire în fluxul pe care il deserveşte. având un impact pozitiv asupra mediului şi calităţii vieţii. Triorul asigură separarea seminţelor de cereale şi plante tehnice având la bază o noua tehnologie în coformitate cu cerinţele UE.

INTRODUCTION

The milling industry is perhaps the oldest branch of the industry. An important role is to create the appropriate conditions for taking over, processing, storing and capitalizing the obtained agricultural products. The production and quality of any agricultural crop is determined by factors that influence it from sowing to harvesting, as well as those that directly affect seed prior to sowing.

As a major factor in increasing agricultural production, the seed has a great deal of attention, many disciplines, institutions and economic agents competing to obtain the most valuable sowing material.

The technical equipment is part of the strategy for providing a technical and material basis which allows the seeds to be prepared as well as possible before being processed at the level of the European norms in the field, including the compliance with the ecological requirements.

One of the basic machines, is the cylindrical sieve, which is a complex machine designed to work in the technological flow of the technological lines of the seed conditioning stations; it performs the separation of the grain by length and technical plant seeds.

Universal cylindrical separator belongs to universal cylindrical separation machines that underpin on a new technology of separation based on size of cereal seeds and technical plants, according to EU requirements.

MATERIAL AND METHOD

At performing of the universal cylindrical separator, (fig. 1) a series of modern constructive solutions were adopted, which lead to superior technical-functional performances.

The universal cylindrical sieve consists of the following main components: frame, separator cylinder, feed funnel, exhaust hoods, visor doors, technological connections, and caps.

The frame is a welded construction made of laminated profiles on which the trellis cylinder, the drive shaft, the exhaust hoods and the protective guards are mounted in a row on which are mounted removably assembled two drums on which the casing is attached, which is made of sheet metal with pockets.

Also on the ax is mounted the drainage collector whose exhaust screw consists of a number of blades whose assembly on the shaft provides the necessary pitch of the spiral. The drive consists of a planetary gearmotor and a rigid coupling.

The feed hopper consists of a welded construction and is provided at the base with a bead. Inside the funnel there is a group of two vats that secure the seeding and the introduction of the seeds on the site.

For proper product tracking, the machine is equipped with a clear transparent polymetacrylate viewfinder.

The exhaust funnels consist of welded constructions and ensure the evacuation of the processed product and impurities.

Visiting doors are sheet metal constructions that contribute to the complete construction of the machine while ensuring access to the treadmill, if necessary.

. Caps are made of sheet, metal or rubber and are intended for access to cleaning and intervention sites.

Fig.1 Universal cylindrical separator

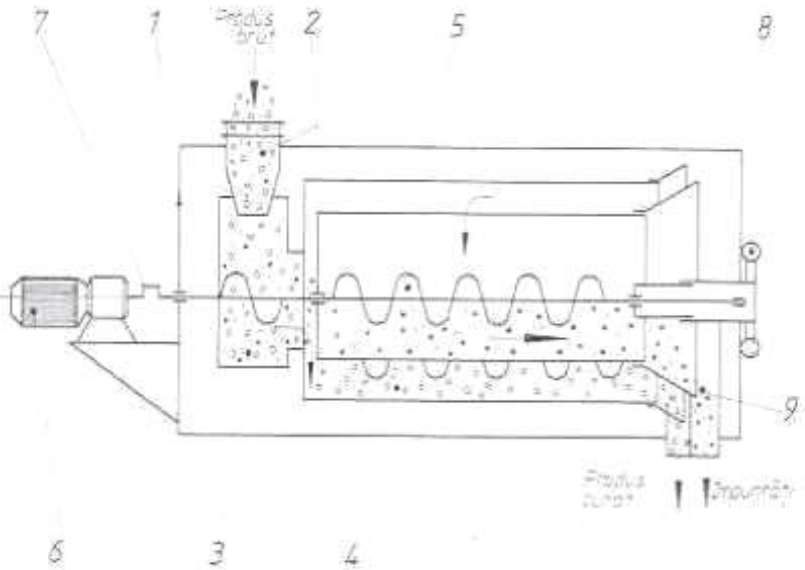

Fig.2 - Outline of the machine. Longitudinal section

1. Framework 2 Feed viewfinder 3. Feed funnel 4. Alveoli coating 5.Groove; 6. Planetary motorgear 7. Rigid coupling; 8. Gutter tipping mechanism; 9. Processed product evacuation funnel

RESULTS

The product is powered through the power sight glass and inserted into the power funnel. By means of the group of pallets having the inclined blades to ensure good feeding of the coating, the seeds are placed on its surface. The separator cylinder can be equipped according to the technological requirements with casing segments with the same type of alveoli or with different alveoli depending on the quality of the processed product. Here, the sorting process takes place, small splinters and impurities penetrate into the alveoli, they are taken over by the roll of the cylinder in rotary motion and when they get above the gutter. they fall into it. The product remaining on the casing advances and is discharged through the finished product discharge funnel. Impurities and gullies in the trough are pushed by the snail and discharged separately. Depending on the product to be sorted, use a covering with appropriate alveoli.

The separator can be used as a stand alone or in a series or parallel power supply. In the case of battery operation and serial feed, both shredders are equipped with the required mantle type. With the product discharged from the first separator, the second separator is fed, the impurities being collected separately. In case of battery operation with parallel supply, both shredders are equipped with the same type of coating. In this case. both the clean product and the impurities will be collected together from both separators.

Technical and functional features

1. Overall size:
   - length: with drive mm 4508
     without action mm 3695
   - width: mm 1000
   - hight: with feed viewfinder mm 1240
     without feed viewfinder mm 1025
2. Separator cylinder diameter mm 630
3. Active surface length mm 2440
4. Installed power kw 2.2
5. Speed of cylinder separator rot./min. 40
6. Processing capacity
   for wheat with 1% impurities t/h 5
7. Technological effect for wheat
   with 1% impurities % 75-80
8. Mass kg 9

Table 1

Real parameters obtained in exploitation

Den. no.	Requirement	M.U.	Provided in the project execution	Performed in tests
1	Overall size : Length: - with drive - without action Width Height: - with feed viewfinder - without viewfinder	mm mm mm	 4508 3695 1000 1240 1025	 4510 3695 1000 1240 1025
2	Diameter of the separator cylinder	mm	630	630
3	Shelter length	mm	2440	2440
4	Alveole size	mm	5.25	5.25
5	Separator inclination angle	○	0 - 4	0
6	The angle of the chute	○	0 -30	15
7	Mass	kg	960	938

CONCLUSIONS

Table 1 presents the results of the Universal Cylinder Triple Tests - TCU 5. The results of the tests that have confirmed the opportunity of the chosen constructive solutions and the technological equipment, which have allowed the execution of a particularly efficient machine with performance at the level with the latest worldwide achievements, ensuring the reduction of specific energy, maintenance and operating consumption per ton of processed product.

As a result of the test results obtained with Universal Cylinder Trigger - TCU 5, the following were found:
- a modern fully-constructed construction concept that ensures an increased speed of product penetration into the separation zone on an optimized high-efficiency trajectory;
- technological and qualitative indices according to the requirements of the execution documentation;
- simplicity of technological adjustments, stability over time;
- the superior valorisation of cereal seed by seed producers with reduced material costs;
- reduction of specific energy consumption maintenance and easy operation;
- reducing specific material consumption;
- increasing the availability of export offers;
- improving working conditions by:
- easy adjustments, fast service for daily and periodic maintenance;
- protecting the environment by preventing dust and dust emissions at the workplace and in the atmosphere, the equipment being provided with couplings at the de-dusting facilities of the user units;
- low cost price compared to the prices of companies producing milling machines from abroad.

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RESEARCHES ON THE BIOCHEMICAL COMPOSITION OF *SAMBUCUS EBULUS L.* LEAVES AND THEIR ORIENTATION FOR NATURAL TREATMENTS
/
CERCETĂRI SUPRA COMPOZIȚIEI BIOCHIMICE A FRUNZELOR DE SAMBUCUS EBULUS L. ȘI ORIENTAREA EI PENTRU TRATAMENTE NATURISTE

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Keywords: *flora, spontaneous, chlorophyll pigments, naturist product.*

ABSTRACT

The purpose of the research was to demonstrate the importance of knowing the biochemical composition of leaves of Sambucus ebulus L.. a spontaneous flora plant which, under the direct knowledge of its properties, can be used in natural medicine for the control of abnormal diseases or conditions for the body human.

As green plants are of particular importance due to their ability to produce large amounts of organic substances rich in chemicals, Sambucus ebulus L.. i confirms the existence of mineral elements, namely N, P and K. which varied according to the harvested plant and chlorophyll pigments did not show large changes and concentrations from one sample to the other.

The same thing happened when determining protein and dry matter. From the leaf harvesting area of Sambucus ebulus L.. laboratory determinations and soil analyzes have been carried out with respect to soil pH, total nitrogen, phosphorus, potassium, sum of bases and humus.

REZUMAT

Scopul cercetării a fost de a demonstra importanța cunoașterii compoziției biochimice din frunzele de Sambucus ebulus L.. plantă venită din flora spontana. dar care sub o cunoaștere dirijată a proprietăților ei poate fi intrebuințată în medicina naturistă pentru combaterea unor boli sau stări anormale pentru organismul uman. Deoarece plantele verzi prezintă o importanță deosebită datorate capacității lor de a elabora mari cantități de substanțe organice bogate în energie chimică. Sambucus ebulus L.. vine să confirme existența elementelor minerale, respectiv macroelemente N. P și K care au variat în funcție de planta recoltată. iar pigmenții clorofilieni nu au prezentat modificări și concentrații mari de la o probă la alta.

Același aspect s-a întâmplat și la determinarea proteinei și substanței uscate. Din zona de recoltare a frunzelor din plantele de Sambucus ebulus L. au fost efectuate determinări și analize de laborator pentru sol. în ceea ce privește pH-ul solului. azotul total. fosforul. potasiu. suma bazelor și humusul.

INTRODUCTION

The small elder *Sambucus ebulus L..* Fam. *Caprifoliaceae* is known under the name of bozie, small elder. In Romania, the species *Sambucus ebulus L.* is common; being met in all zones of country, in different places and it is not pretentious at climate and soil. This plant is found in the spontaneous flora of our country in three species (*Grigoresc E.. 1962*): *Sambucus nigra L.* (black elder); *Sambucus ebulus L.* (small elder); *Sambucus racemosa L.* (red elder).

From the species of *Sambucus* genus are used in medicine the flowers and sometimes the fruits. The black elder flowers have an ancient usage in scientific and popular medicine. They have an sudorific, diuretic, galactogen, expectorant action, are used against obesity, cold, cough (*Berger FR 1949; Constantinescu C.. 1967; Davidek C..1961; Petkov V.. 1982*).

Externally, black elder flowers have emollient effect, being recommended in baths, poultice,. Boils, pharyngitis, laryngitis and the small elder ones have anti-phlogistic effects (*Khare C.P.. 2008*). The black elder flowers are parts of anti-rheumatic, depurative and sudorific tea (*Vilar A.. 1986*).

The small elder is a perennial plant known as the step-brother of elder and it measures up to 1.6 m.; the flowers are white and the fruits are black. The radicular system is strong and presents a deep rooting, being the most used part in therapeutic interest.

Infusion. decoction (10%). extract - all have diuretic, anti-rheumatic, laxative, antiseptic, purgative anti-allergic, anti-inflammatory, anti-suction, sudorific properties. The bark is a plant very used for its pharmaceutical qualities (I. Bara. P.. 1993). The effect of the bosom is very strong, so that the recommended doses should not be exceeded. It is not advised for people who are weak, suffer of diarrhea, irritable bowel, hyperacid gastritis; people with a strong feeling of vomiting (*Constantinescu D. Gr. & Bojor O.. 1969*).

The chemical composition of medicinal and aromatic plants, the therapeutic action of their active principles were studied and presented by (*Leon M.. 2007*).

The small elder is usually used in diets, being is a very good diuretic, painkiller, anti-inflammatory. Antispasmodic, emetic, expectorant. The small elder also contains: fatty acids, phytosterols, ursolic acid. Glycosides, iridoid compounds. It is distinguished by a repulsive smell of leaves, stems and roots.

MATERIAL AND METHOD

Chemical and biochemical determinations were performed in the Agrochemistry Laboratory, Faculty of Management. Economic Engineering in Agriculture and Rural Development. Slatina Branch.

Because the leaves at *Sambucus ebulus L*. have purgative and emetic proprieties, for establishing their importance for naturist medicine there were made studies in 2015 on 10 lots of small elder plants, harvested from 10 different places from S-V Oltenia area, more precisely from Cernătești village, Dolj county. in August, the preponderant soil in this area being argic chernozem.

Experimental soil variants are presented in Table (1) and the methods used for the determinations were:

The pH of the soil was measured by the potentiometric method, which is based on the determination of hydrogen ions according to the potential difference between the two electrodes introduced into the soil suspension and the results are read on the scale of the measuring apparatus that is graded in pH units.

The Ah was determined by treating the soil with the solution of an alkaline hydrolysis salt with 0.1 N sodium hydroxide in the presence of phenolphthalein.

Sb. The method of determination is to treat the soil with an excess of 0.05 HCl 0.005 n and the sum of the bases being equivalent to the amount of HCl consumed in the reaction is determined by titration with NaOH in the presence of the methyl red used as an indicator.

Phosphorus was determined by the Engner-Riehm-Domingo method and was carried out by removing the mobile phosphorus with a solution of ammonium lactate acetate. The concentration in the phosphorus thus obtained is determined by colorimetry.

Potassium was determined by the same method as phosphorus and its dosing was carried out on a flame photometer.

For the determination of Humus, the Walkle and Black method was used and was made by oxidizing the organic substance in the soil with potassium dichromate in the presence of sulfuric acid and titrating excess potassium dichromate with a Mohr's salt solution.

Nt was obtained by applying the Kjeldahl method, which was done by soil mineralization with concentrated sulfuric acid and by measuring excess sulfuric acid with 0.1N NaOH, the nitrogen content of the sample to be analyzed can be calculated.

The preparation of plants samples for analysis

The harvested samples (leaves) do not present visual symptoms of nutrition disorders and they are prepared for the established analyses program. Some leaves which have presented slight traces of dust have been wiped with a gauze or cotton pad softened in distilled water.

The mineralization of vegetal material for determining nitrogen

For determining nitrogen was been used Kjendal method, by mineralization with sulfuric acid.

Procedure

From the sample of dried vegetal material and finely chopped it is weighed at analytical balance 1 g of material and it is introduced in a 250 ml Kjendal disintegration balloo; 5 g of catalyst mixture and 12.5 ml of concentrated sulfuric acid are added. The balloon is covered with a pear or glass funnel and the violent boil is avoided. The mineralization is considered done when the balloon content fades from brownish-yellow to colorless or slight green hue.

The determination of gross protein. Total nitrogen

Total nitrogen content from the vegetal material is determined by wet mineralization, the sulfuric acid being widely used in different variants of classical Kjendal method.

The calculation and results expression

For the calculation of N content in % the next formula is used:

$$N_t \text{ \% from DS} = (V1 - V2) \cdot f \cdot 1000 \cdot 100/\ m \cdot 1\,000\,000 \quad (1)$$

where:

DS is dried substance;
V1 - ml of sulfuric acid used at titration of the analyzed sample;
V2 - ml of sulfuric acid n/14 used at titration of the blind sample;
f - the factor of n/14 sulfuric acid solution;
m - the quantity of vegetal material taken for analysis in [g];
100 - the factor of percent reporting;
1000- the factor for transformation of micrograms of N in g of N;

In these conditions, the formula has the simplified form:

$$N_t \text{ \% from DS} = (V1 - V2) \cdot f \cdot 0.1 \quad (2)$$

The determination of phosphorus

The prepared materials are determined and read at the spectrophotometer when they are yellow, using the formula:

$$P\% = C \cdot Vt \cdot 100/ \cdot Va \cdot m \cdot 1\,000\,000 \quad (3)$$

where:

C – the content of P in micrograms of the aliquot part used at color metering;
m – the quantity of vegetal material used at mineralization in [g]
Vt – the total volume of extract obtained at mineralization in [ml]
Va – the volume of aliquot part used in color metering;
100 – the factor of percent reporting;
1 000 000 – the factor of transformation of micrograms in [g].

The determination of K is made by calcinations and the dosage of K is made by photometry of flame emission or potentiometry with selective electrode ion.

The results obtained at the total K dosage from the vegetal material are expressed in percent from the dried substance.

$$K\% \text{ from DS} = C \cdot V \cdot r \cdot 100\ /\ m \cdot 1000\,000 \quad (4)$$

$$K\% \text{ from DS} = C \cdot V \cdot r\ /\ m \cdot 10\,000 \quad (5)$$

where:

C – the concentration in micrograms K per ml. found on the calibration curve;
V – the volume of diluted solution used at the dosage in [ml];
r – the dilution report used;
m – the quantity of vegetal material used at mineralization in [g].

The determination of carotene and chlorophyll pigments

5 g from the fresh substance from the analyzed plant sample is weighted and milled very well, then 25-30 ml of ethyl alcohol are added in small glasses of 50 ml. The next day this is filtered and brought at the sign (50 ml) with alcohol. The readings are made at the photo-colorimeter and the results are introduced in the calculation formula.

RESULTS

The results on the chemical content of soil from which the 10 soil samples were collected are shown in Table (1) and the results on the biochemical content of the analyzed leaves are presented in Table (2).

Table 1

Determination of chemical proprieties of argic chernozem harvested from the study area

Sample number	pH	N total	P_2O_5	K_2O	Ah	S.B.	Humus
	H_2O	%	%	%	me/100 g sol		%
1	6.13	0.190	4.2	11.5	2.70	16.7	2.15
2	6.35	0.223	4.9	15.3	2.54	16.9	2.17
3	6.27	0.210	5.1	12.7	2.62	17.8	2.15
4	6.31	0.214	4.3	11.8	1.94	16.5	2.18
5	6.30	0.198	4.4	14.3	2.57	18.3	2.21
6	6.24	0.203	5.5	16.7	2.68	17.4	2.18
7	6.17	0.220	5.3	18.2	2.11	16.2	2.16
8	6.19	0.216	5.0	16.5	2.00	19.0	2.16
9	6.26	0.215	4.8	17.7	1.92	18.6	2.19
10	6.15	0.221	4.1	18.6	1.87	19.2	2.20

Source: Author

Soil pH was noted due to the small differences between the samples collected from 6.13% to 6.30%; the total nitrogen is present in the soil at significant doses with small differences from 0.190 to 2.221% being a good way for development of the plant.

Phosphorus is found in the proportion of 4.1 to 5.3%. but sufficient for the growth of the plant. Potassium which reaches a minimum of 11.5% has a maximum of 18.6% and the sum of the bases and humus in the soil are found in sufficient quantities in the soil for these plants to develop properly.

Fig.1 - The determination of phosphorus from small elder plant

Fig.2 - The determination of total nitrogen from small elder plant

Fig.3 - The preparation of samples for determinations

Fig.4 - The extract used for determining the carotene

Fig.5 – Sambuculus ebulus L in the vegetation

In the five images, there are presented aspects of the preparation of samples for laboratory analysis and obtaining extracts for reading the results, as well as the laboratory equipment used.

Thus, the results on the biochemical content of the leaves of Sambucus ebulus L. are shown in Table (2).

Table 2

The biochemical determinations obtained from *Sambucus ebulus L* plant

Sample number	Nitrogen %	Protein %	P_2O_5 %	K_2O %	Chlorophyll pigments mg/dm^2 %			Dried substance
					Ca	Cb	K	g %
1	3.10	19.3	1.95	1.65	10.614	4.708	3.962	28.51
2	3.09	19.2	1.90	1.62	10.605	4.712	3.958	28.53
3	3.09	19.5	1.91	1.64	10.412	4.719	3.950	28.51
4	3.11	19.3	1.94	1.65	10.542	4.721	3.943	28.51
5	3.08	19.01	1.94	1.63	10.612	4.710	3.950	28.52
6	3.09	19.5	1.95	1.62	10.578	4.721	3.951	28.50
7	3.07	19.2	1.96	1.62	10.603	4.716	3.950	28.50
8	3.12	19.01	1.92	1.65	10.476	4.723	3.957	28.50
9	3.10	19.3	1.91	1.65	10.495	4.722	3.962	28.53
10	3.09	19.4	1.95	1.64	10.610	4.722	3.943	28.53

Source: Author

Because plant physiological activity is closely related to the water content of the cells, the essential role of water is determined by its physical properties, therefore, the determinations that have been made on the bosom leaves, which is a plant of the spontaneous flora and which depends only from the water from the fall of rainfall, demonstrated that most of the results are differentiated between them with small values.

Thus, nitrogen has values ranging from 3.7% to 3.12. while the phosphorus and potassium yields are very close to each other. The protein has a minimum of 19.01% and a maximum of 19.4%, the values being less significant.

Chlorophyll pigments have good values for the three forms of determination, which leads to the conclusion that the plants have been harmoniously developed. The dry matter has normal values ranging from 28.50 to 28.53.

CONCLUSIONS

The biochemical substance from the leaves of indigenous species of Sambucus genus was studied qualitatively and quantitatively.

From leaves, a 5% infusion can be made, being used as diuretic, sudorific, for cough and for cleaning heavy throat.

A certain limit must not be overcome because it becomes emetic.

For laxative purposes a cup of infusion per day can be served.

The small elder effect is very strong, and because of that one must not overcome the recommended dosage.

The small elder, as plant used like naturist remedy, is not advised to weak persons, suffering of diarrhea, IBS. hyperacid gastritis, persons with stressed emetic sensation.

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CONSIDERATIONS REGARDING THE IMPORTANCE OF THE ROSEMARY CULTURE IN TERMS OF THE BENEFITS AS MEDICINAL PLANTS
/
CONSIDERAŢII PRIVIND IMPORTANŢA CULTURII DE ROZMARIN DIN PUNCT DE VEDERE AL BENEFICIILOR ADUSE CA PLANTĂ MEDICINALĂ

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Keywords: *active principles, extracts, medicinal plants, rosemary.*

ABSTRACT
Within this paper are synthesized the aspects regarding the importance of rosemary culture for pharmaceutical and cosmetic industry in terms of benefits as medicinal plants.

Active principles (active substances) within medicinal plants are those that give the therapeutic effect. Each plant is important for a specific substance, which can be isolated through different procedures. Rosemary contains many active principles. Flavonoids are stimulants and antioxidants; phenols - especially rosemary acid - are antiseptics and reduce inflammation; astringents tannins fight against infections; it has been shown that rosemary has analgesic and stimulating properties. Volatile oil has a sharp, stimulating aroma among its compounds, including cineol and camphor.

REZUMAT
În cadrul acestei lucrări sunt sintetizate aspecte privind importanţa culturii de Rozmarin pentru industria farmaceutica si cosmetica. din punct de vedere al beneficiilor aduse ca plantă medicinală.

Principiile active (substantele active) prezente in plantele medicinale sunt cele care dau efectul terapeutic. Fiecare planta, in principiu. prezinta interes pentru o anumita substanta activa. care poate fi izolata prin diferite procedee. Rozmarinul contine multe principii active. Flavonoidele sunt stimulente si antioxidanti; fenolii – mai ales acidul rozmarinic -sunt antiseptici si reduc inflamatiile; taninii astringenti lupta impotriva infectiilor; s-a aratat ca rozmarinul are proprietati analgezice si stimulatoare. Uleiul volatil are aroma acutita. stimulatoare. printre compusii sai numarandu-se cineolul si camforul.

INTRODUCTION
Rosemary (Rosmarinus officinalis) is a perennial aromatic plant with extraordinary therapeutic efficacy, being among the most used natural remedies.

Its latin name " ros marinus " - which means 'sea dew' - can be associated with its Mediterranean origin or the colour of a pale or purple blue, rarely white of its beautiful, small and fragrant flowers; however it is a tight plant connected to the sea. Stuffy and very branched, with many small and narrow needle-like leaves, very fragrant and always green, it is often used as an ornamental plant that we can grow in the garden but also in pots; therefore, we always have it at your fingertips and, with gratitude, we can enjoy its many qualities. [4]

Rosemary (fig 1) is used both fresh and dry; it has many phototherapeutic uses, being both a spice and a melliferous plant, rosemary honey, but also a product often used in perfumery.

Fig. 1 – Rosemary [1]. [6]

The flowers are harvested when fully opened, then dried. The evergreen leaves can be harvested at any time of the year. The leaves turn to yellow and then dry. Rosemary is used for the preparation of infusions, fine and an essential oil [3].

Rosemary contains many active principles, namely:

- ✓ polyphenolcarboxylic acids (rosmarinic acid, caffeic, gentisic, vanilic, Gallic, siringic acids)
- ✓ flavonosids
- ✓ tannins
- ✓ bitter diterpenic principles
- ✓ triterpenes
- ✓ Vitamin C
- ✓ amino acids
- ✓ wax
- ✓ acyclic and cyclic hydrocarbons, saturated and unsaturated
- ✓ volatile oil [2].

Rosemary exercises on the body a refreshing and stimulating action, being an excellent tonic. The rosemary flavonoids stimulate the circulation by toning the capillaries and improving venous blood flow - benefits that justify the traditional use of rosemary for improving memory and concentration, for treating headaches and stimulating hair growth.

The plant relieves digestion, and is prescribed for problems such as dyspepsia, gastric cramps, aerophagia and constipation. Animal studies in 1987 have found that rosemary increases gallbladder secretion, which is important for fat digestion. A paper published in 1995 showed that the plant has a diuretic effect and detoxifying liver function.

Rosemary is an effective anti-inflammatory substance. It has antibacterial and expectorant qualities and can be used to treat respiratory tract infections. It is also a good tonic for people who suffer from fatigue. Externally, rosemary essential oil is diluted with excipient oil, such as sunflower oil and is used as a massage to treat muscle pain, sciatica, and rheumatic pain and inflammation. Infusion added to bath water is beneficial in rheumatism. The rosemary extract stimulates hair follicles and scalp movement; is applied on the head to prevent premature alopecia. Its antiseptic and astringent qualities make it useful in the treatment of dandruff. [3].

The cosmetics industry benefits from the delicate flavour of rosemary. The aromatic extracts obtained are used in the preparation of creams, shampoos, perfumes and other personal and cosmetic care products. Rosemary is found in the composition of lotions and other products for skin care and beauty, especially for the treatment of impure skin [4].

MATERIAL AND METHOD

Rosemary is cultivated from saplings (Figure 2). The cuttings must have a length of approximately 10 cm. Once they have their roots, they are planted in a luminous and warm place; ideal on sandy soil, rosemary is cultivated from saplings (Figure 2). The cuttings must have a length of approximately 10 cm. Once they have their roots, they are planted in a luminous and warm place, ideally on sandy soil.

Fig. 2 – Rosemary seedlings [5]

Medicinal plant species owe their phototherapeutic action to the presence of bioactive components, also called active principles with effects in the metabolism of the whole human or animal body. Useful substances from medicinal plants are obtained from plant bodies, in general, either by means of water (usually hot), or by using a solvent (e.g. the alcohol).

The degree of extraction of active principles from plants is strongly influenced by the following factors:

- humidity of cut and selected plants;
- samples consistency (leaves/stems/peels/seeds/etc.);
- percolation time;
- percolation pressure;
- used solvent.

To determine the degree of extraction of active principles, a percolator was used. It (Fig. 4) is the technical equipment operating in the technological line of medicinal and aromatic plants primary processing. The percolator functions on solvent and percolation under pressure, in two phases. It has two compartments for introducing the plant charge, being mounted on the floor of the room. The entire extraction process takes place automatically, its parameters being prescribed, controlled and displayed by a PLC with display. It is designed to extract the active principles from the plant material, dried or freshly harvested to pre-established sizes.

Fig. 3 - Percolator

Table 1 presents the main technical characteristics of the percolator.

Table 1

Den. no.	Characteristic	M.U.	Value
1.	Type of energy source	-	Electricity network
2.	Volume of extraction chambers	l	12 / 24
3.	Maximum air pressure	bar	8
4.	Maximum power consumption	W	500
5.	Dimensions: ✓ length ✓ width ✓ height	mm	 1.000 600 1.350
6.	Mass	kg	175

Before being introduced into the percolator, the plants are weighed in order to achieve the correct plant-solvent ratio. The plants from which the active principles are extracted, weighed and dosed are put in a bag of a special and very fine mesh and then introduced into the compartment that will be used for percolation.

Over these plants is added the solvent used for extracting the active principles (distilled water, alcohol, vinegar. etc.) up to a level at the bottom of the compartment. After introducing the material from which active ingredients are extracted and the solvent into the percolation compartment and after all preparatory operations for starting the percolator were made, the time of the percolation operation and its maximum pressure are set. The START button is pressed.

After the percolation is completed, samples (fig. 4) were taken in special capsules and were put in the oven to accurately determine the percentage of active substance extracted in the process.

Fig. 4 - Capsule of the material subjected to percolating

RESULTS

The percentage of active principles extracted was calculated after the sample was kept inside the oven with the temperature set at 105^{0}C (Fig. 5) as long as it is stipulated in the current standards, for the material undergoing percolation being determined the percentage of active principles extraction from the plant.

Fig. 5 - Setting the drying temperature of the material

In order to extract the active principles from the rosemary plant the following results were obtained and presented in table no. 2:

Table 2

Den. No.	Established parameter	M.U.	Value
1.	Test time	min	***60***
2.	Chopped material mass undergoing extraction	kg	***0.20***
3.	State of raw material undergoing extraction	-	***dry***
4.	Humidity of the sample undergoing extraction	%	***6.12***
5.	Active principles extraction degree	%	***24.13***

CONCLUSIONS

Rosemary is a perennial aromatic plant, being one of the most used natural remedies. The plant exerts an invigorating and stimulating action on the body, being an excellent general tonic. Also, this plant has remarkable digestive properties and a good anti-inflammatory effect, useful in the treatment of rheumatic and muscular diseases, neuralgia or sciatica.

The degree of extraction of active principles from plants is strongly influenced by the following factors: humidity of cut and selected plants; samples consistency; percolation time; percolation pressure; used solvent.

After processing the experimental data it was found that the extraction rate of the active principles for dry rosemary is 24.13% with moisture content of 6.12%.

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EXPERIMENTAL RESEARCHES REGARDING THE QUALITATIVE WORKING INDEXES OF A SOWING MACHINE DESIGNED TO DIRECT ESTABLISHMENT OF STRAW CEREAL CROPS
/
CERCETĂRI EXPERIMENTALE PRIVIND INDICII CALITATIVI DE LUCRU AI UNEI SEMĂNĂTORI NOI DESTINATĂ TEHNOLOGIEI DE INFIINŢARE DIRECTĂ A CULTURILOR DE CEREALE PĂIOASE

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Keywords: *functional model, direct sowing, straw cereals.*

ABSTRACT
The paper presents the experimental researches obtained with an aggregate made of a wheeled tractor of 50 H.P. and the sowing machine designed to direct sowing of agricultural crops in serried rows SSD, for determining the qualitative working indexes under different working conditions. The results obtained have generated valid solutions for achieving a high-performance sowing machine within the technology of direct establishment of straw cereals, soy, rape, medicinal herbs and other similar seed plants. Therefore, the high performance product obtained is destined to economic agents involved in manufacturing agricultural machines adapted to heavy conditions specific to Romania land.

REZUMAT
Lucrarea prezintă cercetări experimentale realizate cu un agregat format din tractor agricol pe roți de 50 CP și semănătoarea pentru semănat direct culturi agricole în rânduri dese SSD, pentru determinarea indicilor calitativi în diferite condiții de lucru. Rezultatele obținute generează soluții valide pentru realizarea unei semănători performante în cadrul tehnologiei de înființare directă a culturilor de cereale păioase. soia. rapiță. plante medicinale și a altor plante cu semințe asemănătoare cu ale celor menționate și oferă un produs performant agenților economici interesați în domeniul fabricării de mașini agricole. adaptat condițiilor grele specifice din România.

INTRODUCTION
Development of agricultural technologies with low power consumption comparing to production could contribute to reducing greenhouse gases in agriculture (*Dalgaard. 2000*), according to Protocol from Kyoto.

Some of important indexes able to preserve soil fertility and evaluate the agricultural system sustainability are represented by the soil working system (*Guş. 1997; Rusu. 2001; Mark et al.. 2004; Jităreanu et al.. 2006*).

In order to prevent soil damaging, diminish fuel consumption, increase the soil productivity and other environment resources, as well as, ensure an efficient water use, the direct establishment technology considered as the most conservative soil operation (it does not allow any other previous soil work, except the concomitant opening of a narrow soil strip of only few centimetres for putting seeds into soil) has been implemented and spread in agriculture. (*Ekboir. 2002; Ekboir. 2003*).

Therefore, within the *ADER 16.3.1.project "Researches regarding the influence of applying new conservative systems and technologies of agricultural mechanized works for fighting against drought effects, preserve soil fertility and qualitatively and quantitatively increase the production of the main plant species cultivated"*. INMA Bucharest conceived, achieved and tested a special sowing machine designed to perform a conservative soil work, able to concomitantly assure the opening of a soil aperture and introduce seeds into the soil.

Sowing machine able to directly sowing, presented here may be important for agricultural exploitations and agro-ecological ecosystems for which diminishing the necessary time and manpower represent a priority. especially with limited production potential.

MATERIAL AND METHOD

Experimental researches were performed with the sowing machine SSD for direct sowing;it is designed to seed agricultural crops in unploughed field in serried rows (for example: wheat, rape, medicinal herbs, peas, mustard+phacelia. trefoil+grass etc.).especially in light and medium soils. on plains or slope field up to 6°. The sowing machine is of carried type and works in aggregate with wheeled tractors of 45 H.P endowed with three-point suspension mechanism of 1-st category according to SR ISO 730:2012.

Fig. 1 – Sowing machine for crops direct sowing in serried rows SSD

Sowing machine is aimed to perform operations appropriate to direct sowing of crops of straw cereals. soy beans, rape, medicinal herbs and other similar seeds plants. The seeds are introduced into the bin, being dosed and driven by a cylinder, which is specific to each culture, to the leading tubes and plowshares by means of an air current coming from a fan. The cylinder and fan are driven by an electromotor of 12 V. automatically adjusted by means of a control system depending on the tractor speed. The aggregate made of the wheeled tractor of 45 H.P. and the sowing machine SSD is driven in the field by an agricultural GPS guiding system.

Experiments in laboratory-field conditions designed to find out the qualitative working indexes have been made in experimental plots of INMA Bucharest, SCDA Brăila and C.C.D.P.C.P.N. Dăbuleni during September-November 2016.

For the usual soil analyses in above experimental plots and for evaluating the soil fertility, by means of compressing and extracting reagents, the following physical and chemical tests were performed: ph., Calcium carbonate (necessary lime), nitrates, phosphates, potassium (NPK). In this case was used the methodology of rapid and accurate testing specified by the manufacturer Martin Lishman from Great Britain with the soil analysis kit model SK 200 (*Găgeanu et al.. 2014; http://www.martinlishman.com*).

Hygroscopic humidity of soil is given by the water quantity remained after removing the imbuing humidity. For the experimental determinations, the method of drying stove at 105°C has been used by performing the following operations:

- weighing the ceramic crucible (m_0) ;
- by means of a spatula, the sample was introduced into the ceramic crucible, the composition was homogenized, then weighed (m_1) in two repetitions by means of an analytical balance. 5±0.0002 g of soil sample, each;
- the crucible containing the sample was introduced into the universal drying stove heated at 105°C. then let there for 2 hours and introduced into the exsicator till it reached the ambient temperature;
- the sample was weighed again (m_2) and the hygroscopic humidity was calculated with formula (1) :

$$W_h^u = \left(\frac{m_1 - m_2}{m_1 - m_0}\right) \times 100,\ [\%] \tag{1}$$

The following measuring and control apparata were used: weighing apparatus of special precision endowed with self-calibration - AW 220M, universal stove with temperature adjustment- MEMMERT-UFE 500 and soil analysis kit - SK 200.

Soil compaction was determined after analyzing the resistance at penetration by means of digital electronic penetrometer with cone FIELDSCOUT SC 900. In order to perform the measurements, the cone of 0.01 m^2 with top angle of 60°, was selected. Resistance at penetration of soil measured by penetrometer is a measure of compaction or of bearing capacity of the field. For example: 0…200 N untilled field. 200…300 N field submitted to compaction, over 300 N compacted field (Marin et al.. 2017).

The qualitative working indexes determined were:

- coefficient of variation for distributing the seeds of alfalfa, rape, peas, wheat was found out by weighing the quantity of seeds sampled collected on each ploughshare in one minute time;
- uniformity of repartition of plants in row for wheat was determined by „ in green" method, namely immediately after rising, by numbering the plants of 5 cm. length from sectors;
- medium sowing depth and the degree of lack of uniformity of sowing depth per working width were performed by the„ in green" method, namely after plants springing, in all the rows, in a passing at each running speed in three repetitions, situated in 3 different areas of the plot (at ends and in the middle).

RESULTS

In table 1 are shown the results in terms of macro-elements, pH- and soil humidity, obtained in experimental plots. They will help to establish fertilization plans aimed to rational utilization of fertilizers.

Table 1

Macro-elements and soil pH-ul tested in experimental plots

Determined parameter	**Soil sample – plot of INMA Bucharest**			**Max. Recommended value***	**Obs.**
	0 cm depth	**10 cm depth**	**30 cm depth**		
pH	7.0	6.5	6.5	7.5	It is recommended to complete the deficit of soil nutrients
Lime needed. [g/m^2]	0	0	0	-	
Nitrogen [mg/l]	25.0	25.0	20.0	20 [mg/l]	
Potassium [mg/]	187.5	250.0	230.0	250 [mg/l]	
Humidity. [%]	22.27	22.98	21.72	-	
Determined parameter	**Soil sample–plot SCDA Brăila**			**Max. Recommended value***	
	0 cm depth	**10 cm depth**	**30 cm depth**		
pH	8.0	8.0	8.0	7.5	
Lime needed. [g/m^2]	0	0	0	-	
Nitrogen [mg/l]	7.5	5.0	5.0	20 [mg/l]	
Potassium [mg/l]	175.0	112.0	< 45	250 [mg/l]	
Humidity. [%]	16.70	16.41	16.31	-	
Determined parameter	**Soil sample – plot C.C.D.P.C.P.N. Dăbuleni**			**Max. Recommended value***	
	0 cm depth	**10 cm depth**	**30 cm depth**		
pH	6.0	6.0	6.0	7.5	
Lime needed [g/m^2]	0	0	0	-	
Nitrogen [mg/l]	15.0	12.5	10.0	20 [mg/l]	
Potassium [mg/l]	150.0	175.0	150.0	250 [mg/l]	
Humidity. [%]	13.6	11.7	9.4	-	

Within the speciality literature, the soil classification in terms of pH is the following: strongly acid pH < 5; medium acid pH 5.01 – 5.80; light acid pH 5.81 – 6.80; neutral pH 6.81 – 7.20; alkaline poor pH 7.21 – 8.40 and strong alkaline pH > 8.40.

After analyzing the results shown in table1, one may notice that:

- after determining pH-. in experimental plot SCDA Brăila, the soil is alkaline poor, in experimental plot C.C.D.P.C.P.N. Dăbuleni; the soil is light acid and in experimental plot INMA Bucharest, being appropriate to crops of straw cereals that prefer a soil up to 6.5 and 7.5 pH;

- a lack of phosphorus in all the experimental plots and nitrogen and potassium content in experimental plots SCDA Brăila and C.C.D.P.C.P.N. Dăbuleni situated at the lower limit recommended in terms of soil nutrients for straw cereals.

In figure 2 are graphically presented the results on resistance at penetration depending on depth, obtained in three experimental plots.

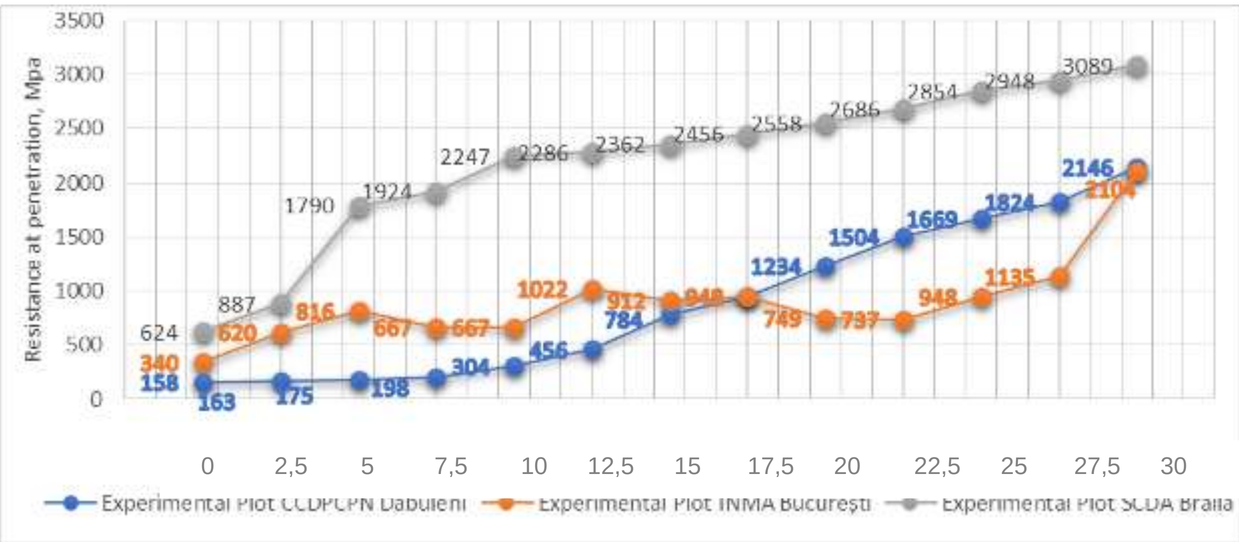

Fig. 2 – Resistance at penetration depending on depth measured in experimental plots

After analyzing the results from figure 2 has been found that only in case of experimental plot SCDA Brăila appeared big penetration resistances, over 3000 MPa. case in which soil is strongly compacted.

In tables 2, 3, 4 and 5 are shown the results obtained for determining the variation coefficient of distribution of seeds of alfalfa, rape, peas and wheat.

Table 2

Variation coefficient for distributing ALFALFA seeds

Row	Seed mass [g]			
	Repetition 1	Repetition 2	Repetition 3	1. Average
1	40.5	40.8	41.5	40.9
2	45.8	47.0	46.3	46.4
3	47.4	47.6	47.7	47.6
4	47.5	46.5	48.2	47.4
5	46.1	44.0	42.2	44.1
6	42.0	41.0	40.2	41.1
7	47.9	45.6	42.0	45.2
8	46.7	44.3	44.0	45.0
Standard deviation				2.6
Variation coefficient				5.76

In order to spread the alfalfa seeds the sowing machine was set as follows: running speed 7 km/h; seed rate adjusted: 22 kg/ha.

Table 3

Variation coefficient for distribution RAPE seeds

Row	Seed mass [g]			
	Repetition 1	Repetition 2	Repetition 3	Average
1	8.1	8.7	9.0	8.6
2	8.1	9.4	9.3	8.9
3	9.3	10.3	9.8	9.8
4	9.0	10.0	9.7	9.6
5	7.0	10.5	8.8	8.8
6	6.1	12.1	8.5	8.9
7	8.2	8.7	9.4	8.8
8	8.2	9.1	9.4	8.9
Standard deviation				0.4
Variation coefficient				4.7

For rape seed distribution the sowing machine was set as it follows: running speed 7 km/h, seed rate adjusted at 5 kg/ha.

Table 4

Variation coefficient for distributing PEAS seeds

Row	Mass of seeds [g]			
	Repetition 1	Repetition 2	Repetition 3	Average
1	325.8	309.5	293.4	309.6
2	316.5	299.4	280.4	298.8
3	313.2	292.6	281.6	295.8
4	323.9	306.6	277.8	302.8
5	307.6	288.6	268.3	288.2
6	322.4	293.3	276.8	297.5
7	396.9	295.9	296.9	329.9
8	351.7	314.2	298.5	321.5
Standard deviation				14
Variation coefficient				4.59

For peas seed spreading. the equipment was set as it follows: running speed 7 km/h, seed rate regulated: 175 kg/ha.

Table 5

Variation coefficient for distributing WHEAT seeds

Row	Seed mass[g]			
	Repetition 1	Repetition 2	Repetition 3	Average
1	346.9	338.3	344.8	343.3
2	352.9	348.9	351.6	351.1
3	352.8	350.0	346.9	349.9
4	349.6	355.2	352.8	352.5
5	347.2	344.5	344.6	345.4
6	352.8	351.4	350.9	351.7
7	354.6	364.8	361.6	360.3
8	362.8	355.0	353.8	357.2
Standard deviation				5.6
Variation coefficient				1.59

In order to distribute wheat seeds. the equipment was set as it follows: running speed 7 km/h, seed rate regulated: 180 kg/ha.

For determining the values of repartition uniformity of plants in row, as well as, the sowing depth and lack of uniformity of sowing depth, a suitable computer program has been performed. We used EXCEL program because it allowed the storing the data and presented the graphic of variation of experimental data obtained. After having processed the measurements, the average results of values in terms of plant repartition uniformity in row, were obtained.

In graphic from figure 3, are presented the average values of measurements related to plant repartition uniformity in row, appropriate to the three working speed values for wheat sown in experimental plot of INMA Bucharest. The graphic has shown a good repartition uniformity with higher values for 5 km/h working speed.

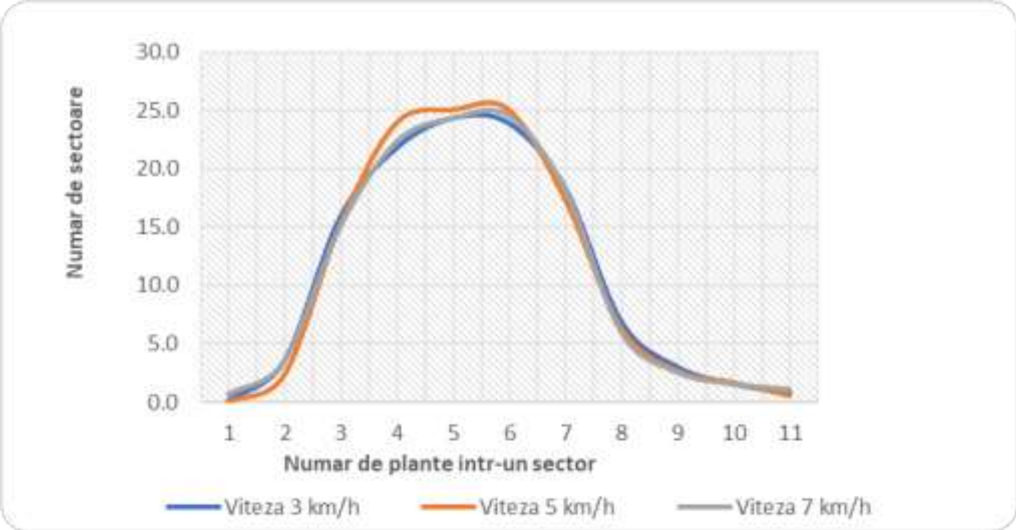

Fig. 3 – Repartition uniformity of plants in row for the three working speed values

Graphic representation of the average sowing depth in row at the working speed of 3 km/h is given in figure 4.

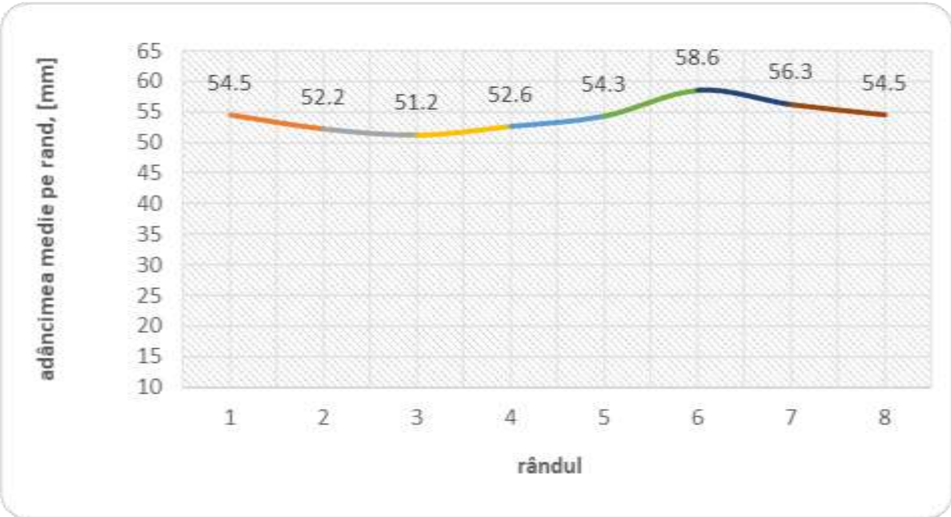

Fig. 4 -Graphic representation of the average sowing depth in row at the working speed of 3 km/h

Graphic representation of the average sowing depth in row at the working speed of 5 km/h is given in figure 5.

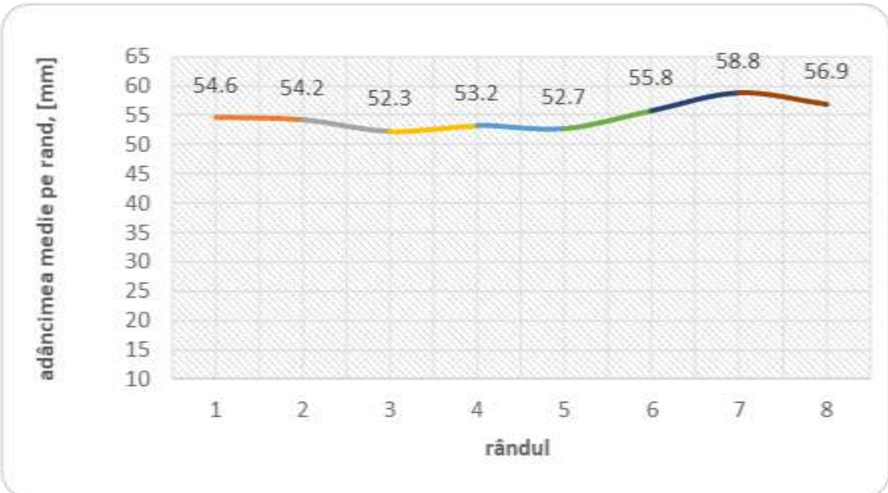

Fig. 5 - Graphic representation of the average sowing depth in row at the working speed of 5km/h

Graphic representation of the average sowing depth in row at the working speed of 7 km/h is given in figure 6.

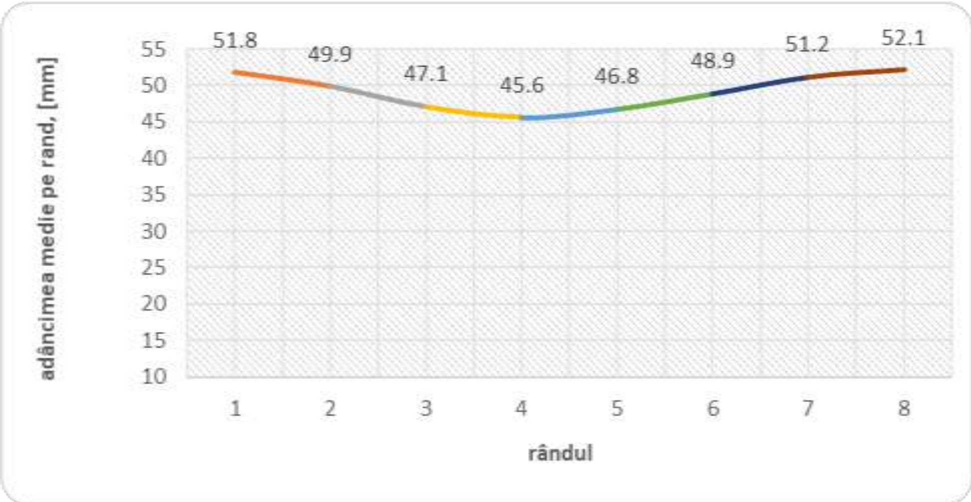

Fig. 6 - Graphic representation of the average sowing depth in row at the working speed of 7km/h

According to agro-technical requirements settled in standards in force, the accepting conditions (repetition capability) are: seed putting at the regulated depth may vary within the limits of ± 1 cm. for those seeds buried at over 4 cm ± 0.5 cm., for those buried under 4 cm not being allowed unburied seeds.

After analyzing the graphics of average sowing depth in row for the three working speed values, it has noticed that the sowing machine SSD accomplished an average depth of 54.4 mm at 3 km/h speed, 54.9 mm at 5 km/h and 49.3 mm at 7 km/h comparing to the depth set at 60 mm. In this case, it is recommended to sow the wheat at 5 km/h working speed.

Average sowing depth per working width at the three working speed values frames within the agro-technical provisions presented in standards in force.

Figure 7 presents the machine work during the determination of qualitative working indexes on experimental plot of INMA Bucharest.

Fig. 7 – Image of the machine during the determination of qualitative working indexes on experimental plot of INMA Bucharest.

CONCLUSIONS

- Experimental researches allowed to validate technically and technologically the solutions tackled when the components of sowing machine were designed, for direct sowing in serried rows of SSD type;
- Experimental results are useful to farmers who apply the direct establishment technology of agricultural crops in serried rows.

ACKNOWLEDGEMENT

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PERFORMANCE TRENDS IN THE FIELD OF MACHINES FOR HARVESTING MEDICINAL AND AROMATIC PLANTS
/
TENDINȚE DE PERFORMANȚĂ ÎN DOMENIUL MAȘINILOR DE RECOLTAT PLANTE MEDICINALE ȘI AROMATICE

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Keywords: *data bases, performances, medicinal and aromatic plants, harvesting machines.*

ABSTRACT

The paper presents an assessment method of equipment framing within a specific category of agricultural machinery, namely the machines designed to harvesting medicinal and aromatic plants, in order to achive a performance hierarchy for optimal selection and purchasing by farmers. Also, the material is interesting for the orientation of those who are manufacturing this type of equipment and machines, because it ensures the knowledge of performances necessary to situate them in the top producers. Results analysis facilitates for beneficiaries, producers and designers, the access to information useful in the adequate adaptation to the geographic characteristics of the exploitation area for producing this type of machines.

REZUMAT

Lucrarea prezintă un mod de evaluare a utilajelor dintr-o anumită categorie de mașini agricole. cele destinate recoltării plantelor medicinale și aromatice.în vederea ierarhizării performanțelor pentru selectare și achiziționare optimală de către fermieri. De asemenea materialul este interesant pentru orientarea celor ce fabrică astfel de echipamente și utilaje. deoarece le asigură cunoașterea performanțelor necesare situării in topul producătorilor. Analiza rezultatelor facilitează beneficiarilor. producătorilor și proiectanților accesul la informații utilizabile în adaptarea adecvată la caracteristicile geografice ale zonei de exploatare pentru producția de astfel de mașini.

INTRODUCTION

Using chemical substances extensively has not succeed to solve the problems related to nutrition or health, but instead has had important negative effects on the environment. In the context of a strong artificializing life, natural remedies, based on medicinal plants make a powerful comeback due to the substances contained, which are useful in treating various diseases.

For the seasoning of culinary dishes, aromatic spices are used, such as: dill, parsley, tarragon, basil, rosemary, marjoram, sage, thyme, oregano, etc. Besides the pleasant aroma and taste, these plants have a high content of bioactive substances with beneficial antioxidant effects. Moreover, aromatic plants can have antiseptic human metabolism speeding effects. All these qualities make them indispensable for those preoccupied with a healthy nutrition. (*Guimares et all.2010. Hinneburg et all. 2006*)

In this paper, the notions of “medicinal” and “aromatic” are used in conjunction, because it is considered that in ratio with the presence of certain active principles, all these plants have specific effects, enhanced by their synergic action, having therapeutic, nutritional or preventive qualities (*Badawi and Singab 2012. Martinov and Konstantinovic 2007*).

The cultivation of medicinal and aromatic plants can constitute for many farmers an opportunity to diversify their structure, to reduce risks and to significantly grow the profit of their agricultural businesses. In the case of these species, high earnings on surface unit can be reached. On the other hand, the production of medicinal and aromatic plants requires specific knowledge in the field of production technologies, sometimes needs to use special machines/equipment as well as a concrete qualitative and safe valorising manner. (*Ivanovic et all. 2014; Mathé 2008*).

In many European countries, the surfaces cultivated with medicinal and aromatic plants were reduced drastically, opting for imports (*Barbieri C.2013. Schipmann et all. 2002*). In Romania, in the last years was found a continuous and accelerated decrease of these surfaces. In 2014 and 2015, these surfaces reached and were maintained the same low level of approx. 3.2 thousand hectares. (*Romanian Statistical Yearbook 2015*).

The phytotherapeutic efficiency of medicinal and aromatic plants is mainly influenced by the quality of the plant material, which depends on: the useful part collected (whole plants of plant organs) in which the bioactive compounds are concentrated; the optimal harvesting moment, corresponding to the maximum concentration of accumulated active principles; the harvesting method. [10] Thus, the methods of harvesting medicinal and aromatic plants are differentiated in ratio to the useful part that is collected. Also, no matter the manner in which the plants are harvested: manually or mechanized, the active principles content should be as little as possible affected (*Muntean L.S 2010. Pajic et all. 2016*).

Medicinal and aromatic plants from which the leaves or the stem with leaves (and possibly the flowers) are used, are mechanically harvested mechanized by cutting them at a certain height from the soil (ex. Mint, basil, thyme, sage, hyssop, dill, parsley, etc.). Plants from which the flowers are used, are mechanically harvested using special parts and specialized towed or self-propelled machines. For harvesting chamomile, efficient self-propelled machines were built at prototype level in Italy (2010) and in Germany (2013) (*Ehlert and Beier 2014. Ehlert .2014. Veselinov et all.2014. www.ongsnc.com/prototipi-2/*).

MATERIAL AND METHOD

The sources of the considerations in this article are the technical-economic data obtained from the web pages and the publicity booklets of companies producing machines and equipment destined for harvesting medicinal and aromatic plants. All the sources are given in the references (16 to 27).
In general, these booklets give information on: machine mass, working width, working speed, engine power, productivity and other information. Not all companies give this information.

By using the information listed above, statistic studies can be made directly on the data from the sources or on statistic estimators, for various purposes. The use of this information is facilitated by organizing them in a database. Microsoft Office Excel was used for creating the database. The database can be consulted by accessing the following link: http://www.inma.ro/baze_de_date/Adriana.htm.

Statistical studies on the data from sources refers to, for example: mass of the machines, their working widths, the power of the engines used, productivities. etc. The achievement of a hierarchy of masses, working widths or productivities is an easy operation when working with databases.

Direct statistical estimators

Mass hierarchy highlights useful information for both the designers and the potential users of this type of machines, warning them on the possible consequences in working with this type of machines: higher consumptions for machines with big masses, a more pronounced terrain compaction, reduced manoeuvrability of these machines, etc.

Working width hierarchy correlated with calculating productivities allows potential users / buyers to choose the machines best suited according to the geographic and climatic profile, the sizes of crop parcels, depending on financial resources and on the length of the time period during which harvesting is efficient.

The same conclusions can be drawn concerning the hierarchy of working capacity[1]. whether is taken directly from the sources or is estimated based on the working width and on the working speed.

Elaborated statistical estimators

For the specialized estimation of some technical / economic characteristics useful for the designers of such machines and equipment and less for potential buyers, we elaborated calculus formulas that use data from the sources. These estimators are:
- *Working unit specific mass*: is a complex machine parameter defined as the ratio between the machine's mass and working width. The measuring unit of this parameter is kg/m. The calculus formula is the following one:

$$m_l = \frac{M}{l} \tag{1}$$

where *M* is the mass of the machine in kg. *l* is the working width in m, and ml is the working width specific mass.

[1] There are geographical areas where manual harvesting is cheaper than the mechanized one (*Ivanovic et all. 2014*).

- *Working width specific power* is a complex machine parameter defined as the ratio between the power of the driving engine and the machine's working width. The measuring unit of this parameter is kW/m. The calculus formula is:

$$P_l = \frac{P}{l} \tag{2}$$

where P is the machine's power in kW. l is the working width in m. and P_l is the working width specific power.
- *Maximum theoretical productivity*: is a complex machine parameter defined as the multiplication between the machine's working speed and its working width. The measuring unit of this parameter is ha/m. The calculus formula is the following one:

$$W_t = 0.1 \cdot v \cdot l \tag{3}$$

where v is the machine's working speed in km/h. l is the working width in m and W_t is the maximum theoretical productivity.
- *Material consumption per maximum theoretical productivity unit*: is a complex machine parameter defined as the ratio between mass and the maximum theoretical productivity. The measuring unit of this parameter is kg/ha. The calculus formula is the following one:

$$m_W = \frac{M}{W_t} \tag{4}$$

where M is the machine's mass in kg. W_t is the maximum theoretical productivity in ha/h. and m_W is the material consumption per productivity unit.
There are still many such technical-economic estimators which are used for making the hierarchy of agricultural machines and more important, they can be used for optimizing their working regime. These estimators require data that our sources do not disclose (ex.: fuel consumption), usually this data is filled in by testing companies in collaboration with producers. Moreover, this type of data can depend on the geo-climatic data, on the crop's characteristics and on the operator's skills.

RESULTS

Elementary statistical results: For the performances of machines and equipment whose data we were able to get, it is interesting to first have a graphical representation. In Sheet 1 of the online database file we show the graphical representation of: the mass of machines and equipment included in this database, the minimum and maximum working width, the maximum working speed. From these graphs, the variation of the measurements stated above for the multitude of machines and equipment included in the database can be observed.

For the maximum working width, the arithmetic mean (for the machines that have this characteristic given) is 1.658 m. and the square mean deviation is 0.415 m. It results that, in the interval centred in the arithmetic mean with the radius of one square mean deviation, is situated the maximum working width of almost 78% of the machines. More than 86% of the maximum working widths of machines are situated between 1 and 2 m.

It is highly likely that the machines with these working widths are the most demanded by the market. Due to this reason, the information extracted can direct the producer towards an important working parameter of a machine for harvesting medicinal and aromatic plants. A similar reasoning can be made for the minimum working width and also for the mass of harvesting machines.

Although the correlations are affected by the lack of data and the calculation is made by introducing null values, a few conclusions are possible (see database file. Sheet 1. correlation matrix). The power of the engine used is mostly influenced by the productivity and the maximum movement speed, a normal conclusion, keeping in mind the theoretical relation between these sizes. The mass of the machine and the engine power are well correlated. Other conclusions can be drawn from the correlation matrix (Sheet 1) with the mention to keep in mind the lack of a large volume of data.

Complex statistic results: These results are based on the calculation formulas elaborated based on the gross values from the database and are given for the machines that had all the data for calculating them. The calculation formulas of these estimators are given in relations (1). (2). (3). (4). Graphical representations of the distribution of these estimators for the machines in the database are shown in figure 1 a, b,c ,d (Sheet 3 – online database).

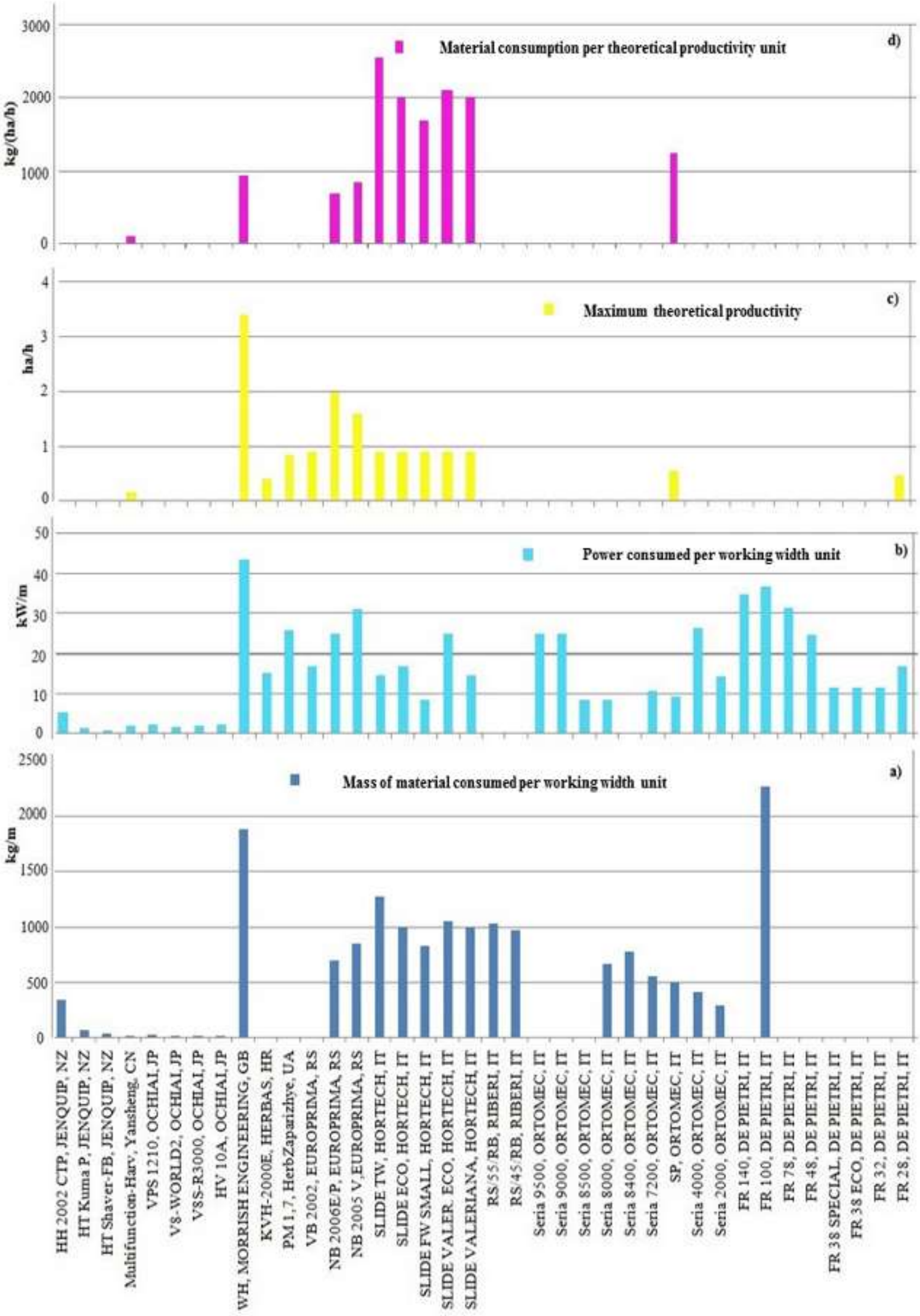

Fig. 1 - Variation of complex estimators: *a) – Mass of material consumed per working width unit; b) – Power consumed per working width unit; c) – Maximum theoretical productivity; d) – Material consumption per theoretical productivity unit*

From figure 1 a is observed that the highest specific consumption on the working width is found for FR 100 DE PIETRI IT machine[2], whose mass was considered as being the value declared in the materials from the year 2012. This machine also has the larger working width of the machines for which the distribution was calculated. For this estimator, at a small difference is found the WH MORISH ENGINEERING machine from United Kingdom.

From figure 1b, the values of the consumed power on the working unit are observed. Thus, the biggest material consumers on the working width are not also the biggest consumers of power specific for the working width unit[3].

From figure 1c is observed that the maximum theoretical productivity is clearly superior for VH MORISH ENGINEERING GB machine[4]. Comparable values for this estimator are found for models NB 2005V and NB 2006 E/P produced by EUROPRIMA company in Serbia.

Material consumption per theoretical productivity unit shown in figure 1d is highest for SLIDE TW machine, produced by Hortech company in Italy.

CONCLUSIONS

The databases containing technical-economic characteristics of agricultural machines offer the possibility to valorize them in the purpose of making a hierarchy of their performances in working processes. Thus, for example, if we have offers from multiple dealers, we can elaborate synthetic hierarchy estimators that take into consideration the price and the performance. The potential buyer can optimally choose the machine. Also, the farmer's choice can be further oriented with limit conditions for the financial resources, landscape conditions, etc.

The database formed by the information in the sources given sets at the disposal of designers, estimations for the performance parameters of the most modern machines built and, indicates what materials, dimensions, etc. they need to use in order to place themselves in the area of top machines.

The database constitutes a source of information for the companies producing machines in the purpose of perfecting performance characteristics for own products.

The database set at the disposal of producers also provides them the range of information they should fill in to form complex performance estimators, with high resolution power.

For soft terrains or for those predisposed for compaction, from the database and the rankings achieved, which allow to choose a working width, the machine / equipment with the smallest mass will be chosen.

Perspectives refer to the possibility to create algorithms for automatic choice in the database, for a minimum of entry data, which will be possible to be used by companies / in the consultancy activity. Also, in the view of using it, the value of the database can increase by acquiring very important data for these machines and equipment, which are usually not given by the profile companies: fuel consumption, actual working capacity, the possibility to attach additional equipment / subassemblies.

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[2] FR140 DE PIETRI (Italy) has the working width bigger than FR100 DE PIETRI, but the second one we do not have the declared mass;

[3] The larger value of P_l if found for VH MORISH ENGINEERING GB, which is fitted with additional devices that require extra power consumption

[4] Working speed is an extremely important parameter for any type of agricultural machine, but depends on the concrete working conditions in the field and on the operator's skill, the values presented being indicative.

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CONSIDERATIONS ON THE TECHNICAL EQUIPMENT USED FOR SEPARATING SEED MIXTURES BASED ON THE AERODYNAMIC PRINCIPLE / *CONSIDERATII PRIVIND ECHIPAMENTELE TEHNICE UTILIZATE LA SEPARAREA AMESTECURILOR DE SEMINTE PE PRINCIPIUL AERODINAMIC*

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ABSTRACT

Cereal seeds pre-cleaning and cleaning, prior to their storage or processing is a complex technological process that includes a multitude of constructive types for technical equipment designed to separate and remove existing impurities in the seed mass, which are based on various separation principles. The paper presents some theoretical aspects regarding the separation of seed mixtures based on the aerodynamic principle, which were the basis for the development of an innovative technology to obtain the seed material for the efficient establishment of agricultural cultures and the design of a new type of aeration cleaning separator SCA for seed mixtures cleaning and sorting. At the end of the paper, we present the advantages of using this equipment in the process of pre-cleaning/cleaning cereal seeds and industrial plants.

REZUMAT

Precurăţirea şi curăţirea seminţelor de cereale înaintea depozitării sau procesării lor reprezintă un proces tehnologic complex, care include o multitudine de tipuri constructive de echipamente tehnice proiectate pentru separarea şi îndepărtarea impurităţilor existente în masa de seminţe. echipamente care au la bază diverse principii de separare. Lucrarea prezintă câteva aspecte teoretice privind separarea amestecurilor de seminte pe principiul aerodinamic. aspecte care au stat la baza elaborării unei tehnologii inovative de obţinere a materialului semincer pentru înfiinţarea eficientă a culturilor agricole şi conceperii unui nou tip de separator curatitor prin aerare SCA. destinat curăţirii şi sortării amestecurilor de seminţe. La finalul lucrării sunt prezentate avantajele utilizării acestui echipament în procesul de precurăţire/curăţire a seminţelor de cereale şi plante tehnice.

INTRODUCTION

Primary processing is an important link to the process of capitalizing plant origin products and is a primary operation of the conditioning chain. This is primarily based on removing foreign bodies from the product mass, providing optimal processing dimensions, preventing or limiting chemical or biochemical processes during storage, leading to deterioration in quality and even the alteration of plant material. (Costin I. 1999. Danciu I. 2001).

Taking into account these considerations, the attention of the specialized researches (in Barsky E. Barsky M. 2004; Didyh V.F. 2002. Geankoplis Chr.2003) focused on the study of the phenomena that influence the process of separating the impurities, the aim being to minimize the impurities that reach the final processing stages of cereals.

Also, primary grain processing operations play a particularly important role in preparing the product for various future uses because:

- the percentage of impurities, seeds of some other crops, or pieces of the basic crop seeds contained in the mass of agricultural products harvested with the combine, reaches fairly high values;
- the processes of increasing the purity of agricultural products differ according to their nature and the destination they receive after harvesting (conservation, consumption, industrialization, marketing, sowing, etc.);
- these operations aim at eliminating impurities of any nature, creating better storage conditions and reducing the volume of transport and storage [2. 4. 8. 11. 14].

In order to obtain the maximum quality with minimum energy and labour consumption it is necessary a thorough knowledge of the technology used, the functioning of the technical equipment specific to the technology as well as the regulation of the technical and functional parameters of this equipment (see Căsăndroiu T. 1993. Rus Fl. 2001).

The paper presents several reference theoretical aspects regarding the separation of seed mixtures based on the aerodynamic principle, aspects that were underpinnings of elaborating an innovative technology to obtain seed material for the efficient establishment of agricultural cultures and designing a new type of aeration a world-class performant cleaning separator SCA 5 destined to cleaning and sorting seed mixtures.

MATERIALS AND METHODS

Impurities in the seed mass are different from the main crop seeds (grain seeds or industrial plants) in terms of aerodynamic properties. These aerodynamic properties take into account the different movement resistances of seeds in an air stream.

In order to carry out the aerodynamic separation process of a mixture of solid particles (seeds in particular), we must take into account a number of factors which have a major impact on the way of its development, among which [1.10. 12.15]:

- the properties of solid particles subjected to aerodynamic separation;
- the properties of the air stream, respectively: the direction of the air stream and the flow regime;
- the way of making the biphasic gas-solid (G-S) mixture.

The resistance of the seed mass layer to the passage of air or gas is a property of particular interest in aeration, gas, drying processes.

The total resistance of the granular material layer to the passage of air or gas is calculated with the relation:

$$R = A \cdot h \cdot W^n \text{. mmH}_2\text{O} \qquad (1)$$

where: *h* - the thickness of the material layer, in m;

W - the conventional air or gas velocity relative to the entire section of the seed laye,. in m/s;

A. n - coefficients determined experimentally according to the characteristics of the seeds (Table 1)

Table 1

The values of coefficients A and n for the main cereals [5]

No.	Cereal	Seed diameter, mm	Coefficients value		Observations
			A	***n***	
1	wheat	3.48	1.43	1.41	Layer thickness varied between 0.05 and 0.5 m
2	maize	7.37	1.55	0.67	
3	rye	3.82	1.41	1.76	
4	barley	3.50	1.53	1.44	
5	rice	3.73	1.41	1.76	

Table 2 shows the resistance of 0.01 m seed layer for different air velocities and different cereals.

Table 2

Resistance values of 0.01 m seed layer for different cereals

No.	Cereal	Coefficients value		Seed layer resistance R. mmH₂O					
		A	***n***						
1	wheat	1.41	1.43	0.52	1.41	2.53	3.81	5.23	14.1
2	maize	0.67	1.53	0.19	0.55	1.04	1.62	2.28	6.7
3	rye	1.76	1.41	0.68	1.81	3.22	4.84	6.62	17.6
4	barley	1.44	1.43	0.53	1.44	2.58	3.89	5.35	14.4
5	rice	1.76	1.41	0.68	1.81	3.22	4.84	6.62	17.6

At its turn, the seed floating capacity is defined by the air velocity for which the seeds in a vertical duct are in a steady state (floating) and is particularly important for the separation based on the difference in aerodynamic properties, for aspiration calculation, etc.

Table 3 shows the floating velocity of the main cereals at the temperature t=20°C.

Table 3

Floating velocity values of different cereals [6.10]

No.	Cereal	Floating velocity. m/s. determined at 20°C
1	wheat	8.5...10.5
2	maize	12.5...14.0
3	rye	8.5...10.0
4	barley	8.5...10.5

Floating velocity at temperature t ≠ 20°C is re-calculated using the relation:

$$W_t = W_{20} \cdot \sqrt{\frac{\rho_{20}}{\rho_t}} \qquad (2)$$

where: W_t is the floating velocity at temperature t, in m/s;
W_{20}- the floating velocity at temperature 20°C, in m/s;
ρ_{20}. ρ_t- air density at 20°C and t°C in kg/m³

The floating velocity depends on the specific mass, surface condition, shape and geometric dimensions of the particles forming the components of the seed mixture.

Table 4 shows the aerodynamic characteristics of different cereals.

Table 4

Aerodynamic characteristics of different cereals

Product	**Aerodynamic characteristics**		
	Specific mass. g / cm³	**Aerodynamic drag coefficient**	**Floating velocity. m / s**
Wheat	1.3 – 1.4	0.18 – 0.26	8.1 – 12.3
Rye	1.2 – 1.5	0.16 – 0.22	8.3 – 9.9
Barley	1.2 – 1.4	0.19 – 0.27	8.4 – 10.7
Rice	1.1 – 1.2	0.19 – 0.26	8.0 – 10.8
Maize	1.2 – 1.5	0.16 – 0.24	12.5 – 14.0
Millet	1.1 – 1.2	0.04 – 0.07	9.8 – 11.8

The air flow(m³/s) for processing a mixture with a mass flow rate of 1 kg/s depends on the nature of the product and the purpose of the work being carried out.

For preliminary cleaning, the air flow can be determined with the relation:

$$Q_{ap} = k_u \cdot S_{cp} \cdot v_{a1} \qquad (3)$$

while for sorting, it is determined with the relation:

$$Q_{as} = k_u \cdot S_{cs} \cdot v_{a2} \qquad (4)$$

where: k_u is a uniformity coefficient of the air stream on the sieve (k_u=0.65);
v_{a1} and v_{a2} – air stream velocities in the two cases;
S_{cp} and S_{cs}- sections of channels for the transport of separated fractions that are determined by relations:

$$S_{cp} = \frac{Q \cdot (100 - q_{cp})}{100 \cdot q_s} \qquad (5)$$

$$S_{cs} = \frac{Q \cdot (100 - q_{cp} - q_{cs})}{100 \cdot q_s} \qquad (6)$$

where: Q is the feed flow rate of the installation;
q_{cp} and q_{cs}- flow rates of the fractions that must be removed;
q_s- product specific feed rate for an installation that is supplied with an air flow rate of 1 m³/s.

The total air flow rate (m³/s) required by an aeration cleaning separator can be determined by the relation:

$$Q_a = \sum_{i=1}^{n} Q_{si} + \sum_{i=1}^{n} Q_{ti} \qquad (7)$$

where: Q_{si} is the air flow rate required for separation in step i (for an installation with n separation steps);
Q_{ti}- the air flow rate required to transport the product from step i to the next step.

The total pressure losses h of the aerodynamic separation unit are determined with the relation [13]:

$$h = h_t + \sum_{i-1}^{n} h_{li} = \frac{\gamma_a}{2 \cdot g} \cdot v_a^2 \cdot (\lambda \cdot \frac{l}{d_i} + \sum_{i=1}^{n} \xi_i \quad (8)$$

where: h_t is the loss of pressure during air transport from the source to the separator;

h_{li} - local pressure losses;

ξ - the coefficient of local resistances;

λ - loss coefficient;

v_a - air velocity in the channel;

l - channel length;

d_i - inner diameter of the circular channel.

If the channel has a section form other than circular, we consider an equivalent diameter d_e. which for rectangular channels is determined with the relation: $d_e = \frac{2 \cdot a \cdot b}{a+b}$ (where *a* and *b* are the dimensions of the rectangular channel section).

The air streamworking velocities are chosen according to the aerodynamic characteristics of the mixture components, respectively the critical floating velocity of these components (Table 3).
The determination of the total air flow Q_a (m^3/s) required for the separation and transport of a particle mixture depends on the specific feed rate q_s. (kg/s) and the static pressure losses in the installation air ducts.

Experimental data show that admissible loads can be considered those presented in Table 5.

Table 5

Admissible load q_a (kg/sm^2) for different types of cereal seeds [6.10]

Type	**Admissible load q_a. kg/sm^2**	
	Pre-cleaning duct	**Sorting duct**
Wheat	3.5...4.0	1.8...2.0
Rye	3.5...4.0	1.8...2.0
Oat	2.5...3.0	1.3...1.5
Barley	2.5...3.0	1.3...1.5

The working capacity of a separation equipment takes into account the volume of material separated in a given period of time, under the conditions of a directed medium feed flow rate and a use coefficient of the calculated working time (e.g. k_t = 0.7).

RESULTS

The proposed aeration cleaning separator SCA 5 (figure1) designed by INMA is intended for seed cleaning and removal of all impurities (weed seeds, broken grains, plant debris, soil, dust, etc.) of the main product mass in order to be as pure as possible and for seed sorting, namely the division of the main product into several categories according to well-defined criteria (dimensions, weight, shape).

Technical characteristics of SCA 5:

Processing capacity. kg/h:	
- pre-cleaning	5,000
- cleaning (selection)	2,500
Air flow ratefan I, m^3/min.	150
Aspiration air flow rate fanII, m^3/min.	120
Installed power, kW	depending on the fan used
Overall dimensions:	
- length (with dust decanting cyclone), mm:	
- without cyclones battery	4,100
- with cyclones battery	5,350
- width, mm	1,300
- height, (with cyclones battery). mm	3,650
Weight, kg	
- with cyclones battery	500

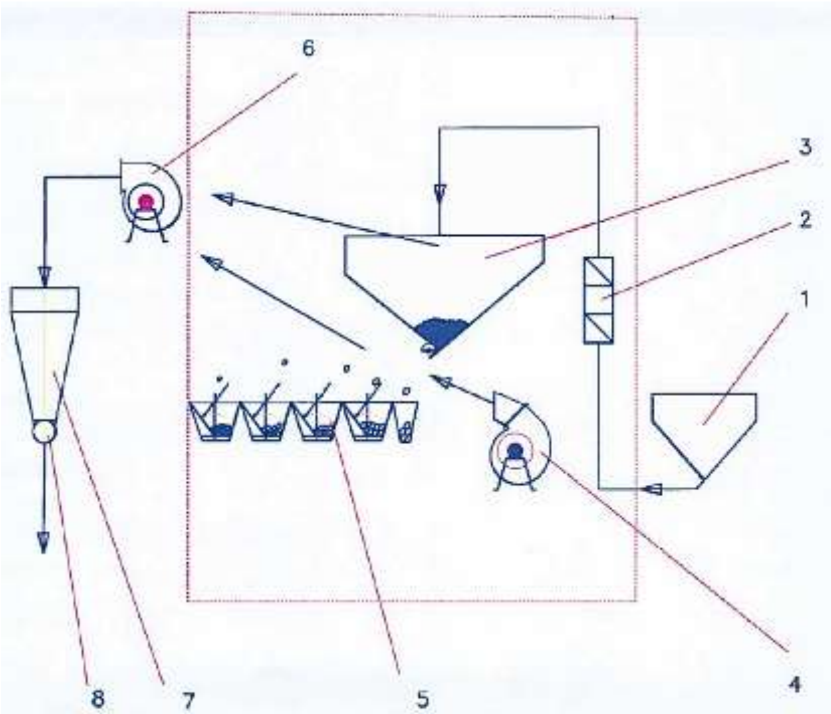

Fig.1 - Technological flow scheme of the aeration cleaning separator SCA 5

1- supply funnel; 2-conveyor; 3- intermediary funnel; 4-radial-axial fan I; 5-collecting funnel; 6- radial-axial fan II; 7-cyclones battery; 8-lock

The product is inserted into the hopper and from there it is taken up by the conveyor buckets, it is raised to the upper part of the machine and inserted into the levelling chamber.

By free fall the product falls into the separating chamber where it meets the air that has been discharged by the radial-axial fan I. The chaff, the dust and light impurities are guided by the air flow provided by the fan II to the impurities collecting cyclones battery, and the seeds, depending on their specific weight, are thrown into the outlets: the lightest in the farthest outlets and the heaviest in the nearby ones. The working capacity is adjusted according to the purpose for which the machine is used: pre-cleaning or cleaning.

The aerodynamic separation takes place in a differentiated way, depending on the particle mass, the air pressure and the flow direction. Dust removal is justified by the fact that it impurifies the raw materials, making them unfit for processing and consumption, as well as due to the premature wear of the transport and processing equipment, by its abrasive action.

The equipment allows for the best possible preparation of seeds for use as seed material, consumed or stored, at the level of European standards in the field, observing the ecological requirements.

CONCLUSIONS

Based on the difference in aerodynamic attributes, the components of the cereal seed and industrial plant mass can be separated by entraining them in an air stream.

The aeration cleaning separator SCA 5 has the ability to clean and sort seeds according to the specific weight in a single working cycle, respectively, separating into distinct fractions by a single passage of the raw material through the machine. The separator can process all seed classes, irrespective of culture (cereal, legume, perennial herbs, medicinal plant seeds and other cultures such as beet, sunflowerseeds). Also, the machine can clean and sort the groats and their products. The execution of the above-mentioned operations ensures obtaining seeds, which will present differentiated qualities for sowing (if seed lots are processed), for proper storage and for a different valorisation depending on the quality indices of the fraction.

The introduction to manufacturing of the Aeration cleaning separator SCA 5 does not require special facilities, the economic agents specialized in the execution of this type of technical equipment having the technical facilities needed to assimilate it.

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EXPERIMENTAL RESEARCHES REGARDING THE ACCURATE ASSESSMENT OF DISTRIBUTION OF SPRAYED SOLUTION OBTAINED BY A NEW TECHNICAL EQUIPMENT FOR FOLIAR FERTILIZATION IN AGRICULTURE
/
CERCETĂRI EXPERIMENTALE PRIVIND EVALUAREA PRECISĂ A DISTRIBUȚIEI SOLUȚIEI PULVERIZATE OBȚINUTE DE UN ECHIPAMENT TEHNIC NOU PENTRU FERTILIZAREA FOLIARĂ ÎN POMICULTURĂ

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ABSTRACT

The improvement of the technologies of applying foliar fertilizers and their appropriate technical equipment represents a major concern of researchers, aiming to increase fertilization by performing unpolluted working processes that restore the environment and lead to the obtaining of health products. The paper presents some aspects regarding the experimental researches made within INMA Bucharest for obtaining a precise evaluation of distribution of sprayed solution by one new equipment for foliar fertilization in orchards. Results obtained have generated valid solutions for promoting high-performance equipment aimed to be used within the foliar fertilization technology in orchards. This equipment distributes the solution according to vegetal matter (leaves, branches) by means of an automated system of tree crown detection and a command mechanism of target spraying. Utilization of technical equipment will result in diminishing the environment pollution through an innovative technology by which an as small as possible quantity of ecological fertilizers is accurately applied.

REZUMAT

Perfecționarea tehnologiilor de aplicare a fertilizării foliare și a echipamentelor tehnice adecvate constituie o preocupare majoră în rândul cercetătorilor, în scopul creșterii calității fertilizării prin realizarea unor procese de lucru nepoluante care să conducă la reabilitarea mediului și obținerea unor produse sănătoase. În lucrare sunt prezentate aspecte privind cercetările experimentale efectuate în cadrul INMA București pentru evaluarea precisă a distribuției soluției pulverizate obținute de un echipament tehnic nou pentru fertilizare foliară în pomicultură. Rezultatele obținute generează soluții valide pentru promovarea unui echipament tehnic performant pentru a fi utilizat în cadrul tehnologiei defertilizare foliară în plantații pomicole. care administrează soluția în funcție de existența masei vegetală (frunze. ramuri) în raza de acțiune a pulverizatoarelor, cu ajutorul unui sistem automat de detectare a coroanei pomului și de comandă țintită a stropirii. Utilizarea echipamentului tehnic în exploatare va conduce la reducerea poluării mediului printr-o tehnologie inovativă care permite aplicarea precisă a unor fertilizanți ecologici în cantitate cât mai mică.

INTRODUCTION

Worldwide, most of the manufacturers of spraying machines are manufacturing equipment that uses high working pressure (up to 50 bar) and reduced speed and therefore the quantity of solution sprayed is relatively large, of over 2000 l/ha (*Braekman și Sonck. 2008*). (*Goossens et al.. 2004*) and (*Vissers. 2005*).

Starting with 1939, when DDT (dichlor phenyl-trichlor-ethane) was discovered, chemical fertilization has been more and more used in agricultural fields. Nowadays, it is surpassing the quantity of 3 milliard kilos of pesticides annually applied with a purchase price of over 40 billion USD a year (*Pimentel. 2005*).

Pesticides usually used for increasing both productivity and quality of crops cultivated might be noxious to environment and people health. Effects of their application might determine persistent problems in rural and urban areas because of different ways of transport of pollutant agents in culture areas, from air, water and other natural resources (*Gil și Sinfort. 2005*).

Environmental-friendly orchards agriculture was developed as a component of biological agriculture, which is one of main orientation of developed countries, especially in EU aiming to improve the food chain security (*Manea D.. 2012*).

The foliar fertilization is largely spread being able to correct the lack of micro-nutrients that is important for obtaining a maximum yield. (*Crisosto et al.. 1997*).

The simultaneous application of foliar nutrition with bio-stimulating agents of plants growing leads to the increment of crop production and improves its quality (*Smoleń S.. 2012*).

For example, for apple culture the utilization of foliar nutrients may be more efficient than their application on soil, but it is recommended to apply both on soil and on leaves for better managing the nutrients. (Mohammad E.. 2008).

Thus, INMA Bucharest designed, performed and tested in laboratory conditions a new technical equipment for the soil work in the row of fruit trees concomitantly with the root cutting in order to obtain a moderate growth of offshoots and a precision foliar fertilization.

The goal of researches made consisted in developing one new equipment aimed to obtain every year high productions in optimum conditions and optimally use the land; by foliar fertilization, this equipment should be able to diminish the environment pollution, phenomenon more and more stringent in latest years, ensuring at the same time the plants nutrition normal development.

This paper aims to promote an innovative technology able to perform soil work by a single passing, make roots cutting and foliar fertilization in orchards of Romania with powerful impact on orchard farmers from rural areas.

MATERIAL AND METHOD

Within the experimental researches. was used a technical equipment for the soil work in the row of fruit trees concomitantly with the root cutting in order to obtain a moderate growth of offshoots and a precision foliar fertilization, aiming at maintaining orchards from rural areas and raise fruit production efficiency. The equipment concomitantly performs the following operations:

- ploughing in a narrow strip of land situated at a certain distance from tree trunk for maintaining the soil loosening at surface;
- cutting the root at a certain distance from tree trunk for moderating the offshoots growing;
- foliar precision fertilization.

The technical equipment (fig. 1) consists of an automated system of detection of the tree crown and precise spraying command, mainly made of a box where are placed a micro- controller, a sensor of real time speed running, two ultrasonic sensors that emit short acoustic pulsations of high frequency at regular time intervals, as well as two electro-valves for opening-shutting control for each vertical ramp that spreads the foliar fertilizer.

Fig. 1 – Technical equipment for soil work in fruit tree row concomitantly with the root cutting aiming a moderate growing of offshoots and the precision foliar fertilization

The automated system of detection of the tree crown and precise spraying command (fig. 2), based on data given by ultrasonic sensors x_s detecting the presence of tree crown, ensures the adjustment of flow rate thorough the double jet nozzle ramps in accordance with the instantaneous value of running speed up to the ratio value (Q/v), equal to that imposed by the adjustment of liquid rate per hectare. Information related to flow rate (through the ramps endowed with spraying nozzles) and speed is expressed as electric elements x_Q and x_v. generated by suitable transducers. Ratio between the two signals (x_Q/x_v) is compared to the ratio imposed for setting in the automated regulator. Deviation x_a obtained is transmitted to automated regulator, where it transforms in a dimension x_c that commands the electric servomotor. It actuates the opening of regulation tap, adjusting its passing section and implicitly the rate Q_l sent to spraying ramps till the ratio (Q_l/v) equals the imposed ratio.

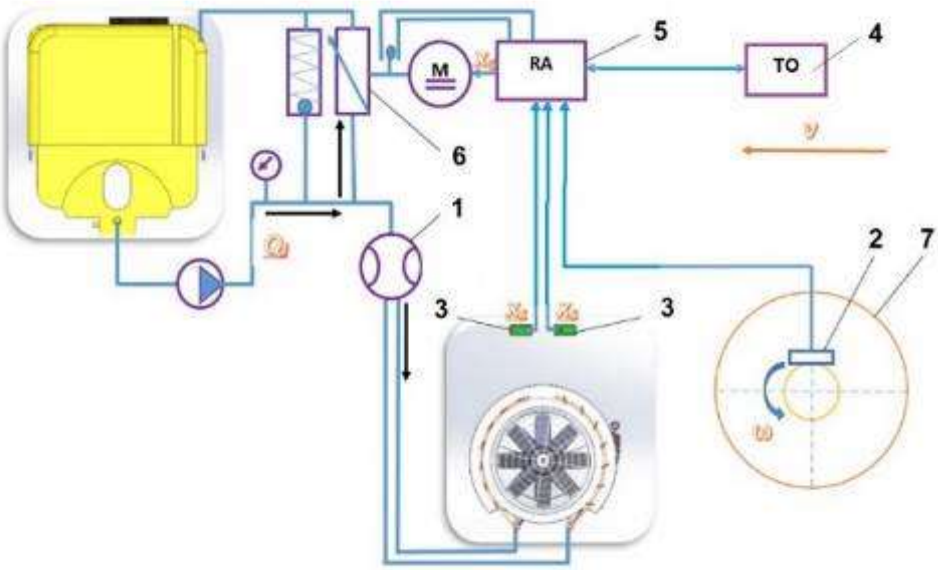

Fig. 2 – Principle scheme of automated system of detecting the tree crown and controlling the precise spraying
1 – rate adjusting device; 2 – tachogenerator; 3 - ultrasonic sensors; 4 – operation terminal; 5 – automated regulator; 6 – electro-valve normally shut; 7 – transport wheel.

The following adjustments were made during the experimental researches of technical equipment for foliar fertilization in laboratory conditions:

- adjustment of operation pressure of installation;
- adjustment of safety valve;
- adjustment of ventilator air flow rate.

Within the tests made in laboratory, the following indexes have been determined:

- rate of pump of type M50 IMOVILLI;
- uniformity of liquid rate necessary to foliar fertilization.

- Flow rate of pump of type M50 IMOVILLI comprised in technical equipment

In order to find the pump flow rate, the testing bench for pumps AAMS (fig. 3) was used. at a starting revolution of 550 rot/min.

Tests were made with pump mounted on technical equipment of foliar fertilization at pressures of 0, 10, 15 and 20 bar.

Fig. 3 – Stand for testing AAMS pumps

The pump flow rate was verified to see if it is appropriate to its original performances and find out if the respective quantity of liquid is enough for a part of liquid to be sent to nozzles and another to ensure sufficient tank agitation.

For this purpose, the stand designed to test AAMS pumps was connected to pump pressure section and the other part was returned via a hose into the foliar fertilization equipment tank.

For performing the measurement, the stand above is equipped with sensor with inductive flow and one electric pressure sensor that are connected to a monitoring system displaying permanently the pressure and rate. After performing the measurements, the values obtained might be transferred to a portable computer in order to be read or printed.

- Uniformity of flow rate of liquid needed in foliar fertilization has been determined on the testing stand of distribution of nozzle rate ED 20/900 E.

The testing stand of distribution of nozzle rate ED 20/900 E being computer-aided by a portable P.C. through a specialized software, has allowed to control and acquire data with a more accurate precision measuring, shorten the time of tests and, at the same time increase the trust in values obtained.

In order to measure the spraying, stand ED 20/900 E is endowed with a scanner with 24 couples among which 12 are set on spraying ramp nozzles. Liquid is collected in separate cylinders on each nozzle, being weighed afterwards. Measurement results are transmitted by radio-link to the portable computer that processes them and displays as table. At least 3 measurements have been performed for each pressure and every nozzle type.

RESULTS

Testing stand of pump AAMS of type M50 IMOVILLI allowed to display on portable computer the results of rate control as a table.

In table 1 are presented the results related to verification of rate of pump of M50 IMOVILLI type.

Table1

Flow rate of pump of M50 IMOVILLI type

Specifications		Measured values (litres)						Pump rate (l/min)
Number of rotations (rot/min)	Pressure (bar)	R1	R2	R3	R4	R5	Average	
540	0	50	50	50	50	50	50	50
	10	49.6	49.7	49.5	49.5	49.6	49.58	49.58
	15	49.2	49.1	49.3	49.3	49.2	49.22	49.22
	20	49	49	49	49	49	49	49

Stand that controls the distribution uniformity ED 20/900E, after having processed the data transmitted by portable computer, has allowed to display them as a table.

In table 2 are shown the results related to uniformity control of foliar fertilization equipment.

Table2

Uniformity of liquid flow rate designed to foliar fertilization

Specification			Flow rate measured (l/min)				S Standard deviation l/min	Rate coefficient %
Type of nozzle	Pressure (bar)	Nozzle No.	R1	R2	R3	Average		
F20002	10	1	1.11	1.1	1.1	1.10	0.01	0.71
		2	1.15	1.15	1.15	1.15	0.00	0.00
		3	1.14	1.12	1.12	1.13	0.02	1.39
		4	1.09	1.09	1.08	1.09	0.01	0.61
		5	1.24	1.23	1.23	1.23	0.01	0.63
		6	1.26	1.25	1.25	1.25	0.01	0.62
		7	1.27	1.27	1.27	1.27	0.00	0.00
		8	1.05	1.04	1.04	1.04	0.01	0.75

Specification			Flow rate measured (l/min)				S Standard deviation l/min	Rate coefficient %
Type of nozzle	Pressure (bar)	Nozzle No.	R1	R2	R3	Average		
		9	1.2	1.19	1.19	1.19	0.01	0.66
		10	1.16	1.16	1.16	1.16	0.00	0.00
		11	1.26	1.25	1.25	1.25	0.01	0.62
		12	1.18	1.17	1.17	1.17	0.01	0.67
F20002	**15**	**1**	1.49	1.5	1.51	1.50	0.01	0.82
		2	1.35	1.35	1.36	1.35	0.01	0.49
		3	1.51	1.51	1.51	1.51	0.00	0.00
		4	1.59	1.58	1.58	1.58	0.01	0.49
		5	1.35	1.35	1.34	1.35	0.01	0.50
		6	1.42	1.42	1.42	1.42	0.00	0.00
		7	1.32	1.34	1.34	1.33	0.02	1.17
		8	1.38	1.39	1.4	1.39	0.01	0.88
		9	1.47	1.47	1.47	1.47	0.00	0.00
		10	1.44	1.44	1.44	1.44	0.00	0.00
		11	1.56	1.56	1.55	1.56	0.01	0.43
		12	1.49	1.49	1.49	1.49	0.00	0.00
F20002	**20**	**1**	1.46	1.44	1.45	1.45	0.01	0.98
		2	1.54	1.53	1.54	1.54	0.01	0.51
		3	1.49	1.49	1.49	1.49	0.00	0.00
		4	1.44	1.43	1.43	1.43	0.01	0.55
		5	1.67	1.65	1.66	1.66	0.01	0.85
		6	1.72	1.72	1.73	1.72	0.01	0.39
		7	1.75	1.74	1.74	1.74	0.01	0.45
		8	1.41	1.4	1.4	1.40	0.01	0.56
		9	1.62	1.61	1.61	1.61	0.01	0.48
		10	1.59	1.58	1.58	1.58	0.01	0.49
		11	1.72	1.7	1.71	1.71	0.01	0.83
		12	1.58	1.58	1.57	1.58	0.01	0.42

After analyzing the test results obtained, it has established that the technical equipment has respected the agricultural requirements imposed to foliar fertilization, thus it has obtained a variation coefficient of flow rate below 10%.

In figure 4 is shown one aspect during the determination of uniformity of distribution of technical equipment on testing stand ED 20/900 E.

Fig. 4 - Aspect during the determination of uniformity of distribution of technical equipment on testing stand ED 20/900 E

CONCLUSIONS

- Experimental researches have enabled to technically and technologically validate the solutions tackled for designing the components of technical equipment for precision foliar fertilization;
- Experimental results have enabled to elaborate a useful recommendation for farmers who are applying the precision foliar fertilization in orchards.

ACKNOWLEDGEMENT

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IMPACT OF HUMAN ACTIVITIES ON NATURAL COMPONENTS FROM PERIMETER OF PROTECTED AREAS
/
IMPACTUL ACTIVITATILOR UMANE ASUPRA COMPONENTELOR NATURALE DIN PERIMETRUL ARIILOR PROTEJATE

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Keywords: *protected area, sustainable development, key sectors: tourism, transport, agriculture*

ABSTRACT

Moto: "The world of protected areas is the most important inheritance we can leave to future generations: ensuring and continuing access to nature, to the material and spiritual values that it holds (...). A world lacking protected areas, stripped of wild natural sites, would become an extremely poor environment" [1].

The paper presents the impact of human activities on the natural components of the landscapes protected by agriculture, forestry, tourism, transport and industry. The majority of modern farming practices have proven to be harmful to nature and landscapes. Numerous rare habitats have been destroyed, especially by draining wetlands and irrigating arid areas to increase productivity.

Another economic activity that can cause large damage to protected areas and benefits, is tourism. Tourism has facilities that degrade natural landscapes and are particularly strong while another activity such as transport has an increasing impact on protected areas: noise, air pollution, congestion and road construction itself. Industry has four sectors with a special impact on protected areas, such as: energy industry; manufacturing industry; extractive industry; small-scale craft industry.

REZUMAT

Moto: „Lumea ariilor protejate reprezinta cea mai importanta mostenire pe care o putem lasa generatiilor viitoare: asigurarea si în continuare a accesului la natura. la valorile materiale si spirituale pe care aceasta le detine (…). O lume lipsita de arii protejate. deposedata de situri naturale salbatice. ar deveni un mediu extrem de saracit” [1].

In lucrare se prezintă impactul activitatilor umane asupra componentelor naturale ale peisajului ariilor protejate prin: agricultură, silvicultură, turism, transport şi industrie. Nocive pentru natură şi peisaje s-au dovedit a fi majoritatea practicilor agricole moderne. Astfel, au fost distruse numeroase habitate rare. în special prin drenarea zonelor umede si irigarea zonelor aride pentru a creste productivitatea.

O altă activitate economica care poate cauza pagube mari ariilor protejate şi care aduce beneficii este turismul. Turismul are facilităţi care degradeaza peisajele naturale şi sunt deosebit de puternice în timp ce o altă activitate precum transportul. are un impact crescând asupra ariilor protejate: prin zgomot, poluarea aerului, congestie si prin însasi construirea drumurilor. Industria are patru sectoare cu impact deosebit asupra ariilor protejate. cum ar fi: industria energetica; industria manufacturiera; industria extractiva; industria mestesugareasca la scara mica.

INTRODUCTION

In developed and developing countries, the main purpose of setting up protected areas was to preserve important natural elements and unique habitats that would otherwise have been destroyed. Once established, they have not been given due attention to the protection of natural impact resources. In developing countries, it is necessary to create a consciousness of visitors; many protected areas are degraded due to the different impacts of tourists. These serious problems have attracted specialists who create theories and methods of visitor management.

Managers recognize that management decisions can not be based solely on the knowledge of the behaviour of natural ecosystems and the design of an infrastructure to maximize recreation, while minimizing adverse effects caused by visitors. It is recognized that there are very few sectors that do not influence the protected areas in one way or another, but the main areas that pose the most serious threats to the protected areas are:

- energy generation;
- the manufacturing industry;
- extractive industry;
- small-scale craft industry.

Agriculture implies the major use of land in the category of protected landscapes (natural parks) and is important in many nature reserves.

On the forestry side, almost all forests have been modified by human intervention for hundreds or even thousands of years. Such alterations can reduce or increase biodiversity but always change the forest structure.

Tourism in kind is a big deal in many countries. But it also jeopardizes the natural resource on which it depends. A natural change in the evolution of ecosystems exists when people are introduced into the scen;. the natural direction and the rate of change sometimes change substantially. This change is inevitable. Managers of protected areas must seek to limit and stop those unacceptable impacts.

Transport, especially on road, has an increasing impact on protected areas: air pollution, congestion, noise and visual intrusion and road construction itself, the establishment of a network of protected areas across Europe with corridors being hampered by the fact that Europe is fragmented by an even denser road network.

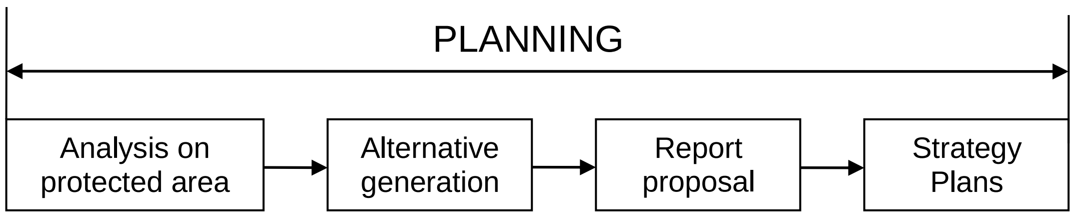
MATERIAL AND METHOD

The National Environmental Protection Strategy - The general principles, which lay down the priorities for the short, medium and long term environmental protection objectives, are the following:

1. Conservation and improvement of people's health;
2. sustainable development;
3. avoiding pollution by preventive measures;
4. preservation;
5. preserving the heritage of cultural and historical values;
6. Stimulation of the environmental recovery activity.

Defining protected areas and their categories

Analysis of human activities on natural components in protected areas perimeter entails the existence of an area declared as a protected area and also involves a planning of activities.



The analysis process includes:

1.The ideal process is based on defining objectives according to the future vision of protected areas. It is primarily based on inviting all the bodies involved at national, regional and local level to debate and it is important to gain the consensus of all the participants on these points;

2. The real process is based on the definition of the objectives for solving the problems faced by the protected areas. It is based in particular on addressing the issues faced by protected areas, such as access to area resources, area development issues, ownership and resource use issues.

RESULTS

The forms of intervention on the natural components of the protected areas can be: industry, agriculture, forestry, tourism and transport.

INDUSTRY: energy industry; manufacturing industry; extractive industry; small-scale craft industry are four industry sectors with a special impact on protected areas. They can be affected by Generation of Energy at every stage of the technological process due to the extraction and transportation of fuels, the process of transmission and generation of electricity to consumers. Oil pollution from the sea endangers many marine habitats; heavy damage to national parks has brought by hydroelectric power stations, dams and reservoirs. and power lines have disfigured many protected landscapes. Mountain landscapes may also be affected by wind power, although it is considered to be non-polluting.

Another impact on protected areas through the effects of pollution and heavy traffic generation is the

Manufacturing Industry. Numerous protected areas overlap with potential supply areas with rocks and even underground deposits necessary for the manufacturing industry, e.g.: the extractive industry. Sand and gravel deposits are often found in wetlands and cause environmental problems.

Exploiting these sources leads to direct conflict with the aims of a protected area. If all these sectors cause difficulties for protected areas, there may be benefits such as former deep mining areas and former quarries provide the chance to restore a forest; abandoned quarries can be used to create new habitats. They may not reward what has been lost, but show that there are opportunities for protected areas to be found in the most uncompromising circumstances, provided they are followed by sustainable policies [2].

Small-scale craft industry is beneficial to protected areas and it helps to support the rural population through a major environmental impact due to the income it generates (from timber or lumber processing, local food preparation, crafting of handicraft products.) Abilities residents through land management can generate income for staff working in parks and their families, which leads to maintaining a protected landscape.

AGRICULTURE

Means both the use of land by itself and the exercise of a strong influence on rural activities. Some agricultural lands are of intrinsic value for conservation, meaning that flora, fauna and landscape depend on the continuation of low intensity, often traditional works.

For nature and landscapes, almost all modern agricultural practices proved to be particularly damaging. To increase productivity, many rare habitats have been destroyed, especially by draining wetlands and irrigating arid areas. In some cases, industrial practices have almost eradicated wildlife. The intensive use of fertilizers, pesticides and herbicides has led to pollution and sometimes to the actual destruction of neighbouring natural areas [3].

In the past, the purpose of farming has been to increase productivity, without taking into account cost; food surpluses have subsequently led to measures to reduce productivity by cutting subsidies, encouraging "rejections" or other ways.

The new democratic governments in Eastern and Central Europe have the opportunity to integrate conservation into policies for agriculture and land use. Fundamental changes in agricultural policies can bring great benefits to conservation. protected areas and society in general [4].

FORESTRY

Virgin forests should be preserved for the most part by protected areas. Conservation of forests in Europe is more about ensuring that their management is sustainable and less preserving original forests.

Natural and semi-natural forests continue to be transformed into more intensive forms of forests (with younger trees, fewer species, less biomass and greater fragmentation of the forests. Grazing can devastate forests. Air pollution does not respect any boundaries. Fire can be natural, but in modified forests it can become devastating, especially if it is followed by intensive grazing.

State-owned and private commercial forestry operators should allow part of their property to naturally evolve without cutting or planting old trees along the watercourses and on the roadside. (in some cases management of active conservation may be necessary.,eg reducing the number of deer in many places in Europe).

These approaches should be part of the management that seeks to increase the value of the entire forest for the environment. National policies for sustainable forestry require:

- establishment of a permanently guaranteed forest;
- training in forest ecology and management;
- standards for permissible annual cuts, cutting cycles, harvesting techniques and infrastructure, environmental saving methods;
- control of all aspects of forest harvesting and treatment for environmental protection;
- economic and financial policies that do not require more from forests than can be sustained;
- Multiple use policies to ensure that the company receives all the benefits (timber, jobs, ecological services, recreation, etc.) from all forests;
- ecological policies that protect ecological services, biological diversity and resource base for all who use forests;
- standards for the composition of species that favour native trees;

[5] (Adapted after *„Caring for the Earth"*-1991).

TOURISM

It is an economic activity that can cause large damage to protected areas, but can also bring great benefits. Valuable natural areas are becoming more and more places for long-lasting, one-day tourism and even sports. In some protected areas, there are simply so many visitors in some places or at certain times that nature - and the quality of visitors' experience - suffers; in others, visitors can enter the farthest areas.

If it is planned and managed to be sustainable, tourism can be a very positive force, bringing benefits both to protected areas and to local communities. Tourism will be welcomed in the perimeter or in the vicinity of the protected areas, if it respects the special character of the area, so that damage and pollution are minimal.

The main forms of tourism approved within the protected areas are:

- tourism based on the appreciation of nature;
- cultural and educational tourism;
- the touristic activity of small quiet groups;
- ecotourism in general.

Tourism can help to justify the establishment of protected areas in marginal regions and can lead to a revival of local economies and traditional cultures.

Techniques for managing visitors in sensitive environments are generally not well known. The European Federation of National and Natural Parks (FNNPE) recently reviewed tourism in and around protected areas and concluded that tourism and conservation can often be mutually beneficial, but only if practised in a sustainable way in the areas matching [6].

From the point of view of the tourist use, the measures taken by the protected areas include:

a) transforming existing non-editable development into more sustainable forms;

b) establishing sustainable standards for new developments, especially in sensitive environments;

c) Designation of areas for different degrees of tourism, based on the carrying capacity of protected areas, including sanctuaries and quiet areas, as well as areas suitable for different levels of tourism and development use;

d) reduction of pollution and decongestion of holiday traffic;

e) avoiding tourism and excessive recreation in protected areas;

f) ensuring that local communities also benefit from tourism;

g) training managers of protected areas in sustainable tourism [7].

At the same time, tourism legislation should be reviewed and improved:

a) to give managers of protected areas the control and the obligation to develop tourism;

b) the full environmental assessment of the proposals concerning the protected areas;

c) to demand that the environmental damage created by past tourism be repaired and that management techniques are adopted to make future sustainable use.

Encourage the tourism by:

a) loans, subsidies or concession fees to farmers and local communities to set up small businesses to use protected areas in an appropriate manner;

b) administrative projects to show an innovative approach to tourism, appropriate to local economies;

c) use of PHARE and national tourism funds to encourage sustainable tourism in the bloc of Eastern European countries.

FNNPE

Has defined sustainable tourism as "all forms of tourism development, management and tourism activities that maintain ecological, social and economic integrity and the well-being of permanently built natural and cultural resources" [8].

TRANSPORT

New and "improved" roads threaten many protected areas; some road projects are part of the European strategic roads supported by international funding. Canalisation of rivers may endanger riparian wetlands, and highway speed track paths can affect valuable habitats. And shipping by sea, often dangerous goods, can affect coastal areas.

g) training managers of protected areas in sustainable tourism [9].

Canalisation of rivers may also endanger riparian wetlands and high-speed rail tracks may affect valuable habitats. Transport at sea, often dangerous goods, can affect coastal areas.

Often damage to protected areas is ignored or underestimated in transport infrastructure planning. The difficulties of reconciling large road-building programs with the requirements of protected areas are particularly acute, where large protected areas lie on the roads between major population centers.

And yet there are alternatives, at least for local transport. Some protected areas have signs of encouraging (or constraining) people to leave their cars near the edge of the protected perimeter and use alternative means of transport (buses, bicycles or boats) or walk. Some people even encourage city dwellers to make their entire trip with public transport.

Like local measures, national measures are also desirable through the adoption of sustainable transport policies by countries. They are urgently needed for wider environmental reasons - notably greenhouse gas emissions and pollution - but it would also be necessary to ensure the protection of so called protected areas. Progress will not be easy: transport policies directly affect the lifestyle of millions of people and sustainability will require reconsideration of our relationship with the most beloved home ownership - the personal car.

The main elements of a policy for sustainability in transport are:

- ensure that transport policy takes full account of the social and environmental costs of each form of transport;
- review the current expenditure balance between road construction and rail improvements and other forms of transport investment;
- use economic instruments such as fines and fees to promote the efficient use of transport and cleaner technologies;
- Link transport planning to land use, planning so as to reduce the need for travel, in particular private means of transport;
- Expanding research in the field of clean vehicles and efficient public transport.

CONCLUSIONS

Protected areas are essential for preserving natural and cultural capital as they include the most representative and significant areas in terms of biodiversity, natural and cultural values associated with it. Management measures in these areas are being developed and implemented in such a way as to maintain or even restore, where necessary, natural ecosystems and wildlife populations, while maintaining or seeking solutions for the use sustainable use of natural resources.

Establishment of protected areas and their efficient management is a necessity because:

• represent the most effective in-situ conservation mode as they are often designated on relatively large areas, may include natural and representative ecosystems and allow for their conservation and monitoring;

• Are model areas where efficient conservation actions of natural and semi-natural ecosystems.

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STUDIES REGARDING THE TECHNOLOGICAL EFFECT OF A NEW DRYING METHOD ON THE QUALITY OF WHEAT SEEDS
/
STUDII CU PRIVIRE LA EFECTUL TEHNOLOGIC AL UNEI NOI METODE DE USCARE ASUPRA SEMINȚELOR DE GRÂU

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Keywords: *wheat, drying, technological parameters, quality parameters.*

ABSTRACT

Agricultural plant seeds are subjected to the drying process to extend the conservation and to maintain the quality and the nutritive value during the storage. Currently, convective dryers are used worldwide, which do not solve the problem of the distribution's uniformity of air temperature and velocity. The seeds behave differently depending on the physicochemical characteristics and some of them do not support aggressive drying conditions.

To preserve the quality of seeds, a cylinder drying unit was designed and built, provided at its inner part with deflectors to equalize the velocity and temperature gradients throughout the surface of the product.

REZUMAT

Semințele de plante agricole sunt supuse uscării pentru a extinde perioada de conservare și pentru a menține calitatea și valoarea nutritivă pe timpul depozitării. În prezent sunt folosite uscătoare convective la nivel mondial. care nu rezolvă problema uniformității distribuției temperaturii și vitezei aerului. Semințele se comportă diferit funcție de caracteristicile fizico-chimice și unele nu suportă condiții agresive de uscare.

Pentru a păstra calitatea semințelor. s-a proiectat și construit o unitate cilindrică de uscare. prevăzută la interior cu deflectoare pentru a egaliza gradienții de viteză și temperatură pe suprafața produsului.

INTRODUCTION

The cereal seeds have an important role in human nutrition, as they are rich in starch and other valuable components. The most known and frequently used cereal seeds for human food are wheat, rye, triticale, corn, barley, rice, oat etc. Every year about 60 million tones of cereals are damaged under the action of bacteria and pests, because of an improper storage. Therefore, according to FAO data (Food and Agriculture Organization of the United Nations), there is an annual loss of more than 20% of the cereal quantity harvested worldwide, most of it because of the insects activity and the spreading of fungi, molds etc.

The heat is brought into the wheat layers by means of hot air (convection). Once the heat penetrates the grain mass, the mass transfer (water) starts inside the product to its surface. The water then moves under the influence of capillary forces and due to shrinkage of the product during dehydration.

The experiences were made in the Department of Agricultural Mechanization of the University of Agricultural Sciences and Veterinary Medicine "Ion Ionescu de la Brad". Iaşi, Romania, using laboratory facilities for drying agricultural products.

MATERIAL AND METHOD

The laboratory dryer allows control and monitoring of the drying process parameters that can be chosen by the user before or during the drying process. The dryer can be equipped with a rectangular box (fig. 1) or a cylindrical baffled box (fig. 2). Mathematical modelling was used in design, in the operational and optimization work. The mathematical model of the convective drying process is based on the theory of fluid dynamics, mass balance and energy. The experiments were conducted under the same conditions for the conventional variant with a parallelepiped drying unit and the proposed cylinder unit by varying and monitoring the operating parameters of velocity and temperature of the warm air (1-2.5 m/s, respectively 40-80°C) and using wheat seeds with three initial moisture contents 21, 19 and 17%.

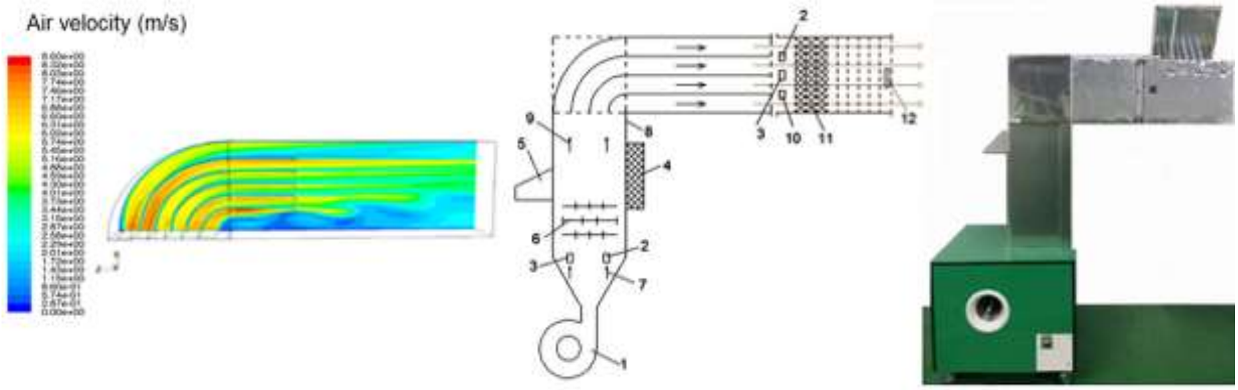

Fig.1 – Laboratory dryer scheme and simulation with the rectangular box

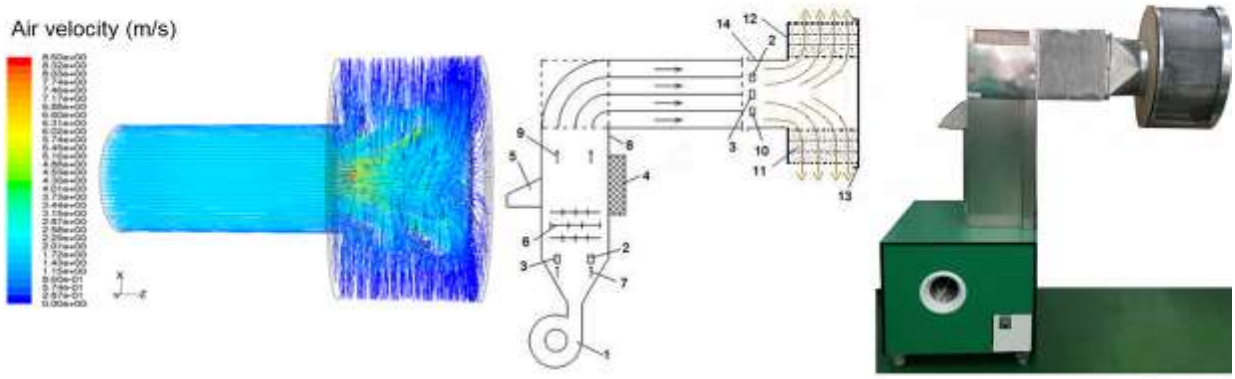

Fig.2 – Laboratory dryer scheme and simulation with the cylindrical box

RESULTS

The influence of heat can be favorable only if applied wisely regarding the correlation of the following three factors: the temperature of the drying agent, its speed and temperature of the grain seed.

The air field lines obtained in the cylindrical case with three layers of seeds have a laminar flow at the entrance of the box and along the cylindrical sieve can be seen a uniform distribution of hot air throughout the surface layers of seeds subjected to drying.

All the values regarding the drying time (fig. 3), gluten and protein content (fig. 4 and fig. 5) obtained using the cylindrical box are better than the ones obtained using the parallelepipedal box.

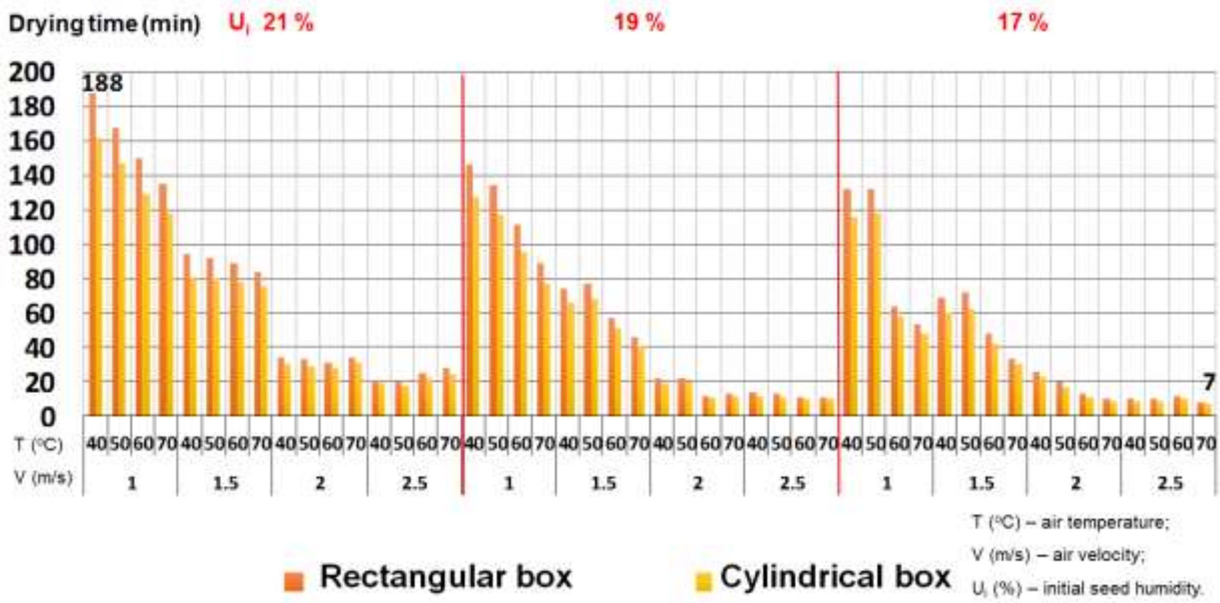

Fig.3 – Laboratory dryer scheme and simulation with the cylindrical box

During the drying process, humidity vary continuously downwards after complex laws. In order to maintain a high proportion of the qualities as the initial seed, it is required a close correlation between the temperature and humidity of the drying agent.

The air flow was numerical simulated in both the rectangular and the cylindrical drying boxes. Because the velocity profile doesn't cover corners, in the middle section of the air flow, for the rectangular box, turbulences occur both for low and high air velocities.

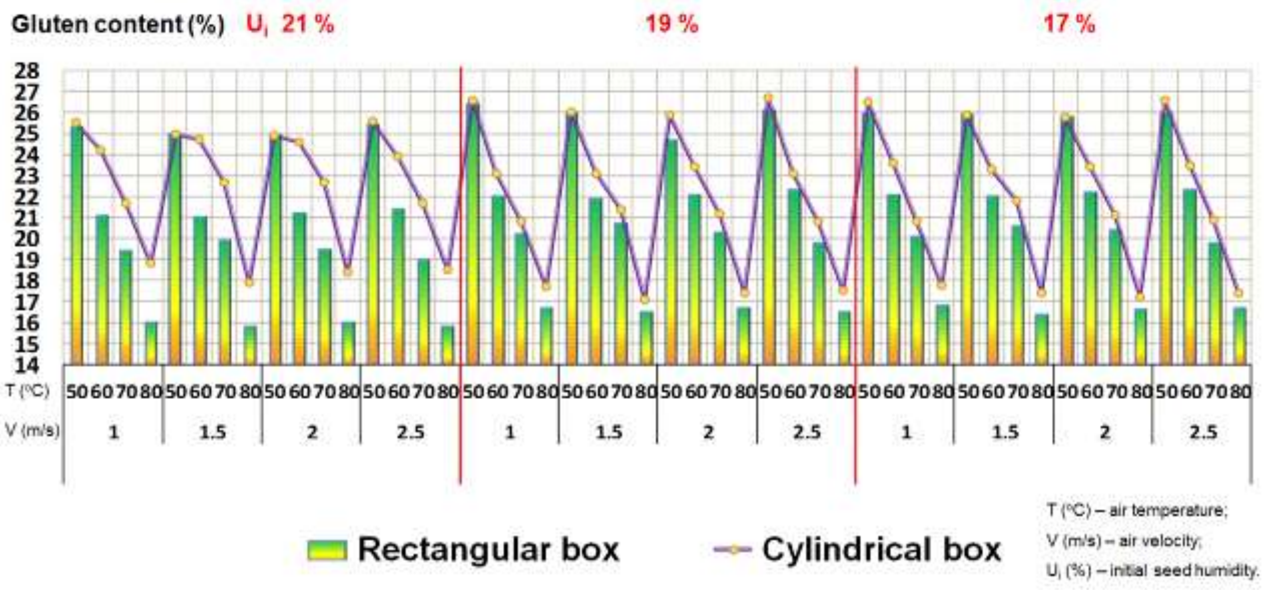

Fig.4 – Laboratory dryer scheme and simulation with the cylindrical box

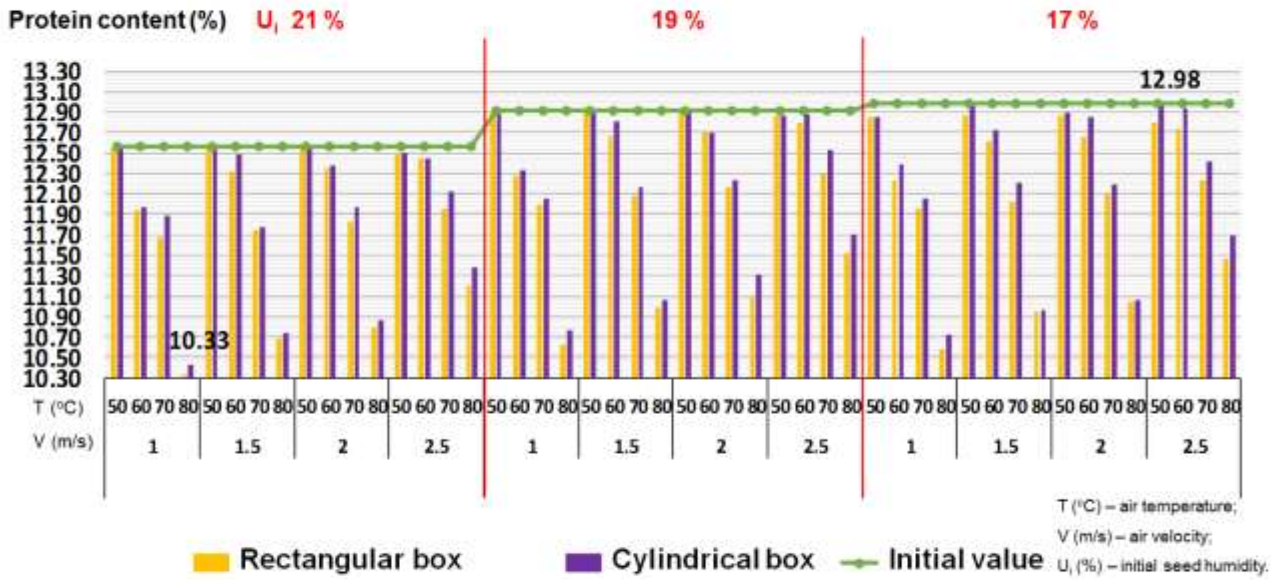

Fig.5 – Laboratory dryer scheme and simulation with the cylindrical box

CONCLUSIONS

For a proper running of the drying processes, the seed cleaning is necessary in order to provide optimal conditions for storage, marketing, consumption, sowing etc. By doing this, the transport, storage and drying volume is considerably reduced.

The grain is a living organism in which occur different biochemical processes whose intensity depends on the drying and storage conditions.

As a result of the temperature influence, the cereal seeds suffer qualitative changes; the drying systems at high temperatures prevent the seed biological activity, diminish the growing power and at exceedingly high temperatures partial or even total losses of the germination power may occur.

The dried products might be stored for a relatively long time as at a low water content, other reactions that could cause a quality rebate of the product, may start; if the wrapping and storage conditions are correct, the dried products may be stored for 1-2 years.

All the seed dryers existing at present, generally have common subassemblies with exact and well defined functions. Agricultural products and those in the food industry that are submitted to a drying process have different reactions according to the structure and composition.

That is why some of this kind of products can't stand the aggressive drying conditions characterized by high temperatures and low humidity content of the drying agent.

The values of the temperature, of the drying agent relative humidity and of its velocity (the parameters of the drying regime) influence both the drying process time and the quality of the material. The drying regime should be optimized in order to reach the minimum time for drying, with a minimum consumption of heat and with the best corresponding values of the technological properties of dried seeds.

Based on the drying experiments, which were carried out on the two drying units, it was obtained for the cylindrical unit compared to the conventional one, an increase of the wheat protein content of 0.1-1.9%. an increase of the wheat gluten content of 3-17 % and a decrease of the drying time of 10-15%.

All these facts are linked together because the protein and gluten content are less affected when the seed are exposed a shorter time to the drying process parameters. It has also been observed that for the air temperatures of 40ºC and 50ºC. the protein content and the moist gluten have not been affected.

ACKNOWLEDGEMENT

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DESIGNING, EXPERIMENTING AND EXECUTING A RECIRCULATION AQUACULTURE SYSTEM FOR FISH BREEDING
/
PROIECTAREA. EXPERIMENTAREA ŞI EXECUTAREA UNUI SISTEM ACVACOL RECIRCULANT DE CRESTERE A PEŞTILOR

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Keywords: *super intensive system, recirculation aquaculture systems.*

ABSTRACT

Aquaculture is considered as the only way to increase fish production. due to the fact that the world's annual industrial fishing production coming from natural water is close to the maximum degree of sustainability. Recirculating aquatic production systems are an important alternative to traditional pond aquaculture.

As a result of water treatment and re-use, recirculating systems require much less water than a pond to produce a similar production.

REZUMAT

Acvacultura este considerată singura modalitate de creștere a producției de pește, datorită faptului căproducţia de peşte anuală provenită din apele naturale se apropie de gradul maxim de sustenabilitate. Sistemele acvacole recirculante reprezintă o alternativă importantă la acvacultura tradițională practicată în heleşteе.

Ca rezultat al tratării și reutilizării apei. sistemele recirculante necesită o cantitate mai redusă de apă decât un iaz pentru a produce o producție similară de material piscicol.

INTRODUCTION

In recent years, there has been a growing interest in superintensive fish in recirculating aquaculture systems (RAS). This is a partially enclosed system which, by treating and recirculating the water, allows the growing of the fish under environmentally controlled conditions (Bura M.. 2008; Cistea V. et al.. 2002).

Treatment of water in the system involves the removal of residual solids, oxidation of ammonia and nitrites, carbon dioxide removal, aeration or oxygenation and disinfection. These systems are an important alternative to traditional aquaculture practiced in the pond (Losordo M.T. et al. 1999, Masser P.M. et al., 1999).

As a result of water treatment and its reuse, recirculating systems require much less water than a pond to produce a similar production. Since recirculation systems use densely populated tank to obtain the crop products, the requirement for the surface area is much lower than for conventional aquaculture (Bura M.. 2008; Cistea V. et al.. 2002).

MATERIAL AND METHOD

A superintensive fish breeding system in a recirculating system (Fig.1) consists of:

- Breeding tanks;
- Test tank;
- Water installation;
- Drainage system in ponds;
- Mechanical water filtration installation;
- Pumping group;
- Installation for the biological filtration of water;
- UV installation for water disinfection;
- Aeration installation;

- Oxygenation installation;
- Feeding devices;
- Water quality monitoring system;
- Heating / cooling installation with heat pump;
- Safety system (electricity generator).

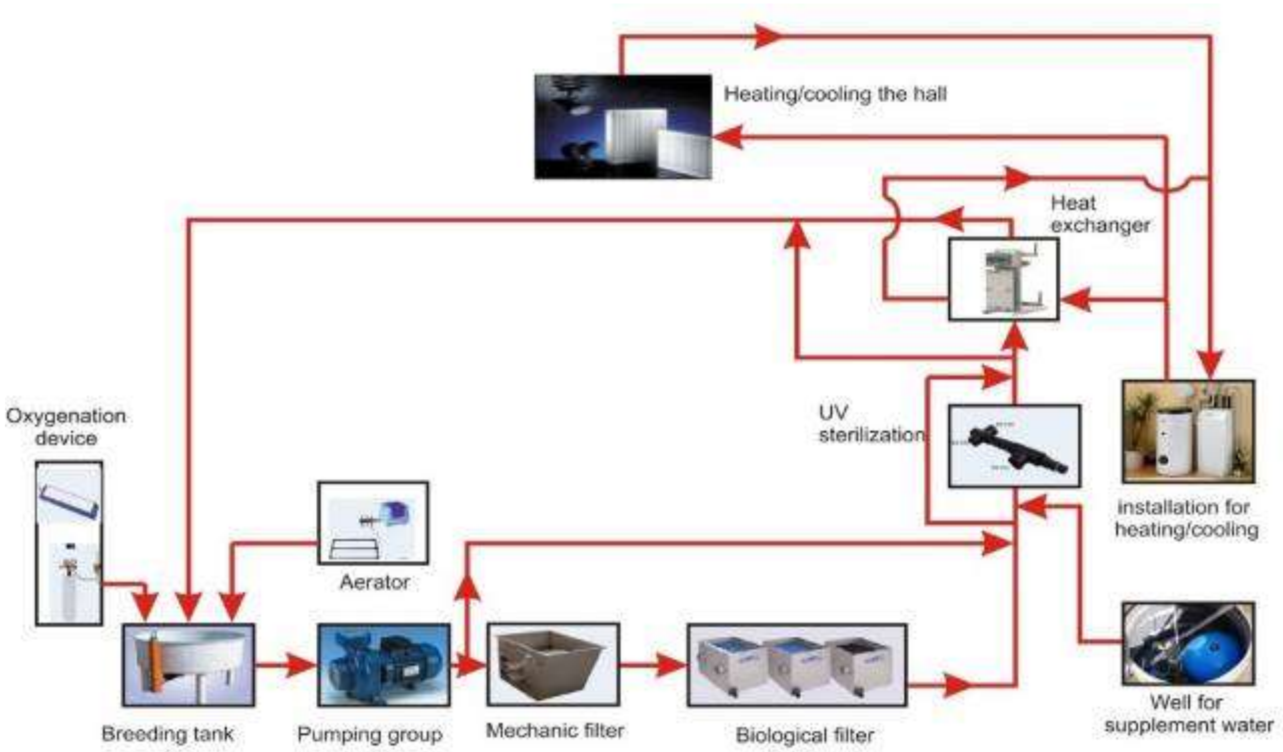

Fig.1 - Technological scheme of an recirculating aquatic system for superintensive fish breeding

Growing tanks generally comprise several different diameters of circular tanks made of polyester resin reinforced with glass fiber. In the testing tanks (Fig. 2) it can be observed probes that monitor successively the water quality from different points of the system (*Bura M.. 2008; Cistea V. et al.. 2002*).

The water supply system has the role of ensuring the continuous supply of the technological water cleaned of coarse impurities and chemically conditioned. The installation consists of a PVC duct, from which the technological water is directed to the tanks by means of taps, which regulate the flow of recirculated water to each tank. The biological filter outlet is above the level of the growth tanks, so the water supply is done gravitationally (*Bura M.. 2008; Cistea V. et al.. 2002*)

The waste water from the growth tank is discharged through a sieve in a horizontal pipe located under the tank, and through the water leveling device passes into the water exaust to the mechanical filtering group (*Bura M.. 2008; Cistea V. et al.. 2002*).

Fig.2 - Testing tank with water quality monitoring probes

Fig.3 - Mechanical filter

The water level maintainer consists of two telescopic concentric tubes. By lifting or lowering the central tube it is ensured that the leveling and lowering of the level and the discharge of the water from the growing tanks are ensured (*Bura M.. 2008; Cistea V. et al.. 2002; Losordo M.T. et al. 1999. Masser P.M. et al.. 1999*).

This operation is performed once a day, or more often if necessary, depending on the biological workload of the system. The mechanical water filtration installation (Fig.3) has the role of ensuring the proper chemical and physical quality of the supply water of the fish tanks, depending on the physiological requirements of the fish species.

The rotating sieve allows to achieve a large capacity filter, much smaller than other filters used in solid-liquid separation. Separation efficiency is five times higher for this type compared to static sieve, and due to the self - cleaning system the risk of locking it with residues is practically null (*Cistea V. et al.. 2002; Losordo M.T. et al. 1999*).

The water stream with suspended particulate matter penetrates axially into the drum and leaves are radially filtered through the mesh network of the sieve. The liquid phase in the wastewater is centrifuged due to the rotation of the sieve to the outside wall from where it is collected and the solid phase (sieve retained impurities), is washed with a pressurized water jet disposed outside and above the sieve; the washed solid material is collected by a gutter and discharged through a duct in the wastewater tank (*Losordo M.T. et al. 1999. Masser P.M. et al.. 1999*).

The efficiency of this type of filter depends on ensuring an optimal correlation between the site characteristics, the rotation speed, the waste water flow and the particle size and composition of the suspended solids.

The maximum filtration capacity of this site is 50 m^3/ h , but in order to obtain maximum efficiency it is recommended that the filtrate flow should not exceed 20 - 25 m^3 / h. The water cleared from the coarse impurities is discharged through the outlet of the mechanical filter into the pool adjacent to it. From here the water is sucked by a centrifugal pump and discharged into the biofilter mounted nearby.

Pumping group (Fig. 4) consists of two pumps with a capacity of 24 m^3 / h each and a pumping height of 6 m. one of which is spare. The pumps can be connected independently by handling the isolation taps for the purpose of replacing or remedying them. Each pump is suctioned with a "Y" type filter to reduce water load with solid particles.

Fig.4 - Pumping group

Biological filtration is a technique that uses living organisms to remove a number of toxic compounds from the water. For The RAS, nitrified filtration systems that control nitrogen compounds and, above all, ammonia removal are of particular interest.

The main problems to establish the functioning principles of nitrifying filters are: the kinetics of the nitrification process, the configuration of the nitrifying filters, the physico-chemical and biological parameters that influence their function.

The decomposition of nitrogen compounds is of particular importance in aquaculture because some of the decomposition products, mainly ammonia NH_3 and (NO_3) nitrates are toxic; to a lesser extent, also (NO_3) nitrates are toxic when they reach high concentrations by accumulation. In recirculating systems the residual organic substance (unconsumed food, manure) is decomposed by heterotrophic bacteria into simpler organic compounds, the final product of this process being ammonium, an unstable compound that turns into ammonia.

In the first phase, ammonium is oxidized by autotrophic bacteria in nitrites (NO_2). In the second phase, under the action of other types of autotrophic bacteria, nitrites are converted by oxidation into nitrates (NO_3) which are not toxic only if they accumulate in a too high concentration (Cistea V. et al.. 2002; Losordo M.T. et al. 1999).

The installation for disinfecting ultraviolet light is based on the UV radiation property of penetrating and destroying all forms of bacteria present in liquids or gases. The action is immediate, no chemicals are used, no dangerous chemical compounds are formed and system maintenance is carried out at low cost.

For water sterilization, two modules with two UV lamps are mounted on the water supply basins of the biological filter.

One module permits disinfection of a 15 mc / hr water flow with a power consumption of 130 W, so the entire plant will be able to disinfect 30 cubic meters of water with a power output of 260 W. The duration of a UV lamp is 7500 hours.

Each tank is provided with an air intake device in the form of a PVC pipe frame and provided with a series of air inlets. The devices are connected to a membrane blower that provides the amount of air at the required pressure. Each tank is provided with an oxygen injecting device consisting of a ceramic plate diffuser connected to an oxygen container and equipped with automatic belt feeders with a capacity of 5 kg of feed. This tape of the device is operated by a clock mechanism set for 12 hours operation.

The heating / cooling system of the additional water is provided with an air - water heat pump which also dehumidifies the air and the heating / cooling of the air in the hall is carried out with a water - water heat pump (INMA Bucharest.2008; David P. et al. 2006).

A recirculating aquaculture system must be fitted with a safety system in the event of a power failure. The interruption of the power supply of a recirculating system where the density of the culture biomass is high causes, in only a few minutes, ensures the decrease of the dissolved oxygen concentration to critical values.

The other water quality parameters degrade more slowly. A longer power supply failure affects all system components and. Implicitly, the quality of crop water that deteriorates in all aspects: organic load, ammonia, nitrite, pH. Alkalinity, carbon dioxide, temperature etc. Therefore, the system was equipped with an independent 18.2 kVA stand-by electric generator. (Fig.5), which is to supply the vital components of the system during the interruption of the power supply.

The electrical generator is controlled by an automatic switch which, when the power supply is accidentally switched off, ensures automatic start-up and continuity of operation of all the equipment.

Fig.5 - Electrical generator

RESULTS

The fish breeders are interested in a super intensive aqua recirculation system because it offers a series of advantages in comparison to the extensive or semi intensive fish breeding system practices in fish ponds. These advantages are:

- saves space and water resources;
- may be placed in regions where fish breeding in fish ponds is not possible;
- permits an increased degree of controlling the fish breeding environment;
- fish can be bread all year long under optimal conditions;
- the fish can be collected at the wanted moment;
- the fish production is much higher reported to the volume of used water;
- the fish productions and the level of incomes obtained by selling them can be determined more precisely than in the case of fish ponds.

Because of these advantages, the main interest for the fish production systems with recirculation water is increasing even if there is a lack of technical and economic information in the field. At the moment one cannot be directed to such a standard recommended project.

CONCLUSIONS

Aquaculture is the agricultural field which has encountered the most rapid evolution at the world's level. At present, this sector gives us approximately 20% of the aquatic consumable products. Among the aquatic organisms the fish have the highest share, representing over 65% of the world's aqua production.

At present, intensive researches are done in order to establish the most suitable intensive technologies and systems of growing the species which have the highest economic value, aiming at reaching a high competitivity level on the world's market and a real protection of the natural fish mass.

In Romania, the fish breeding is still done in an extensive system by using large surfaces and big quantities of water in order to produce a unit of fish mass.

By implementing the super intensive fish breading technology in a recirculation water system the fish production will increase and diversify. Because all the system parameters are permanently monitored and optimized, this technology can ensure the achievement of qualitative and safe products.

The following conclusions can be drawn from the researches:

- aquaculture is still a growing area and aquaculture in recirculating systems has been impressive in recent years;
- intensive fish farming is a good opportunity to reduce hunger in the world, get the quantity of aquaculture products demanded by the market and provide a chance to recover natural systems;
- although the initial costs are high, with a fair management and modern equipment and a carefully chosen recirculating aquaculture system, this domain can prove to be a very profitable business;
- Knowing the physiological needs of the fish material leads to the establishment of optimal growth parameters with increased efficiency and the choice of suitable plants for the cultivation of sturgeons in recirculating aquatic systems.

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CONSIDERATIONS ON REDUCING GRAIN STORAGE LOSSES IN ORDER TO INCREASE FOOD SECURITY FOR POPULATION
/
CONSIDERAȚII PRIVIND REDUCEREA PIERDERILOR LA DEPOZITAREA CEREALELOR PENTRU A SPORI SECURITATEA ALIMENTARĂ A POPULAȚIEI

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Keywords: *grain storage, food safety, ventilation, grain quality.*

ABSTRACT
Keeping properly the seeds can be achieved only in the spaces that meet a wide range of conditions, all competing to maintain their quality without quantitative and qualitative losses and ensuring food security for the population. The technical conditions of seeds preservation are in close correlation with storage technologies and conservation of seed grain in bulk, with crop species, with their subsequent destination and geographic area in which they are located (the weather conditions and vegetation specificity to reach suitable humidity of conservation and optimum temperature).Regarding the systems for preserving and conserving agricultural products in the form of seeds, the most rational and economical system for Romania is (long-term)dry storage .

REZUMAT
Păstrarea corespunzătoare a seminţelor nu poate fi realizată decât în spaţii care să satisfacă o gamă largă de condiţii toate concurând la menţinerea calităţii acestora fără pierderi cantitative şi calitative şi la asigurarea securităţii alimentare a populaţiei.Condiţiile tehnice de păstrare sunt în strânsă corelare cu tehnologiile de stocare şi conservare a seminţelor de cereale în vrac, cu speciile de cultură, cu destinaţia ulterioară a acestora şi cu zona geografică în care sunt amplasate (condiţiile meteorologice şi de vegetaţie specifice ajungerii produselor la umiditatea şi temperatura optimă conservării).În ceea ce priveşte sistemele de păstrare şi conservare a produselor agricole sub formă de seminţe. sistemul cel mai raţional şi economic pentru România este cel al stocării în stare uscată (pentru durată lungă).

INTRODUCTION
Storage of cereal grains requires special attention and permanent control of microclimate parameters. Storage of cereals is done separately, by lot, according to the qualitative indices of each lot and the technological classification of the grain: superior, good or weak.

Agriculture, as it is known represents one of the most important branches of national economy, with a central role in ensuring food security for people by providing food products in sufficient quantities and of high quality at affordable prices.

Keeping properly the seeds can be achieved only in locations that meet a wide range of different conditions, all competing to maintain their quality without of quantitative and qualitative losses. Meeting the food demand of a rapidly increasing global population is emerging as a big challenge to mankind in these days. The population is expected to grow to about 9.1 billion people by the year 2050. and about 70% extra food production will be required to feed them (Godfray H.C.J, Hodges R.J. Parfitt J).

Most of this population rise is expected to be attributed to developing countries, several of which are already facing issues of hunger and food insecurity, increasing urbanization, climate change and land use for non-food crop production, intensify these concerns of increasing food demands. In the last few decades, most of the countries have focused on improving their agricultural production mainly, land use and population control as their policies to cope with this increasing food demand.

Cereals are basic food supply of billion people in the world. They are grown in a large number of countries and under very different climatic zones which allow for small and large scale cereal grain production. The highly variable environmental conditions at which are exposed cereals before and after the harvest in so different grain-producing regions are determining the risk level of qualitative issues occurrence up to the moment of the delivery of stored grain to food processing users. (Fleurat-Lessard);

Despite significant efforts to control fungal contamination in raw cereals for food and feed, extensive mycotoxin spoilage of consumed cereal food or feed has been reported to occur in many countries of the world whatever their climate or their technological development level is (Park et al., Hajjaji et al., Kuiper-Goodman et al.,Bhat et al. Senbeta and Gure.). Besides the overall damage of grains by mould fungi, a few species of these 'storage fungi' are able to produce mycotoxins.

Mycotoxins are poisonous compounds produced by certain species of fungi growing on grain and feed products when stored in unsafe moisture content condition. Mycotoxins have the potential to cause serious implications for human and animal health and several EU regulations are applied to avoid the risk to introduce mycotoxin-contaminated foodstuffs in grain food and feed processing chains (European Commission. 2006 a.b. 2007; 2010 a.b; Choudhary and Kumari. Codex Alimentarius Commission.)

The lack of suitable storage structures for grain storage and absence of storage management technologies often force the smallholders to sell their produce immediately after harvest. Consequently, farmers receive low market prices for any surplus grain they may produce (Kimenju et al..)

During the storage period, soybeans are susceptible to changes in physicochemical, technological, and nutritional properties. The main factors that affect the quality of these grains during storage include grain moisture, storage time and temperature, relative humidity in the storage environment and grain quality prior to storage (Kong & Chang. Ziegler. Marini. et al..; Ziegler. Vanier. et al..).

To achieve a modern agriculture in Romania after the European agricultural model it is necessary to ensure certain basic principles: preserving human health and safety, animal health maintenance, providing farmers with incomes which to ensure farm's stability. Therefore, regulation of the system of agricultural production capitalization is the most important and urgent problem of the rural economy.

The issue of preservation and storage of grains can be approached from two perspectives:

- Storage and preservation of cereals and industrial crops in individual farms;
- Storage and preservation of cereals and industrial crops in the agricultural associations and companies.

In Romania, preservation and storage of grain from small farmers are poor in terms of ensuring optimal storage standards.

All the problems in the storage and preservation are due to factors such as:

- Lack of an organized body of cereals and inter-market regulation;
- Quality of wheat, small farmers do not use it most often for financial reasons, good seed quality, therefore the wheat enters the fodder category.
- More capricious weather in the latest years, which affected their quality crops regularly.
- Pric, the most sensitive chapter in the talks between producers and grain traders and processors.

As a result of all the reasons listed, more and more small producers prefer to keep grain cereals from own production or for recovery for consumption, for sowing, but without assuming the task of maintaining unaltered the characteristics of biological value, ones to improving their cultural value, to make appropriate treatment against diseases and pests.

This gap between production and the system made it impossible to achieve the capitalization of small and medium producers, blocking the access to investment credit.

All these reasons lead to the need for concerted action on the issue of grain storage and conservation, action to determine grain producers to consider a number of factors that contribute to good grain storage and conditioning.

MATERIAL AND METHOD

To meet the optimal storage and transport conditions, the product harvested and transported to the storage location must follow the flow of figure 1.

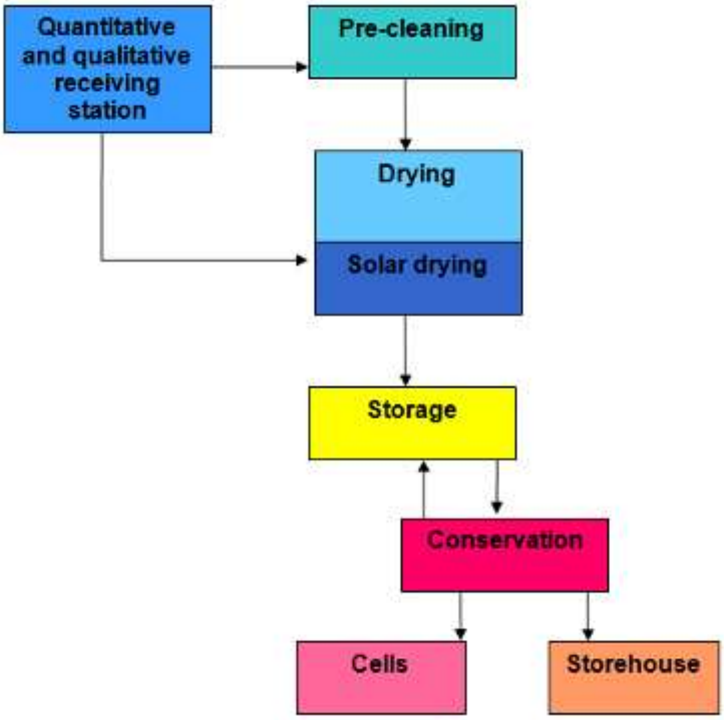


Fig.1 - Technological flow of products storage

The technical conservation conditions are in close correlation with storage technologies and conservation of seed grain in bulk, with crop species, with their subsequent destination and geographic area in which they are located (the weather and vegetation products to reach specific humidity conservation and optimum temperature).

In terms of storage and preservation systems for agricultural products as seeds, the most rational and economic system in Romania is the storage of dried (for long time) grains.

Problems arising from storage of agricultural products inevitably leads to deteriorating quality (products are hot, blackening, rot, rancidity, moth beans or emptied of content, etc.) of the product stored and classified according to the source causing the problem.

In order to ensure optimal storage conditions, such facilities must:

- properly store the seeds in a clean and uninfected facility;
- location and implementation so that any water source (rainfalls. soil. etc.) does not enter inside;
- sealing the access openings, so that birds or rodents do not penetrate inside;
- ensuring natural or artificial aeration to avoid the phenomenon of hot.

Foreign substances content - this parameter determined by laboratory tests is strictly verified during storage, especially when the contents of grains, moldy, rotten (from wheat) and stained grains (maize) rose comparing to the situation found before storage.

Foreign bodies that appear frequently in mass seed are:

- inert organic foreign matter (husks, leaves and chips, dead insects. etc.).
- inert mineral foreign bodies (earth in the form of lumps, free dust or adherent to seed, sand, gravel, metal pieces of different sizes);
- weed seeds;
- basic seed of the crop damaged by various diseases such as: coal, smut;
- Seeds of other crops than the basic culture.

Any grain storage involves biological decomposition of the substance. Moreover, the risk of development of insect pests is possible.

With the sounding products for determinations of moisture and foreign objects is analyzed also the visible infestation.

Infestation discovery must be made at an early stage of infestation that the measures taken are effective. All these conditions can be ensured through the use of performance storage systems. Grain storage and preservation facility, ISC , Installation for grain stored and preserved , IDC and Grain storage system. SDC *are machines performed at* - INMA BUCHAREST, aiming at supporting agricultural producers and grain crops producers.

Grain storage and preservation facility for ISC . figure 2 is a complex, modern plant for cereals (wheat, barley, rye). Corn, vegetables and oilseeds, the species with the largest share in overall agricultural production carried out in small and medium-sized farms, grain and plant pre cleaning ensuring their aeration during storage.

Fig. 2 - Grain storage and preservation facility, ISC

Characterized by high-performance parameters, this product tends to largely satisfy the people requirements starting from small landowners who have min. 10 ha of arable land to those whose properties require high capacity storage.

Conservation and storage facility with capacity of 10 tons is composed of the following equipment:

-Screw-conveyor;
- precleaning group;
- cell;
- pneumatic mobile installation of conveying;
- mobile installation of aeration;
- electrical installation of power and control;

Screw conveyor is tilted, mobile, with adjustable height easy to move according to the required position in the process of flow (feeding pre-cleaning group or unloading cell).

The pre-cleaning group comprises: a divider in cascade with its own fan, cyclone for impurities decanting and a product dispenser – sluice type.

Its functional role is to separate by suction the light impurities, ferromagnetic components and insects and to direct the pre-cleaning product to pneumatic transport installation.

The cell is a metal removable, cylindrical construction with corrugated galvanized walls alternating with special galvanized walls which allow natural and artificial aeration.

A cone is mounted on the inside of top cell and it provides a uniform distribution of the product, all around central column aeration. Proper aeration is one of the most important processes in a grain storage system and is essential for maintaining the quality of stored products.

An aeration system used properly helps controlling insect infestation and moisture migration, reducing grain damage, saving money in this way.

Central column aeration, figure 3 is a metal cylindrical construction, made of perforated sheet.

Fig. 3 - Aeration through a central column

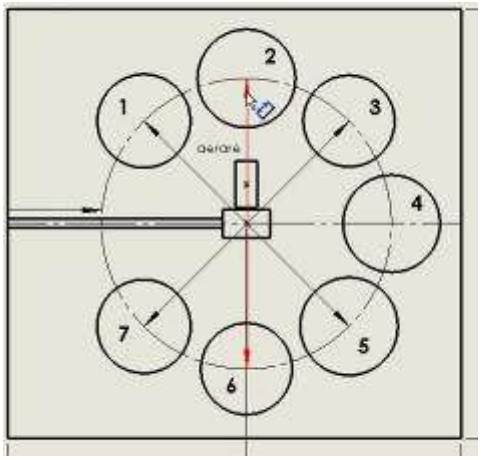
At its base is a connector that allows it to couple to aeration mobile installation.

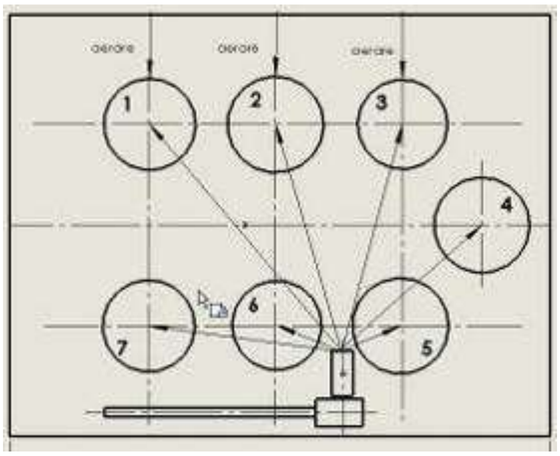
On the lateral surface of the cell are provided connections for taking samples and for temperature control.

Pneumatic mobile conveying installation includes a fan whose radial mono-sucking operating parameters can be adjusted with a device with flap mounted on its sucking location. On fan's exhausting is mounted the product receiver and the flexible tube that assures the carriage of pre-cleaning product from the group of pre-cleaning to product distributor mounted on cell.

Pneumatic conveying installation is a mobile installation.

Mobile installation of aeration is similar to pneumatic transport installation but is characterized by other structural and functional parameters. This installation is provided on its discharge side with pipes for connection to the aeration column of the cell and can be used to aerate a group of cells in the situation when the cells location schemes allows. figure 4 a and b.





a **b**

Fig. 4 - Default cells location schemes

a. b - version with 7 cells with different location

Grain storage system for SDC - figure 5 ensures optimal conditions for holding stocks of seed in bulk, according with technical and functional competitive performances in the world and includes:

- Cell control system CCS ;
- Horizontal screw conveyor - TEO

Cell control system CCS is a metal cylindrical removable construction with galvanized corrugated sheet walls. Cylindrical body is made of high quality galvanized corrugated sheet FeE350G covering with Z350NA and Z450NA (EU standard).

Corrugated panels forming the walls are made of high strength steel, assembled together with bolts. Nuts, flat washers and rubber washers.

The roof has 40 panels that provide excellent insulation against the weather being provided with 6 vents with grid and an access mouth for inclined conveyor funnel. After loading cell the mouth is sealed with a lid.

The cell is equipped with a control system which provides temperature control and aeration of seed from the cell. The cell has a storage capacity of 400 m^3.

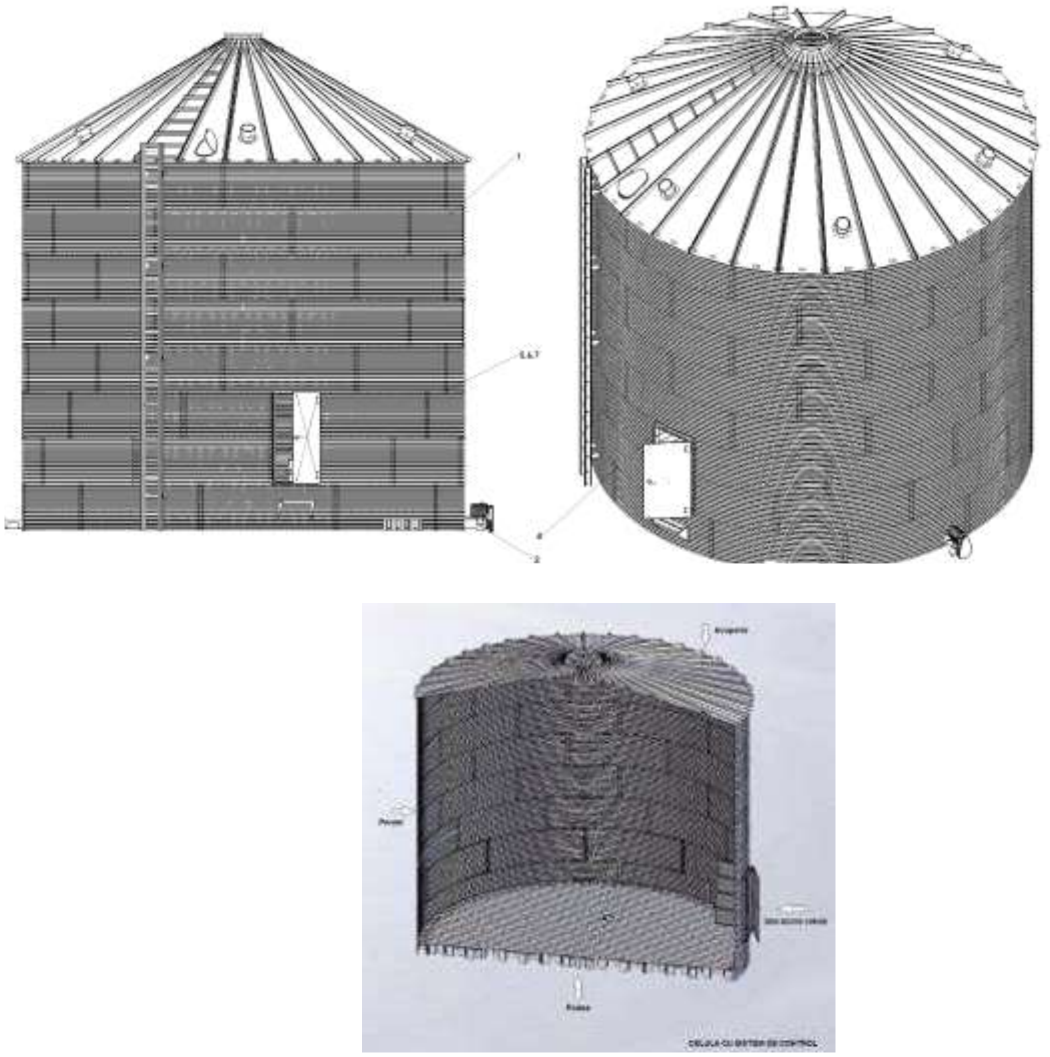


Fig. 5 - System for storage grain SDC

This control system uses as parameters the outside air temperature, grain temperature and relative humidity. The system allows the use of outside air for drying grain, so that products can be stored safely for a longer period.

To achieve products aeration subject to retention and storage processes the *System* for s*torage grain SDC* is equipped with a flat floor, made of perforated panels with round holes ø 1.5 mm.

The design adopted for perforated panels, figure 6, provides an effective aeration and also a quick installation on site.

The panels have a special construction which allows a precise and strong assembly with metal brackets placed on the entire surface of the cell.

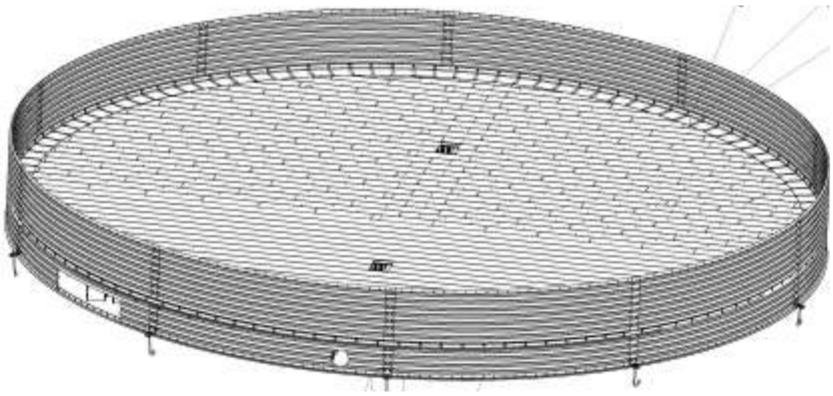


Fig. 6 - Assembled floor

After the harvest the agricultural products (seeds, fruits, vegetables, etc.) cannot be directly used for various purposes such as: storage, consumption, industrialization, commercialization, for planting, etc.. because they contain impurities (plant remains, other bodies, etc.) and damaged products.

Before they receive a particular destination, the products must undergo cleaning and sorting operations. These operations are aimed at enhancing product purity, while realizing better preservation, a reduction in the transport and storage.

- *Determination of technological effect*

Grain storage and preservation installation ISC is provided as shown previously with a group of pre-cleaning. In the experiments was analyzed the effect of technology pre-cleaning group of installation for storing and preserving cereals ISC compared with product standards and the results were evaluated according to the output obtained in a single pass through the product under processing equipment. To determine the effect of technology have made the following:

- E_{csM}-% of large foreign bodies removed
- E_{csm}-% of small foreign bodies removed
- E_{csu}-% of light foreign bodies removed
- C_{PS}- % of the good seed of product to be processed lost in by-product

The calculation references used for determining the technological effect of pre-cleaning group were:

- $E_{csM} = [(C_{sMi} - C_{sMe}) / C_{sMi}] \times 100$ (%).

where:

- C_{sMi}-large external substances content at equipment input(%)
- C_{sMe}-large external substances content at evacuation equipment (%)

$$E_{csm} = [(C_{smi} - C_{sme}) / C_{sMi}] \times 100 \ (\%).$$

where:

- C_{smi} - small external substances content at equipment input (%)
- C_{sme} - small external substances content at evacuation equipment (%)

$$E_{csu} = [(C_{sui} - C_{sue}) / C_{sui}] \times 100 \quad (\%).$$

where:

- C_{sui}-content of external substances light from entering the machine (%)
- C_{sue}-light content external bodies in the evacuation of the machine (%)
- C_{ps} coefficient is calculated as:

$$C_{ps} = (\Sigma m_k / M) \times 100 \qquad (\%)$$

where:

- Σm_k - good seed masses sum in the products collected at the outputs of the equipment, during the sampling and determined by laboratory analysis, based on collected samples separately from each by-product. expressed as a percentage of the total mass of the sample
- M- mass of good seed at equipment input determined by laboratory tests on samples taken on product input in equipment and expressed as % compared to total weight of the samples.

- *Determine the amount of air required for the active aeration*

Aeration mobile installation allows the aeration of seeds in storage cell.

Amount of air to be blasted (Q) is expressed in m^3air/hour/ton of seeds (sometimes m^3air/hour/ton of seeds) and is calculated using the formula:

$$Q = \frac{D}{G}$$

where:

- D-flow air supplied by fan, m^3 / h.
- G- batch weight under aeration, t.

When calculating the amount of air necessary for the active aeration in storage cells was taken into account the number of air exchanges.

The required number of air exchanges per hour in inter-granular space varies depending on seed moisture and is calculated using the formula:

$$N = \frac{D}{P}$$

where:

- D-fan flow, m^3 / h.
- P- porosity of seed mass for the main species seeds; the porosity is as it follows: wheat 35-45%, 45-55% barley, 50-79% oats, 30-50% corn, 60-80% sunflower, 30-50% lin oil.

RESULTS

Following experiments in conditions of exploitation with Installation for grain storing and conservation ISC were obtained the qualitative and functional parameters of Table 1.

Table 1

Den.No.	Determined parameter	UM	Value of measured parameter
1	Cell capacity	t	10.5
2	Pre-cleaning ability	t/h	2.2
3	The technological : - large external bodies content removed E_{csM}	%	97.97
	- small f external bodies content removed E_{csm}	%	95.49
	- light external bodies removed E_{csu}	%	94.88
	- retention of ferromagnetic bodies	%	98.5
	- the degree of breakage of the plant	%	0.17
	- coefficient of losses the good seed in by-products (C_{ps})	%	0.065
	- seed-mass temperature in the center of cell	ºC	18.5
	- air temperature	ºC	12
	- layer wheat height in the cell	m	2.6
	- the decrease of temperature after an hour of aeration	ºC	0.28
4	Total power absorbed by the installation	kW	7.513
5	Power absorbed by the screw carrier	kW	0.53
6	Pre-cleaning installation fan - flow rate	m^3/h	1540
	- total pressure	mmCA	116
	- absorbed power	kW	0.856
7	Power absorbed by the sluice	kW	0.526
8	The fan of mobile pneumatic transport installation - flowrate	m^3/h	699
	- total pressure	mmCA	290
	- absorbed power	kW	2.73
9	The specific consumption of electricity for pre-cleaning and loading the cell	kWh/t	1.864
10	Specific air flow rate at t of seed	m^3/h/t	125
11	Max.quantity of air blown by aeration fan	m^3/h/t	450

It is recommended that active aeration to be made also in load flow of the cell that is to start as soon as the product layer covered the distribution channels and continue throughout the filling.

In this way, the seeds that fall like rain have more contact with the air blasted, drying or cooling them more easily.

For proper ventilation it should not exceed 12º C differences between air temperature and seed temperature.

Above this threshold, there can appear condensation along the cell wall, which can lead to wetting.

CONCLUSIONS

Grains are stored in spaces that can grow horizontally or vertically, in bulk or in bags. When grains are stored in bulk, the moisture content is taken into account to determine the height of the storage layer. If the deposit is equipped with active aeration facilities the layer thickness is increased. For cereals with a humidity of less than 14%, the height is conditioned by the strength of the storage.

Installation for grain storage and preservation ISC , Installation for grain stored and preserved IDC and System for grain storage SDC are machines made in the INMA Bucharest which contribute to promoting sustainable agriculture to improve the whole food chain (from soil to table – „from farm to fork") by:

- Providing storage and preservation locations for agricultural producers at low prices;
- Ensuring optimal storage conditions (temperature, humidity according to standards) for grain seeds necessary to consumption, sowing and obtaining concentrated fodder for their own livestock sector ;
- Assurance of new advanced technologies needed to agriculture. in the field of seed preservation;
- Maintaining unaltered the characteristics of their biological value;
- Assuring an appropriate technological pre-cleaning effect and possibilities of disinfection;
- Assuring environmental protection;
- Providing storage space up to 150 tons, according to arrangement of cells by different schemes;
- Using the pre-cleaning group as stand-alone module, at processing of sunflower seeds and even beans.

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RENEWABLE ENERGY IN CONTEXT OF SUSTAINABLE DEVELOPMENT / *ENERGIA REGENERABILA IN CONTEXTUL DEZVOLTARII DURABILE*

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ABSTRACT

At the basis of the evolution and development of modern human society lies the energy, being one of the input components for most production processes and comfort offered to people. Energy can be analyzed from a safety perspective through the availability of energy resources for the economy, sustainability ,the impact of using different energy sources on the environment and competitiveness, at the level of attracting energy sources. The paper explores the analysis of renewable energy resources: biomass, wind, solar energy and its current development at national and European level.

REZUMAT

La baza evoluției și dezvoltării societății umane moderne stă energia , fiind una din componentele de intrare pentru majoritatea proceselor de producție. dar si o premiza a confortului oferit pentru oameni. Energia poate fi analizată din perspectiva siguranței, prin prisma disponibilității resurselor de energie pentru economie, a durabilității. cu privire la impactul utilizării diferitelor surse de energie asupra mediului și a concurențialității, la nivelul costului atragerii surselor de energie. In lucrare se face analiza resurselor energetice regenerabile:. Biomasa, energia eoliana, hidraulica, solara, dezvoltarea lor actuala la nivel national si european.

INTRODUCTION

The concept of energy security is in connection with sustainable development by identifying and exploiting alternative energy sources, reducing environmental pollution, upgrading and modernizing existing transport routes. The European Union is increasingly exposed to instability and rising prices on international energy markets, as well as, to the consequences of the fact that hydrocarbon reserves are gradually being mobilized by a small number of holders.

Renewable energy refers to forms of energy obtained through energetic transfer of the resulting energy from natural renewable processes. Therefore, solar energy, wind energy, flow waters energy , that of biological processes and geothermal heat can be taken by humans using different procedures. The types of energy that are not renewable include nuclear energy, as well as, the energy generated through burning of fossil fuels, like oil, charcoal and natural gases. These resources are, evidently, not renewable, as they are found harder each year. From the renewable energy sources we can find-wind energy, solar energy, water energy, biofuels,biogas . All of these forms of resources are been used for generating biofuels, electric current, hot water, etc.

Wind energy is generated through the transfer of wind energy by a wind turbine. Winds form because the Earth is heated unevenly by the energy radiated by the Sun which reaches our planet. This variable warming of the air layers produces different air density zones, which, in turn, creates movement of the air. The kinetic energy of wind can be used by the wind turbines, which are capable of generating electricity. Some wind turbines are capable of producing up to 5 MW of electric energy, even though they require a constant speed of the wind of about 5.5 m/s. or 20 km/h. There are only a few areas on Earth which have those attributes, especially at high altitude and oceanic areas.

The concept of solar energy refers to the energy that is directly produced through transfer of solar energy radiated by the sun. This can be used to generate electric energy or to warm the air inside a building. Even though this type of energy is reusable and easy to produce, the main problem is that the Sun doesn't offer constant energy in any place on Earth.

Not to mention the rotation of the planet, the day-night temperature difference, the solar light can be used for energy only for a short part of every day. Another setback of using this type is that of the cloudy days, when the energy potential drops because of the blocking of the solar light.

Hydro-energy represents the capacity of a system (water) to make energy from the passing from one state to another. In practice, this is the energy produced in hydro stations with the help of the movement of water, caused by the level difference between the accumulation lake and the station.

Biomass represents the renewable resource which is most abundant on our planet. This includes absolutely all the organic matter produced through metabolically processes of the living organisms. Biomass is the first form of energy used by man, once with the discovery of fire.

At the present day, in the European Union, the Renewable Energy Directive sets rules for the EU to achieve its 20% renewables target by 2020. http://ec.europa.eu/energy/en/topics/renewable-energy.

MATERIAL AND METHOD

From the 1990, the UE has put itself in an ambitious plan to become a worldwide leader in the renewable energy domain. For example. the UE disposes at the present day of a capacity to create wind energy the equivalent of 50 coal based factories, to which their costs have been reduced to half in the past 15 years. The renewable energy market of the UE has an annual business number if 15 billion EURO (half of the entire worldwide market), an average of 300000 workers and is an important exporter. At the present day, the renewable energy is beginning to compete, from the cost point of view, with fossil fuels.

In 2001, EU decided that the electricity percent produced from renewable resources should reach 21% by 2010. In 2003, it was decided that at least 5.75% of the entire quantity of gas and diesel should be made from bio-fuels by 2010. A few countries record a rapid rise in usage of renewable energy through support national policies. But according to the actual times< EU will be around 1-2 percent below the fixed targets.

For the EU to fulfill its long term objectives of climatic changes and reduce its dependency for the import of fossil fuels, it must reach and even top those objectives. The renewable energy occupies the third place for producing electricity and still has rise potential, with all the advantages for the environment.

Efficient measures for preventing climatic changes represents an urgency and the EU must continue to keep control as a leader through examples and act for extending as much as possible the international action. Europe must be ambitious and act in an integrate way and promote the Lisbon objectives.

The EU made already its first steps in the direction of limiting the economic rise from the energy usage increment. The EU initiative combined legislative initiatives and energy efficiency programs which encourage competition and the efficient usage of renewable energy. The EU engagement of preventing climatic changes is a long term one.

For reducing the rise of global temperature to a maximum of 2 degrees over the pre-industrial levels, the gas emissions with greenhouse effect should reach the maximum value until 2025 and then they should be reduced by at least 15%, preferably at most 50% comparative to those levels from 1990. This challenge means that Europe should react now, especially in the fields of energetic efficiency and renewable energy.

Aside from the prevention of climatic changes, measures regarding renewable resources and the energetic efficiency will contribute to the rising of this energy usage and lowering the UE dependency to average energy.. Also this policy will create numerous workplaces of good quality in Europe and will maintain the no.1 place as a leader in technology, for a worldwide sector in full development.

From this perspective, the UE plan of Emission Commercialization creates a flexible frame from the point of view of costs for a cleaner production of energy. This plan is also the nucleus for the worldwide market of CO2.

The maximum potential will be exploited only through a long term engagement for development and installation of renewable energy.

Table1

A synthetic analysis of the resources and their potential on the market in Romania

Technology	Level of resource existence	Market Potential
Wind	2-3	2
Solar Photovoltaic	2-3	1
Solar Thermal	2-3	2-3
Micro-hydro	3	3
Biomass	3	3
Geothermal	3	2-3
Energy valued waste	2	2

In Romania there is a technical and scientifical experience important in the domain of renewable resources, but that remained at the theory levels. In present the market conditions do not favor their direct competition. The closest to a commercial use are applications that use biomass, micro-hydro, geothermal resources.

In the present day, the electric energy that comes from renewable sources is 42.29% . Threfore, Hydro 29.88%. wind is 11.07%. Solar Photovoltaic 1.18% . Biomass 0.16% [www.agerpres.ro/economie/2017/04/19].

Both the energy law and the energy efficiency law stimulate the development of renewable energy and the ANRE has in plan the completion of a specific program.

RESULTS

Renewable energy resources that compete directly with fossil fuel are biomass and wastes from agriculture.

Since biomass is the only carbon-based renewable fuel, its application becomes more and more important for climate protection. Among the thermochemical conversion technologies (i.e.. combustion, gasification and pyrolysis), combustion is the only proven technology for heat and power production. Biomass combustion systems are available in the size range from a few kW up to more than 100 MW. The efficiency for heat production is considerably high and heat from biomass is economically feasible[14]

Biomass represents the renewable resource which is most abundant on our planet. This includes absolutely all the organic matter produced through metabolically processes of the living organisms. Biomass is the first form of energy used by man, once with the discovery of fire.

Biomass has a worldwide interest as a renewable energy resource that can make a big contribution to rural development and to the implementation of sustainable energy supply systems at local, regional and global level. The current primary energy conversion technologies contained in biomass are the following: direct burning, gasification, pyrolysis, biological fermentation.

Energy security and climate change mitigation are core elements in current European energy policy. The EU countries are mandated to meet by 2020 a target of 20% renewable resources in the energy supply and 10% renewable resources in energy in the transport sector [4]. The latter corresponds to a replacement of 50 billion liters of fossil transportation fuels. The Energy Strategy 2020 [3] of the European Commission calls for increased use of renewable resources in the energy system and the European Council has presented a long term target for the EU and other industrialized countries of 80 to 95% cuts in greenhouse gas emissions by 2050. A cornerstone in renewable energy projections of the European Union is biomass, which is expected to account for 56% of the renewable energy supply in the EU by 2020

When biomass is used as a fuel. instead of fossil, the same amount of carbon dioxide is released into the atmosphere. If the use of biomass is to produce energy, it is considered a neutral carbon fuel, due to the drastic reduction of gas emissions into the atmosphere by producing methane instead of CO_2. Carbon represents about 50% of the dry vegetal mass and is part of the atmospheric carbon cycle. Biomass fixes CO_2 from the atmosphere during growth after carbon dioxide is released as a mixture of carbon dioxide (CO_2) and methane (CH_4), depending on the last use of the plant material.[1]

Almost all the resulting agricultural residues can be used as resource for renewable energy, but considering the possibilities of collection and baling for transportation, only the following types of agricultural residues are considered:

a) straw
b) maize stalks
c) corn hammers
d) sunflower – strains, capite and seed husks
e) vineyards
(f) flax and hemp pocketing

In the category of "straw" were included the residues resulting from the harvesting and treatment of the main crops of grain cereals – wheat, barley, rye, oats. It is obvious that depending on the species and the variety, the weight of the straw in relation to the weight of the grain varies widely. Under these conditions it was considered that an average of straw weight is about 90% of the grain weight. [4]

Corn stalks are the plant, as harvested less. The weight of the maize strains is very varied depending on the maize variety and the humidity at harvest. Corn ham is the support of corn grains in the pot. The weight of corn ham is on average equal to the weight of the grain. The flakes and hemp are the remains of the plant stems after the fibers have been extracted. The weight of the cases is approx. 50% of the weight of the plants. [20]

Starting from the above, the total biomass production used for fuel is:
- straw – 3,357 thousand t / a
- maize stalks and corn hammers – 17,286 thousand tons / year
- sunflower – 7,350 thousand t / a
- vineyards - 255 thousand tons / year
- flax and hemp pocket – 5,590 thousand t / a

The resulting agricultural biomass traditionally has three possible uses, namely:
• Re-use in agriculture (animal husbandry)
• Raw materials in the pulp and paper industry
• Fuel

What is not consumed by one of these forms is burnt in the field, embedded in soil or stored for biological degradation.

In areas with a lot of arable land, biomass can play an essential role in energy production.

Table 2

The biomass potential by sorts, regions

No.	Region	Forestry biomass thousand tones/year	Wood waste thousand tones/year	Agricultural biomass thousand tones/year	Biogas ml.mc/year	Urban waste thousand tones/year	TOTAL TJ
1	Dobrogea	54	19	844	71	182	29,897
		451	269	13,422	1,477	910	
2	Moldova	166	58	2,332	118	474	81,357
		1,728	802	37,071	2,462	2,370	
3	Carpatic Region	1,873	583	1,101	59	328	65,415
		19,552	8,049	17,506	1,231	1,640	
4	Transilvania	835	252	815	141	548	43,757
		8,721	3,482	12,956	2,954	2,740	

No.	Region	Forestry biomass thousand tones/year	Wood waste thousand tones/year	Agricultural biomass thousand tones/year	Biogas ml.mc/year	Urban waste thousand tones/year	TOTAL TJ
5	**Vest Plain**	347	116	1,557	212	365	60,906
		3,622	1,603	24,761	4,432	1,825	
6	**Subcarpatic Region**	1,248	388	2,569	177	1,314	110,198
		13,034	5,366	40,849	3,693	6,570	
7	**South Plain**	204	62	3,419	400	1,350	126,639
		2,133	861	54,370	8,371	6,750	
TOTAL		4,727	1,478	12,637	1,178	4,561	518,439
		49,241	20,432	20,0935	24,620	22,805	

Table 3

Energy potential of biomass

Parameter	UM	Technical	Economical
		a)Vegetal biomass	
Thermal/electrical energy	TJ/year	471,000	289,500
	Thousant tep/year	11,249	6,915
		b)Biogas	
Thermal/electrical energy	TJ/year	24,600	14,800
	Thousand tep/year	587	353
		c) Urban waste	
Thermal/electrical energy	TJ/year	22,800	13,700
	Thousand tep/year	544	327
TOTAL	TJ/year	518,400	318,000
	Thousand tep/year	12,382	7,595

CONCLUSIONS

From the 1990, the EU has put itself in an ambitious plan to become a worldwide leader in the renewable energy domain. For example, the EU disposes at the present day of a capacity to create wind energy the equivalent of 50 coal based factories, to which their costs have been reduced to half in the past 15 years. The renewable energy market of the UE has an annual business number if 15 billion EURO (half of the entire worldwide market), an average of 300,000 workers and is an important exporter. At the present day the renewable energy is beginning to compete, from the cost point of view, with fossil fuels.

In 2001, EU decided that the electricity percent produced from renewable resources should reach 21% by 2020. In 2003, it was decided that at least 5.75 % of the entire quantity of gas and diesel should be made from bio-fuels by 2010. A few countries record a rapid rise in usage of renewable energy through support national policies. But according to the actual times, EU will be around 1-2 percent below the fixed targets. For the EU to fulfill its long term objectives of climatic changes and reduce its dependency for the import of fossil fuels, it must reach and even top those objectives. The renewable energy occupies the third place for producing electricity and still has rise potential, with all the advantages for the environment.

For the potential to be reached, the web of policies must support and stimulate competitiveness of such sources of energy. Some internal sources of low CO2 emission are already available, others, such as wind energy, wave energy still require support for entering the market.

The maximum potential will be exploited only through a long term engagement for development and installation of renewable energy.

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DETERMINING THE DAMPING COEFFICIENT FOR THE SUSPENDING ELASTIC ELEMENTS OF A VIBRATING FEEDER
/
DETERMINAREA COEFICIENTULUI DE AMORTIZARE AL ELEMENTELOR ELASTICE DE SUSPENDARE A UNUI ALIMENTATOR VIBRATOR

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Keywords: damping coefficient, elastic element, vibrating feeder, accelerometer.

ABSTRACT
The damping coefficient describes how vibrations are decreasing after a disturbance occurring in a mechanical system. In other words, a damping coefficient is a material property that indicates whether a material will react to a disturbance or return energy to the system. If the reaction of the material is caused by an unwanted vibration or shock, a high damping coefficient in the material will diminish the response. The suspending elastic elements from a vibrating feeder are made of steel and accumulate some of the vibration energy and then return back, in time, thereby reducing the dynamic loads. In order to evaluating the system responses to dynamic loading conditions we perform an experiment where we determined the damping coefficient of the suspending elastic elements.

REZUMAT
Coeficientul de amortizare descrie modul în care vibrațiile scad după o perturbare care apare într-un sistem mecanic. Cu alte cuvinte, un coeficient de amortizare este o proprietate a unui material care indică dacă acesta va reacționa la o perturbare sau la o întoarcere a energiei către sistem. Dacă reacția materialului este cauzată de vibrații nedorite sau de un șoc, un coeficient de amortizare ridicat în material va diminua răspunsul.

Elementele elastice de suspendare de la un alimentator vibrator sunt realizate din oțel și acumulează o parte din energia vibrațiilor și apoi se întorc înapoi în timp, reducând astfel încărcările dinamice. Pentru a evalua răspunsurile sistemului la condițiile de încărcare dinamică, a fost realizat un experiment în care s-a determinat coeficientul de amortizare al elementelor elastice de suspendare.

INTRODUCTION
Damping is the phenomenon by which the mechanical energy of the dynamic system is dissipated (converted into internal thermic energy). Knowing the degree of damping of a dynamic system is important for the use, analysis and testing it. The damping level of the components must be known in order to develop a dynamic model of the system. [2]

The internal damping results by dissipating of the mechanical energy from the material due to various microscopic and macroscopic processes. Therefore, the damping coefficient describes how vibrations are decreasing after a disturbance occurring in a system. In other words, a damping coefficient is a material property that indicates whether a material will react to a disturbance or return energy to the system. If the reaction of the material is caused by an unwanted vibration or shock, a high damping coefficient in the material will diminish the response. [5 and 7]

For determining the damping coefficient we use a vibrating feeder (Figure 1). The analyzed vibratory feeder is part of the machine used for removing impurities from seeds built at INMA Bucharest. The machine is equipped with ferrite magnetic drums and is designed in order to eliminate impurities from seeds of legumes, flax, hemp, carrots, onions, chives, spinach, tomatoes, etc.. [1]

The transport of the particles on the surface of the feeder is achieved by providing them a relative movement by printing a linear vibratory movement from the vibration generator, preferably on the Y direction.

Also vibrations on the other 2 axes, X and Z are to be maintained out minimum amplitude, in order to obtain a high degree separation factor.

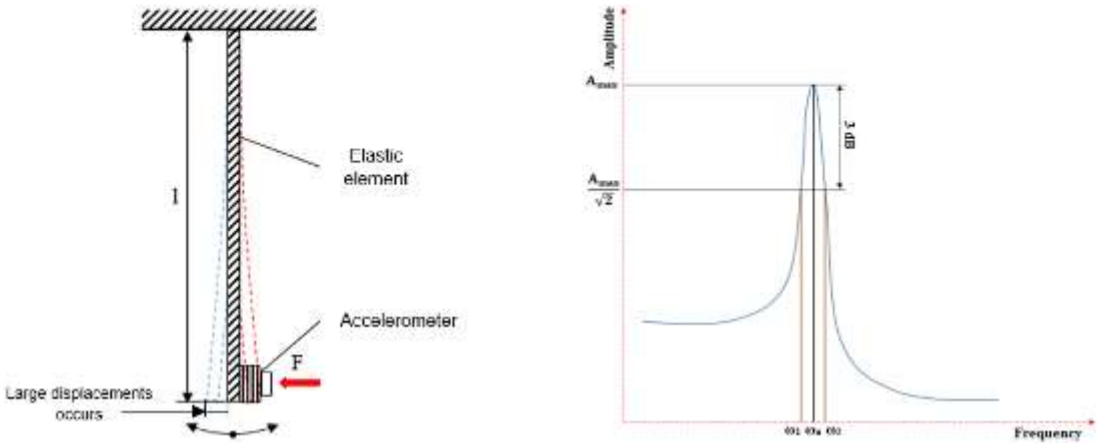
The suspending elastic elements are made of steel. They accumulate some of the vibration energy and then return back, in time, thereby reducing the dynamic loads acting on the transport gutter of the vibrating feeder. These elements are also characterized by large elastic deformation under the action of the signal from the vibrations generator, returning to their initial form after the signal is stopped. Measuring the deformation, under the disturbing, force of the elastic elements during operation involves determining the accelerations. The vibration amplitude gives information about existing gaps between the machine components.

Fig. 1 - The vibrating feeder used in experiment

MATERIAL AND METHOD

The specific deformations are monitored in points from various sections of the elastic elements according with a scheme of accelerometers mounting (see figure 2–a). The points are chosen based on sections with low stress-resistance. The measurement of the specific deformations is generally carried out by means of accelerometers in three directions (X, Y and Z).

The accelerometer must be positioned so that its sensitivity axis is maximal and coincides with the direction in which it is desired to make the measurements. A major disadvantage of using accelerometers is the mounting of these upon the measured elements. This is achieved by gluing the accelerometers to the surface of elastic elements, an operation which requires, besides a special skill of the operator, following strict stages of cleaning and surface processing. As the link between the accelerometer and elastic elements is weaker, the lower became the dynamic field of the accelerometer. [6]



a) b)

Fig. 2 - a) The mounting scheme of the accelerometer. b) The half-power bandwidth method. [6]

The method we are using for determining the damper coefficient of the elastic elements is called the half-power bandwidth method (see figure 2–b). This method consists in: first we must obtain the natural frequencies of the elastic elements by measuring the accelerations on the directions of movement of the vibrating feeder; then, we calculate the frequencies of two points that are corresponding to the half-power bandwidth at the distance of 3 dB down from the top peak, [8]

The damping coefficient can be calculated once the corresponding frequencies were known using the relation (1). [8]

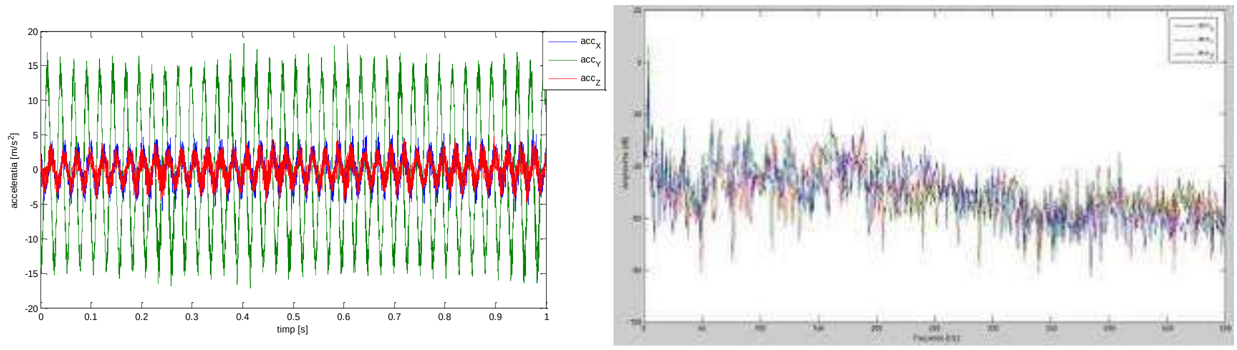
$$\zeta = \frac{\omega_2 - \omega_1}{2 \cdot \omega_n} \tag{1}$$

Where, ω_1. ω_2 and ω_n are the natural frequencies of the elastic elements and ζ is the damping coefficient. The transducers for measuring the accelerations of the elastic elements are being assembled as shown in the figure below.

Fig. 4 - The accelerometer mounting onto the elastic elements

RESULTS

After positioning the accelerometer were measured and recorded the accelerations of the elastic elements using a data acquisition board date DAP 3200 e / 214 – S.U.A. The accelerations were recorded in the time domain. For easier reading of the results it was necessary the processing of obtained data in the Matlab work program, meaning the signal conversion from the time domain into frequency domain (see figure 5).



a) Time domain b) Frequency domain

Fig. 5 - The signal conversion from the time domain intp frequency domain

The vibration signal is identical for both the small and big elastic elements, therefore, we need to determine the damping coefficient for one of them. On the graphic representation of the accelerations in the frequency domain, we choose the peaks of high amplitude on the movement direction and, using the half-power bandwidth method we determine the damping coefficient.

In the figure below we zoom it the first mode measured of the elastic element necessary for the calculation of the damping coefficient.

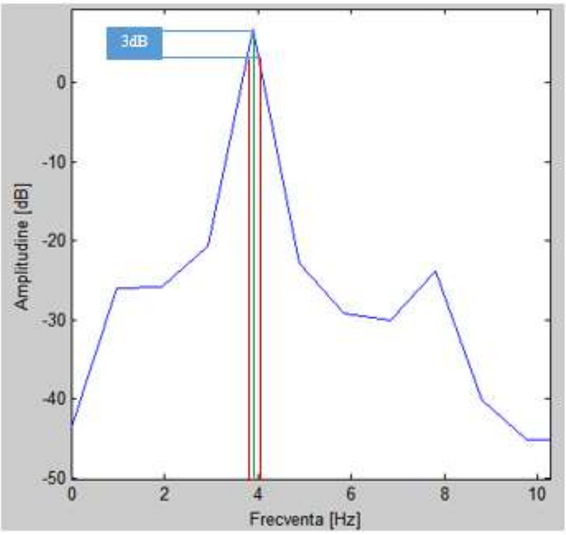


Fig. 6 - The damping coefficient determining using the half-power bandwidth method

Based on the figure 6 and with the help of formula (1) we calculated the damping coefficient and the results are shown in the table below.

Table 1

Results of the damping coefficient calculation

Natural frequencies [Hz]			**Damping coefficient**
ω_1	ω_2	ω_n	ζ
3.803	4.015	3.908	0.027

CONCLUSIONS

The half-power bandwidth method is a good method in calculation of the damping coefficient. In our case is very easy to find the damping coefficient of an elastic element, using this method, after we measured the acceleration in the high displacement of the element.

The calculated value for the elastic element is **0.027**, which is very important in the future FEM analysis and calculation of the vibrating feeder system.

ACKNOWLEDGEMENT

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CONSIDERATIONS REGARDING THE UTILIZATION OF MACHINES DESIGNED TO SHRED FOREST RESIDUES FOR BIOMASS PROCESSING
/
CONSIDERAŢII PRIVIND UTILIZAREA MAŞINILOR DE TOCAT RESTURI FORESTIERE ÎN PRELUCRAREA BIOMASEI

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***Keywords:** biomass, equipment, mincing, forestry choppers.*

ABSTRACT
This paper presents aspects regarding the construction and functioning of various types of technical equipment for shredding forest residues, used for grinding raw material in order to obtain pellets / agripellets, briquettes. etc. The products obtained from solid forest biomass are intended for combustion in thermal power stations to produce heat and domestic hot water.

REZUMAT
În lucrare sunt prezentate aspecte privind constructia si functionarea diverselor echipamente tehnice de tocat resturi forestiere, utilizate pentru maruntirea materiei prime in scopul obtinerii de peleti / agripeleti, brichete. etc. Produsele obtinute din biomasa solidă forestieră sunt destinate arderii în centrale termice pentru producerea de caldura si apă caldă menajeră.

INTRODUCTION
In order to capitalize the forest residues aimed to obtain solid fuel (pellets/ agripellets, briquettes, etc.) designed to thermal power stations [1], grinding is the main operation required. Material obtained after grinding can be directly used at boilers' combustion, for producing compost, in decoration purposes and also as raw material for pellets and briquettes production, after the second mincing in a hammer mill.

Forestry shredders have as working principle the material mincing between knife and counter-knife and comparing to vegetal waste choppers they are strongly built, have a consolidated transmission system and other geometry of rotor and knives.

Due to big size vegetation, the active parts of the shredder should be adapted to the respective task, the transmission should be appropriate to power necessary, able to take over the shocks transmitted in the system and the chassis should resist to working conditions.

MATERIAL AND METHOD
Shredders used for wood of diameters below 18 cm are endowed with cylindrical rotors with alveolar holes in which the pendular knives are mounted. This model allows to withdraw the knives in their holes when they encounter hard materials (rock. metals. etc.) ensuring this way a good protection.

The necessity of diameters below 18 cm appears because of kinetic energy losses when the knife/knives withdraw(s).

Shredders used for wood vegetation of diameters surpassing 18 cm are equipped with cylindrical rotors on which are mounted fixed knives. In this case, there is no energy waste because of knives withdrawing and their protection is assured by replacing the active edge with a harder material (widia plates). This constructive model has the advantage of a superior resistance at impact and the active parts wear negatively influences the grinding degree.

The most important aspects of which on must take care when choosing a shredder model, are: type and diameter of vegetation, an optimum appropriate power, correlating the working speed to the forest vegetation diameter, existence of foreign bodies that could affect the active parts. [2]

RESULTS
There is a series of companies that are manufacturing and trading shredders designed to forest residues, among which we can number: OSMA (Italy), ORSI Group (Italy), INO BREŽICE (Slovenia). Zanon (Italy), Teknamotor (Poland), ELIET (Belgium) and Jansen (Poland).

OSMA Company produces *professional forestry shredders* for tractors and attachable *hydraulic forestry shredders* designed to excavators and mini-excavators.

Professional forestry shredders (forestry mulchers) designed to tractors are used for cleaning the pastures, cutting and chopping branches, forest residues, shrubs and woods which diameter is up to 40 cm, being endowed with a mincing system with rotor with mobile pendular hammers: TLPF / TLPF-UX or fixed teeth for bigger diameters: TPF / TPF-UX.

- *OSMA TLPF model* (fig. 1a and1b) is a forestry shredder for medium and heavy vegetal residues, equipped with a rotary drum with mobile hammers able to cut branches, shrubs and small bushes of maximum 20 cm diameter, with a power source of 70 - 160 HP.
- *TLPF-UX* model (fig. 1c) is a forestry shredder for medium and heavy vegetal residues, endowed with rotary drum with fixed tools able to cut branches, shrubs and small bushes of maximum 25 cm diameter, with a power source of 80 - 180 HP.

a. b. c.

Fig 1. – Forestry shredder model TLPF / TLPF-UX [3]

- *TPF model* (fig. 2a and 2b) is a forestry shredder of category "Heavy Duty" with a steel HARDOX structure. rotary drum with mobile hammers able to cut branches, shrubs and small bushes of maximum 30 cm diameter and a double transmission with belts. The tractor's necessary power is 100 - 200 HP.
- *TPF-UX* model (fig. 2c) also frames in "Heavy Duty" class, being endowed with rotary drum with fixed teeth made of treated metal, able to cut branches, shrubs and small bushes of maximum 40 cm., double transmission and hydraulic opening hood. The tractor's necessary power is of 100 - 220 HP.

a. b. c.

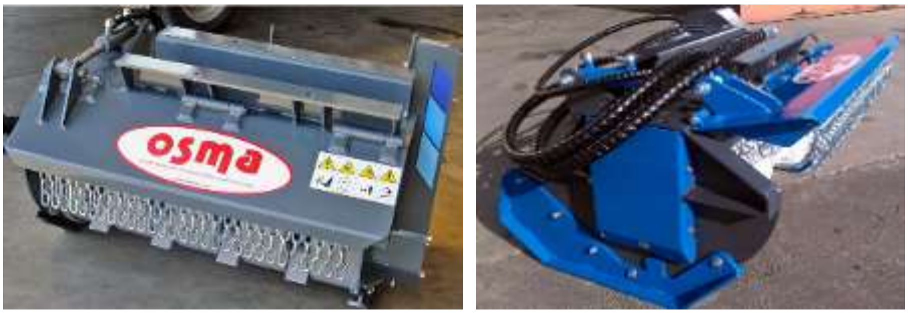
Fig. 2 – Forestry shredder model TPF / TPF-UX [3]

- *OSMA TPF-HP model* (fig. 3) - is a forestry shredder of category "Heavy Duty ". Its structure is made of HARDOX steel. Its working width is of 240 cm. It is equipped with widia fixed teeth for cutting branches, shrubs and small bushes of maximum 50 cm and double transmission and hydraulic opening hood. The tractor's necessary power is of 300 - 350 HP.

Fig 3 – Forestry shredder model OSMA TPF-HP [3]

As we said above, besides the forestry shredders designed to tractors, OSMA Company (Italy) produces hydraulic forestry shredders able to be attached to excavators and mini-excavators of 3 and 35 tons., hydraulic equipment for chopping and mincing vegetal residues, shrubs and branches with diameter framed between 8 and 40 de cm. Different models of different size and working width are available, being endowed with pendular hammers or fixed teeth according to the size of excavator attached, oil rate and working conditions.

- *TFL model* (fig. 4a) and *model TFL-UX* (fig. 4b) – Forestry shredders heads for shrubs, branches and small trees are appropriate to mini-excavators. For TFL model, the maximum working diameter is of 15 cm and for TFL/UX model it is of 20 cm.



a. b.

Fig 4 - Forestry shredders heads TFL / TFL/UX model [3]

- *TFM model* (fig. 5a) *and TFM-UX model* (fig. 5b) - Forestry shredders heads for shrubs, branches and trees are suitable for excavators of maximum power of 120 -150 HP. Maximum working diameter is of 20-30 cm.

a. b.

Fig 5 - Forestry shredders heads TFM / TFM-UX model [3]

- *TFS model* (fig. 6a) *and TFS-UX model* (fig. 6b) - Forestry shredders heads. MAXI-FOREST series are suitable for large excavators of 18 up to 25-30 tons weight and power of 180 - 200 HP. The working maximum diameter is 35 cm for TFS model and 40 cm for TFS/UX model.

a. b.

Fig 6 - Forestry shredders heads TFS / TFS-UX model [3] [4]

- *TFS model and TF-XL model* (fig. 7) – Forestry shredder designed to shrubs. thick vegetation and small plants can be attached to mini-excavators of 6 up to 10 tons weight and power up to 70 HP. Maximum cut is12-15 cm. It is available with pendular hammers or fixed teeth.

Fig. 7 – Forestry shredderl TF-XL [3] [4]

ORSI Group Company(Italy) owns many types of forestry shredders:

- *Forestry shredder W-FORREST* (fig. 8) used for cleaning lands covered by wood with diameter up to 18 cm. It is endowed with frame pushing the vegetation, rotor with pendular hammers and rear hood with hydraulic opening system. The hammers are mounted in alveolar holes that allow a free rotation of 360° and withdraw when encounter obstacles. Variation of hood opening angle can adapt the mulcher for the following situations: fell down (maximum opened hood), grinding. The grinding degree depends on the hood position and proportionally varies with the opening angle.[5]

- *Shredder CHAMPION Hardox* (fig. 9) *that* makes the passage from agricultural mulchers to forestry mulchers with double chassis entirely made of steel Hardox. The active parts are pendular hammers placed on the rotor, in 2 rows, in alveolar holes permitting a rotation of 360°. Hammers' working position is given by the centrifugal force and the joint allows the withdrawing of the hammer into the alveolar hole when encountering hard obstacles, thus avoiding its deterioration. The equipment uses teethed counter-knives, disposed in two rows. Mulcher is endowed with double chassis, made entirely of Hardox steel.

Fig. 8 – Forestry shredder W-FORREST [5]

Fig. 9 - Forestry CHAMPION Hardox [5]

- *Forestry shredder BIG FORREST* (fig. 10) is designed to clean the lands covered by wood vegetation of maximum 25 cm diameter. It is endowed with frame pushing the vegetation, rotor with fixed hammers and rear hood with hydraulic opening system. The fixed hammers are equipped with 2 widia tips aimed at grinding wood matter of big diameter and, at the same time, they are protected against the impact of rocks at land surface.

Fig. 10 – Forestry shredder BIG FORREST [5]

- *forestry shredder BIG FORREST DT* (fig. 11) is designed to clean the lands covered by wood vegetation of maximum 35 cm diameter. It is endowed with frame pushing the vegetation, rotors with fixed hammers and rear hood with hydraulic opening system and double lateral connecting gear. The fixed hammers are equipped with 2 widia tips designed to grind the wood matter of big diameter and, at the same time, they are protected against the impact of rocks at land surface.

Fig. 11 - Forestry shredder BIG FORREST DT [5]

INO BREŽICE Company(Slovenia) presents several types of forestry shredders, namely:
- *forestry shredder INO MG 150 / 130* (fig. 12) **used for** chopping bushes, offshoots, trees of up 18 cm thickness. Knives rotate around their own axis (360º)

Fig. 12 – Forestry choppers INO MG 130 / 150 [6]

Zanon company(Italy) produces and trades the *forestry shredder wirth fixed teeth Widia TL 1800* (Fig. 13)

Fig. 13 - – Forestry shredder with fixed teeth Widia TL 1800 [7]

At the same time, *Teknamotor Company (Poland)* offers forestry shredders driven by tractor, shredders with disc or drum, depending on model.
- *SKORPION 120R / 160 R / 250 R shredder* (fig. 14) is designed to chop the branches and trees trunks of diameter up to 120 / 160 / 250 mm. Skorpion is a machine of shredding endowed with disc, with evacuation pneumatic disc system. The chopped matter is ejected through a rotating tube at 360° comparing to the

chassis. The wood shredder endowed with three-point suspension mechanism is designed to work with the tractor of 60 / 80 / HP.

Fig. 14 - Shredder SKORPION 120R /160 R / 250 R [8]

- *SKORPION 160R/90 shredder and Skorpion 250R/90 shredder* (fig. 15) are designed to chop the branches and trees trunks of diameter up to 160 / 250 mm. They are endowed with one disc, with evacuation pneumatic disc system. The chopped matter is ejected through a rotating tube at 360° comparing to the chassis. The wood shredder endowed with three-point suspension mechanism is designed to work with the tractor of 80 HP.

The *innovating solution of placing the feeding hole at an angle of 90^o against the forward direction has allowed the simultaneous transport with a single tractor of wood shredder and trailer.*

Machine may be additionally equipped with an electronic overcharge system able to stop the driving system by temporarily stopping the feeding.

Fig. 15 - SKORPION 160R/90 shredder [8]

- *shredders SKORPION 280RB and 350RB* (fig. 16) endowed with drum and screen are driven by a tractor of minimum power of 60 / 100 HP (540 rot/min).

The equipment is endowed with a hydraulic supplying system for branches, made of two rolls driven by separate systems of hydraulic engines with reductor. The wood shredder has the advantage of supplying the rolls by own hydraulic pump.

Fig. 16 – Forestry shredder Skorpion 280RB / 350 RB [8]

- *SKORPION 250 RG shredder* (fig. 17) is designed to chop branches and trees trunks of diameter up to 250 mm.
- Skorpion 250RG/90 with caterpillar feeding system is a machine of wood chopping with one disc, with evacuation pneumatic disc system. The chopped matter is ejected through a rotating tube at 360°

comparing to the chassis. The wood shredder endowed with three-point suspension mechanism is designed to work with the tractor of over 100 HP.

The cutting system consists of one disc on which are mounted 2 or 3 knives sharpened on both sides. It is driven from The PTO's of tractor (1000 rot/min). The wood shredder is endowed with hydraulic system actuating the rolls aimed to feed the material, being driven by its own hydraulic pump.

Fig. 17 – Forestry shredder Skorpion 250 RG [8]

- *SKORPION 350 RPB shredder*(fig. 18) is a professional machine for chopping wood., endowed with drum, able to work in parallel with the forestry trailer, that operates at the same time with an agricultural tractor of minimum 100 HP (540 rot/min).

Taking into consideration its high processing capacity (maximum log's diameter of 25 cm) this machine is very efficient in chopping tree trunks and scattered branches. It is suitable especially for companies working in forestry field. It is built on a support by which the shredder is directly mounted on forestry trailer.

Fig. 18 – Forestry shredder Skorpion 350 RPB [8]

- *SKORPION 500 RB* shredder (fig. 19) is a shredder with drum mounted on one caterpillar. This wood shredder is suitable for those companies that produce large quantity of chopped material with homogeneous fraction. The driving is made by a shredder of 120 HP (540 rot. / min). The chopping matter should have up to 300 mm diameter. The caterpillar system facilitates the operator's work and increases efficiency. [5]

Fig. 19 – Forestry chopper Skorpion 500 RB [8]

ELIET Company (Belgium) produces and trades a shredder for branches *ELIET SUPER PROF 2000* (fig. 20) designed to tree branches of maximum 120 mm diameter. Each of the two motor wheels is endowed with a strong hydraulic engine. A rotor with 24 sharp knives (blades) ensures the chopping. These steel blades can be sharpened.

Fig. 20 – Shredder of branches ELIET SUPER PROF 2000 [9]

Jansen Company(Poland) produces and trades the *garden shredder JANSEN GTS-1500E* (fig. 21) with a maximum diameter of material to be chopped of 85 mm. Due to its solid and stable construction, it is aimed to be very successfully commercialized. The strong engine of 15 HP makes its functioning independent in relation to the feeding system, so that the CNC machine may be also used in faraway areas.

Fig. 21 – Garden shredder JANSEN GTS-1500E [10]

CONCLUSIONS

Forestry biomass consisting of branches, forest vegetal residues, shrubs, etc.. can be capitalized especially for obtaining solid fuel (pellets / agripellets, briquettes, etc.) aimed to thermal stations. In order to obtain the granulation necessary for direct combustion of chopped material or obtaining pellets / agripellets and briquettes, the chopping should be previously performed.

The most important aspects which one must take into account when choosing the model of shredder. are: type and diameter of vegetation, ensuring an optimum power, correlating the working speed to forest vegetation diameter, existence of foreign bodies that could affect the active parts.

Nowadays, a series of companies are producing and trading such forestry residues shredders: OSMA (Italy), ORSI Group (Italy), INO BREŽICE (Slovenia), Zanon (Italy), Teknamotor (Poland), ELIET (Belgium), Jansen (Poand),etc.

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THE DECLINE IN VIABILITY AND VIGOUR OF THE HYBRID MAIZE (*ZEA MAYS* L.) SEED UNDER THE INFLUENCE OF GENOTYPE, DURATION AND THE FACTORS OF THE STORAGE ECOSYSTEM
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DECLINUL VIABILITĂȚII ȘI VIGORII SEMINȚEI HIBRİDE DE PORUMB SUB INFUENȚA GENOTIPULUI, DURATEI ȘI A FACTORILOR ECOSİSTEMULUİ DE PĂSTRARE

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Keywords: *maize, seed viability, seed vigour, storage conditions.*

ABSTRACT

*The objective of this research was to determine the changes in quality of maize(Zea mays L.) seed over the three years storage and in five genetically different hybrids, during storage, under open storage conditions. Also, the aim of this study was to evaluate the effect of different type treatments on physiological potential maize (Zea mays L.) seeds. Five experimental corn hybrids, each represented by five seed lots produced by Agricultural Research and Development Station Turda. /Romania, were evaluated. Seeds were stored for **36** months, under different environments and seed performance was evaluated for the time of "initial-phase" and every **12** months by seed viability (germination), seed vigour (seedlings length, İndex vigour-I.(**SVI**), Speed germination index **(SGI)**. The results indicate that the contribution of the factors taken into consideration, at the total variability of viability (germinations) is: hybrid, **26.01%;** storage conditions (treatment), **9.99%;** storage duration, **31.75%,** and in case of seed's vigor variability **(**İndex vigour-I) is**:** hybrid, **5.5%;** treatment, **25.20%;** storage duration, **46.69%.***

The study's purpose was to identify which of the studied genotypes preserves better its initial seminal qualities during storage duration. The large variation range of regression coefficient b_i[0.307 - 1.684] and of determination coefficient R_i^2 [0.68 – 0.90] and ecovalence coefficient W_i^2. indicates the fact that there are differences regarding the behaviour of genotypes in analyzed environments which means different reactions of hybrids taken into consideration, targeted by the storage conditions and storage duration. A model was developed for viability equations to quantify the effect of storage conditions on the orthodox (Zea mays L.) seeds deterioration.

REZUMAT

*Obiectivul acestei cercetări a fost de a determina schimbările în calitatea semințelor de porumb (Zea mays L.) pe parcursul celor trei ani de depozitare și în cinci hibrizi genetic, în timpul depozitării, în condiții de depozitare deschise. De asemenea, scopul acestui studiu a fost evaluarea efectului tratamentului de tip diferit asupra semințelor fiziologice de porumb (Zea mays L.). Au fost evaluați cinci hibrizi experimentali de porumb, fiecare reprezentat de cinci loturi de semințe produse de Stația de Cercetare și Dezvoltare Agricolă Turda, România. Semințele au fost stocate timp de **36** de luni, în medii diferite și performanța semințelor a fost evaluată la timpul de "fază inițială" și la fiecare **12** luni prin viabilitatea semințelor (germinația), vigoarea semințelor (lungimea răsadurilor, Indicele vde igoare-I. (**SVI**), indicele vitezei de germinație (**SGI**). Rezultatele indică faptul că contribuția factorilor luați în considerare la variabilitatea viabilității (germinației) este: hybrid, **26.01%,** condiții de depozitare (tratament), **9.99%.** durată de depozitare, **31.75%.** durata depozitării **31.75%**. iar în cazul variabilității vigorii semințelor (indicele de vigoare-I) este: hybrid, **5.5%;** tratament, **25.20%;** durata depozitării, **46.69%.***

Scopul studiului a fost de a identifica care dintre genotipurile studiate conserva mai bine calitățile sale seminale inițiale pe durata depozitării. Variația mare a coeficientului de regresie b_i[0.307 – 1.684] și a coeficientului de determinare R_i^2[0.68 – 0.90] și coeficientul ecovalență W_i^2. indică faptul că există diferențe privind comportamentul genotipurilor în mediile analizate, ceea ce înseamnă reacții diferențiate ale hibrizilor luate în considerare, vizate de condițiile de depozitare și de durata de depozitare. S-a elaborat un model pentru ecuațiile de viabilitate pentru a cuantifica efectul condițiilor de depozitare asupra deteriorării semințelor ortodoxe (Zea mays L.).

INTRODUCTION

The economic importance of maize since the usage of its caryopsis in the human food, in industry and in animal feed, of strains as feed or in the pulp industry, with a production capacity of about 50% higher than the other cereals, it would not have been possible without the genetic potential and the diversity of physiological expression existing within the seed, life-bearing and genetic patrimony.

The maize seed multiplication activity in E.U. is increasing from year to year as a result of increased seed demand, but annual losses due to deterioration, for various reasons, are over 25% (*Iyoti and Malik. 2013*).

One of the main reasons for annual seed losses is the insufficient knowledge of the influence of all factors with action in pre-harvest, during harvest and conditioning and during storage, on the chemical, physical, biochemical and physiological changes occurring at the metabolic and structural level of the seed.(Bărbos et al..2016). Another reason, are the actual climatic changes which bring changes in the physiological activity of the seed as a result of the increase of entropy with influences not only during production in the field, but also during storage.

All the bibliographic sources emphasize that among the many factors that contribute to the realization of the complex character ..of "Production capacity" the *seed's quality* is also included. The expression **„*seed's quality*"**. is a concept and includes several components highlighted by Ajavi (2003)**:** ***genetical quality*** (biological value), ***mechanical quality*** (resistance to damage), ***health quality*** **(**health level and health status), ***physical quality*** („eye's pleasure"), ***physiological quality*** (refers to germination potential and physiological manifestation), ***storage quality*** (conservation).

As a very important biological factor in the increase of production, the quality of the seeds from the agricultural point of view is given by their genetic and somatic value. Measures to mitigate the impacts of climate change or to improve agricultural technologies to provide the food needed for the continuity of life on earth begin with the use of a *high biological* value seed with high parameter values, which characterizes its ***viability and vigour***, a seed resistant to abiotic and biotic stress factors.

The following factors are ***fundamental*** for keeping seed quality during storage: *moisture content of the seed subject to storage, relative humidity and temperature in the storage medium, seed quality (initial quality) in the moment of storage and the destructive attack of microorganisms and insects.* In order to limit the action of these factors on the *normal seed aging process*, with consequences on seed quality, it is necessary to know, control and regulate this process in order to increase the longevity of the seeds, meaning to extend the useful life of the seed lots with the consequences under the economic aspect and the safety of agricultural production.

In order to meet the demand, seed technology research has focused on identifying various aspects that may be associated with the physiological potential of seeds. It is therefore necessary to know the actual condition of a seed lot in terms of quality, assessing its degree of decline, to provide useful information to the user, thus helping him to decide the manner, the conditions and the time of use of the lot. Viability represents the potential seed capacity to generate live embryos under optimum conditions. Because ***standard germination, viability indicator*** (Badwin et al.. 2006) reflects the maximum seed germination potential under optimal conditions, so, it is not a good indicator to correlate with field emergence (Duurant and Gummerson, 1990)**;** Morad, 2013). In order to obtain precise information on the quality of a seed lot, even if seeds have almost identical germination values, ***different vigour tests*** should be used (Milosovicand Cirovic, 1994**;** Perry, 1981). The ISTA Association, in 2014, develops a comprehensive definition of the concept of seed vigour: *seed vigour is the sum of those properties that determine the activity and performance of seed lots acceptable in a wide range of enviroments; a vigorous seed lot is one that is potentially able to perform well under enviroMmental conditions which are not optimal for the species".*

The size of the increases of the essential parts of germs and the dry weight of these increases are directly proportional to the vigour of the seeds, their degree of deterioration, either due to aging or other causes (Matthews, 2007). At the same time, they are good indicators to differentiate between seed lots in terms of the potential of their physiological expression, but can be very well correlated with field emergence under varying conditions (Chinget al..1972; Perry. 1981; Hermanus-Maree. 2008).; Milosovicet al..2010; Divasalaret al.. 2013). The particularity of the "orthodox" seeds for sowing is that they can be stored in a dry state in open warehouses for a longer or shorter period depending on the values of the fundamental parameters characterizing the storage medium.

MATERIAL AND METHOD

The conditions in which the experiments took place

The research presented in this paper began in 2013, at SCDA Turda /Romania and ITCSMS Cluj/Romania, during 2013-2016. Storage (open space), is thermally insulated, providing small variations of environmental parameters in space, at the major changes of the outside with a temperature variation during the year; 8-28°C and relative variation, 25-75% humidity with the possibility of applying natural aeration. Cold laboratory room (controlled environment) has a temperature variation during the year, 2-4°C and relative variation, 50-75% humidity, intended to test natural resistance and the potential of hybrids to form normal germs under such conditions.

Factors and experimental design

The storage conditions are referred to as **treatment** with subsequent graduations:

an open room(warehouse) where untreated seed is stored; *laboratory chamber with controlled medium in which untreated seed is stored*; *open room with seed treated with fungicide Maxim XL 0.35 FS*; *room (open space) with seed treated with fungicide Maxim XL 0.35 FS + insecticide Seedoprid 600 FS.*

Corn genotypes have a different FAO group but also different initial qualities and come from homogeneous maize lots in terms of physical qualities. with initial humidity of approx. 12% and good health: *Turda 200*; *Turda 165*; *Turda 201*; *Turda Star*; *Turda Favorit*.

Storage duration with graduations: "*before sowing-2014*" is the initial moment of researches; *after 12 months*; *after 24 months*; *after 36 months*.

Environmental factor. $E_{env.}$ with levels: $E_{1.}$ $E_{2.}$ E_{3} ...... E_{16} . results from the combination of two unified factors: treatment and duration of storage.

The experimental design: ***Completely Randomized Design (RCD)*** of type:

* **4x5x4** - four repetitions for the study of viability and vigor;
* **5x16** - four repetitions, to study the stability of viability. under different experimental conditions;

Statistical Analysis

The methods and techniques used in the studies conducted in this paper are given below in order of their use during the research:

* ANOVA for Regression Analysis and calculating the magnitude of the effects .
    * the concept of stability-preservation of the initial (original) qualities . after the linear dependence of Eberhart and Russell (1966):

$$y_{ij} = \mu + b_i \cdot I_j + \sigma_{ij} + e_{ij}\,; \qquad (1)$$

* Vigor index-I (SVI). (Abdul Baki and Anderson .1973):

$$SVI = \text{Germination (\%)} \times \text{total seedling length (root+shoot)} \qquad (2)$$

* Speed germination index (SGI) .(AOSA. 1983) :

$$SGI = G_1/N_1+G_2/N_2+\ldots +G_n/N_n \qquad (3)$$

* complex equation of viability (Ellis and Roberts .1980)

$$v = K_i - \frac{P}{10^{K_E - C_W \log(mc) - C_H t - C_Q t^2}} \qquad (4)$$

RESULTS

Study of the viability of seed lots

The "start-up" phase of the research, the "*before sowing-2014*" phase, was considered to be when determining the indicators that characterize the initial viability, but also those regarding the vigor of seed belonging to the studied hybrids. The analyzed hybrids belong to different FAO groups, thus deviated physiological maturations; this means practically an extended harvest of cobs (in the autumn of 2013) and at different seed moisture hybrids.

Analyzing the germination values obtained for each hybrid at this "*before sowing*" stage, on each level (graduation) of the treatment factor, significant differences can be observed between the majority of the experimental variants on recorded germination (Table1). These differences are determined not only by the graduation of the treatment factor but also by the genotypes studied. For example, in the "*untreated*" version we have: Turda 200 **(98%),** Turda 165 (**92%**), Turda 201 (**96%),** Turda Star **(97%),** Turda Favorit **(95.5%).**

The results of the trifactorial experiment on the studied feature, ***standard germination*** highlights the intake of **31.7%** of the factor ***storage duration,*** on their total variability, followed by the contribution ***of hybrid*** **26%**, as well as, a very significant contribution to the interaction ***hybrid x storage duration*** of **10.3%. (**Figure 1).

Table 1

Combination of studied factors in the experiment on maize

THE COMBINED TABLE OF FACTORS (germination.% - average values)					
TREATMENT	GENOTYPE	DURATION OF STORAGE			
		„initially”	after ”12 months”	after ”24 months”	after ”36 months”
untreated	Turda 200	98.00	96.75	96.00	96.00
	Turda 165	92.00	93.00	86.50	78.00
	Turda 201	96.00	96.50	92.50	89.00
	Turda STAR	97.00	96.00	94.00	90.75
	Favorit	95.50	92.75	90.00	88.50
Controlled environment	Turda 200	98.00	94.00	92.50	91.50
	Turda 165	92.00	92.00	82.50	73.00
	Turda 201	96.00	97.00	87.25	68.00
	Turda STAR	97.00	95.25	91.50	87.25
	Favorit	95.50	87.25	84.50	76.50
fungicide	Turda 200	97.00	95.75	96.00	94.75
	Turda 165	93.50	94.00	89.75	84.00
	Turda 201	96.50	96.00	94.50	92.50
	Turda STAR	97.00	97.00	94.75	93.00
	Favorit	95.00	95.00	93.25	92.75
Fungicide + insecticide	Turda 200	97.50	95.50	94.75	93.75
	Turda 165	93.25	86.25	76.25	62.00
	Turda 201	96.00	95.50	92.75	86.50
	Turda STAR	96.25	94.50	93.00	91.00
	Favorit	94.00	84.50	86.00	76.00

$LSD_{5\%}$ =1.64; $LSD_{1\%}$ = 2.16; $LSD_{0.1\%}$= 2.80

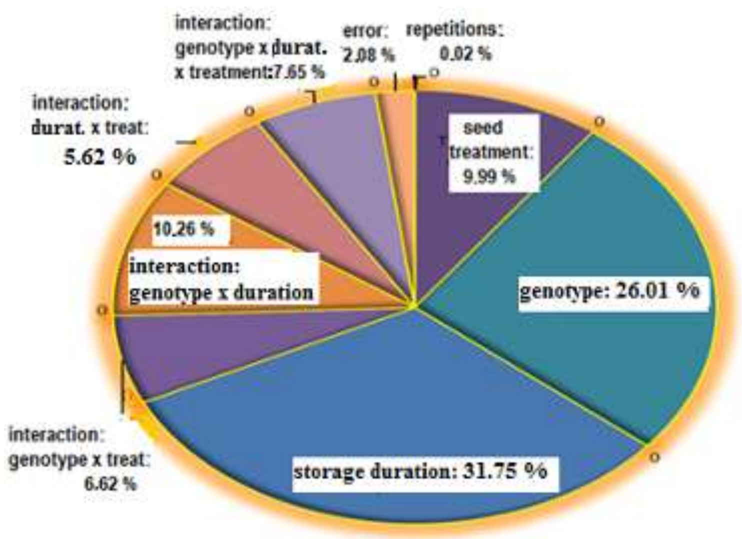

Fig. 1 - Factors contribution to total variability

As time goes by, as a result of the degradation of the enzyme system of substance use, the decline in germination capacity of seeds is accentuated.(Murariu et al.. 1998). The deteriorating process is cumulative, degenerative and ultimately results in the death of the seed. This is shown by the experimental results obtained in the "*after 36 months*" stage. The very low values recorded for seed germination in the 36-month stage, in the case of some hybrids, Turda-165 (**G_{36} = 78%),** Turda-201, Turda Favorit, show the different capacity to preserve the qualities of the attributes that define them as biological material and that this is a genetic feature of each hybrid influenced differently by the storage conditions (Figure 2).

By an "experimental condition" imposed, "*controlled environment*" with specific parameters whose values imply a predictable negative evolution of the seed quality of the hybrids under study, their natural resistance is tested along with their potential to form normal germs under such conditions. After 36 months storage duration, a poor behavior of hybrids is highlighted under these conditions, (in order) Turda 201 **(G_{36}=68%),** Turda 165 **(G_{36}=73%).**and Turda Favorit (**G_{36}=76.5%).**

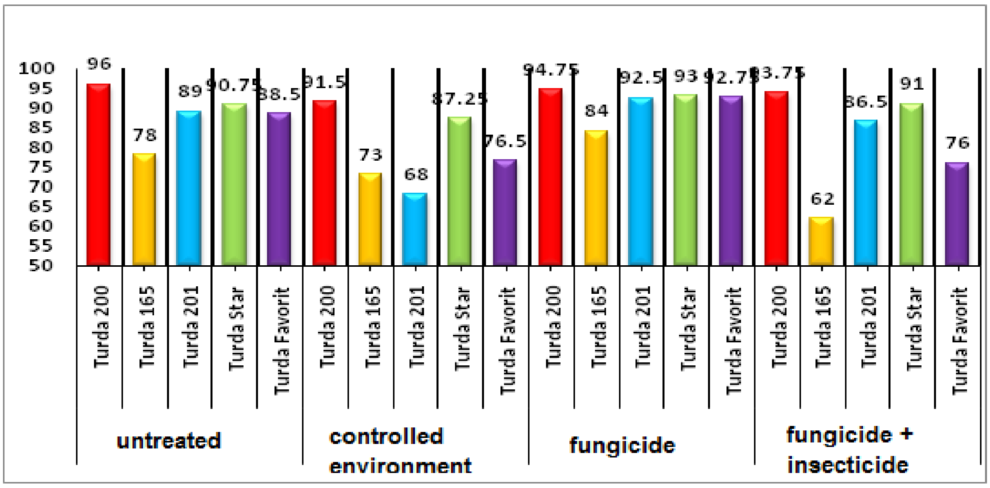

Fig. 2 - Treatment x genotype interaction effect (after 36 months)

By the fungicide seed treatment procedure, a better conservation of germination is particularly evident in Turda -165 hybrids (**G_{36}=84%),** versus "untreated" variant (G_{36}=78%), Turda Favorit (**G_{36}=92.75%)** and Turda 201 (**G_{36}=92.5%**). The fungicide treatment operation has proven to be a solution to increase seed longevity, thereby reducing the aging process.

Combined fungicide + insecticide protection for simultaneous disease and pest control is a good measure to improve seed health and provide the necessary seed protection. The experimental results obtained in the experimental version "*fungicide + insecticide*" show that the seed with this combination treatment declines after a storage of less than 12 months, which means that keeping these seeds for a longer period of time is not recommended. Hybrid Turda 165, in the end, in this experimental condition records the germination. **G_{36}=62%).** And a good resistance and tolerance has been shown to have the Turda 200 hybrid and Turda Star. It is known that certain insecticidal substances by the metabolic process release free radicals, which exerts an exogenous reaction on the seed, leading to the decline of the activity of the enzyme system.

The study of viability stability of seed

We aim in this study to identify genotypes more or less stable from a phenotypic point of view and to assess the individual performance of each, regarding the preservation of the initial seminal qualities under different experimental conditions.

The existence of the interaction **genotype x environment(GxE_{Med})** makes possible that the same genotype does not express itself in the same way in different environments, which means that it will not make the same contribution to phenotypic manifestation and vice versa, different genotypes (can) respond to the same environment in different ways, which means that genotypic contribution to the phenotypic variant is not independent by genotype (Jaques and Larmat. 1977).

By the fact that both components of the interaction **(GxE_{Med}),** (Table 2), both the linear component **(G x Emed-liniar),** as well as the ***residual*** variance **(S2rez)** are significant, it highlights the fact that there are ***differences in the behavior of genotypes*** and the response of genotypes under experimental conditions can be quantified in strongly linear dependencies (all or only some of the genotypes) but also contain a portion that is quantified in non-linear expressions, in which case the response can not be estimated and the hybrid reactions are unpredictable. Results on Regression analysis and Effects size regarding ***stability of characteristic– standard germination*** allowed ***assessing the effects*** of each factor, which in percentage terms represents**:** for the genotype, **27.9%;** environment (experimental conditions), **41.4%;** interaction genotype x average, **28.1%.**

Table 2

ANOVA program for the Regressional Analysis and sizes effects

Cause of variability	Degress of freedom (df)	The average square. (δ)	Variances estimated (σ^2)	Effects(%)
Replication with environments	e (K-1) = 48	1.274	-	-
Genotypes, G	q – 1 = 4	255.773^{XXX}	$\sigma_ə^2 + k*\sigma^2_{qxe} + e*k*\sigma^2_q$	3.75 (27.9%)
Environments. E_{env}	e -1 = 15	126.818^{XXX}	$\sigma_ə^2 + k*\sigma^2_{qxe} + q*k*\sigma^2_{med}$	5 (41.4%)
Interaction. GxE_{env}	(e -1)(q – 1) =60	15.42^{X}	$\sigma_ə^2 + k*\sigma^2_{qxe}$	3.77 (28.1%)
Env. + G x E_{env}	q(e -1) = 75	-	-	-
Environments-linear	1	1902.28^{XXX}	-	-
G x E_{env}.- linear	q – 1 = 4	120.70^{XX}	-	-
Pooled deviations	q(e -2) = 70	6.33^{X}	-	-
Pooled error	e (q – 1) (K-1) = 192	1.41	(S^2_E/K=0.35); $\sigma_ə^2$	0.35 (2.6%)

The calculated values of the specific parameters that assess the individual capacity of each genotype individually (individual stability) are presented in Table 3**.** Wide variation of regression coefficient **bi** between [**0.307-1.684**]. as well as the determination coefficient **R_i^2[0.68-0.90],** indicates that the studied hybrids react, behave differently from the environment. Contribution of each genotype to the interaction G x E_{med} is measured by the coefficient of ecovalance **W_i^2**. which is also desirable to have as little value as possible.

Table 3

Values of regression coefficients(b_i), residual deviations(δ_{ij}), ecovalence coefficient (W_i^2) and determination coefficients (R_i^2)

Genotypes	*regression coefficients[bi]*	*residual deviations [δ_{ij^2}]*	*ecovalence coefficients[W_i^2]*	*determination coefficients [R_i^2]*	*regression* **heterogeneity** *coefficients* **[$ß_i^2$]**
Turda 200	0.307	1.153	97.6089	0.68	0. 48
Turda 165	1.684	12.727	357.5561	0.86	0. 47
Turda 201	1.274	11.910	195.8742	0.78	0. 07
Turda Star	0.537	0.8923	91.9172	0.90	0. 29
T. Favorit	1.185	4.9492	83.4014	0.88	0. 03

Turda Favorit with a *regression coefficient* value close to one (**b_i=1.18**) and a small residual deviation, **δ_{ij}= 4.9492** is considered to have a mean stability of the initial features. *Genotypes with* a *regression coefficient* **b_i>1**, as in our case Turda 201(**b_i=1.274**) and Turda 165.(**b_i=1.684**) characterized them as genotypes with inferior stability in terms of keeping germination under different experimental conditions. Subunit values of the *regression coefficient* **bi<1** registered for Turda 200(**b_i=0.307**) and Turda Star (**b_i=0.537**) characterize them as very stable genotypes with reduced sensitivity to storage conditions.

Equation of seed lot viability

The evolutionary prognosis of viability is a difficult task due to the complexity of the physiological and biochemical phenomena and the presence of a large number of influential factors. The model presented by Ellis and Roberts (1980) is complex and difficult to solve, so we considered that the evolution of the whole system can be relatively well described by retaining the most relevant elements.

For the elaboration of the *linear mathematical* model characterizing the behavior of each genotype in a given environment, the transformation of the distribution of cumulative seed survival frequencies was reversed (percents versus time), in ***distribution of scores*** **„z”**, values without unit of measure and distributed on a straight line.

The regression slope has been assimilated (germination versus storage duration) with **the *deterioration rate*** (the slope of the fall of germination), elaborating for each hybrid a mathematical model called the ***equation of the seed's viability***, of the form:

$$v=K_i- tg\ w *p \qquad (5)$$

where: **w**- the slope of the straight line(**°**); ; **p**-storage duration(days); **d=tg w-** deterioration rate

To better illustrate the usefulness of equations, to differentiate the seed lots and a more accurate appreciation of their quality after a certain retention period, we will use the graphic method. On the axis of the ordinates is represented on the left the *transformed germination* in scores, **z,** and on the right remained in percent **(%**,. and on the axis of the abscissae is represented the *storage duration* (**p**), *in days*, of seed (illustrated version: untreated seed stored in open space). (Figure 3.).

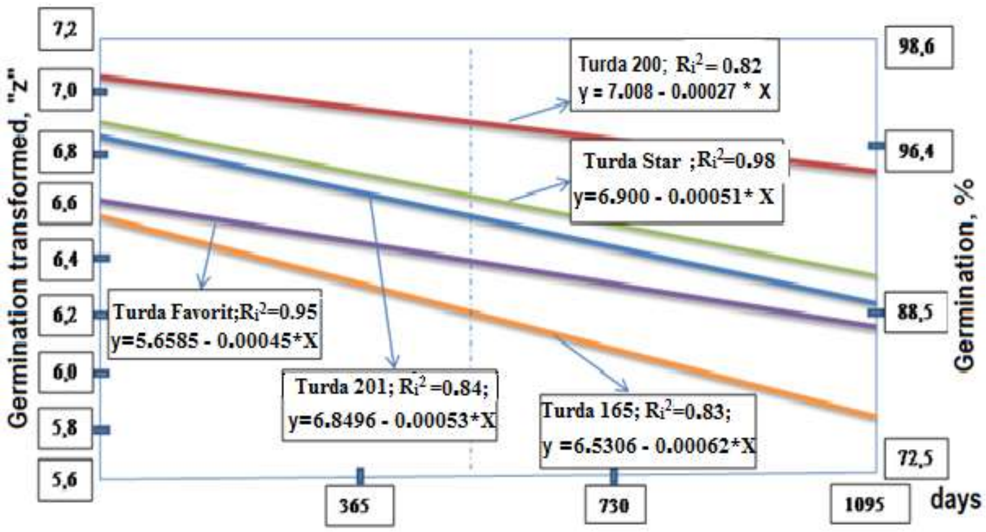

Fig. 3 - The slope (rate) of deterioration of untreated seed lots from the studied hybrids, stored in „open space".

Indicator **d-deterioration rate** reveals an aspect difficult to be found through other methods, namely that genotypes with superior germination in certain environments record during storage much higher rates of decline. For example, Turda Favorit has the initial average germination of 95.5% and Turda 201 the initial average germination of 97%. Appreciate by coefficient size, ***deterioration rate***. Turda 201 hybrid has a rate **($5.3x10^{-4}$).** bigger than Turda Favorit **($4.5x10^{-4}$),** which is clearly visible according to the slope of the two graphically drawn dependencies (Figure 3.). From the graph, one can appreciate the good behavior of the Turda 200 hybrid in this environment, with the lowest damage rate of only **$2.7x10^{-4}$.**

Study of the vigour of seed lots

Different lots of seeds, even if they have the same germination (sometimes almost identical), do not mean they have the same physiological potential, that is to say, when sowing in the field, do not show the same uniform germination and sprouting.

The physiological manifestation of seed vigour can not be measured directly, but can be highlighted by a series of tests to assess the growth of essential germ elements. (Table 4).

It is noted that as the storage duration increases, at each treatment level and for each hybrid, the sizes of growth of the essntial parts of the germs, decrease considerably.

A remarkable increase in the root system is recorded for Turda Favorit and Turda 201 hybrids, as well as the positive action of fungicide treatment on them.

Table 4

Values of increases of primary roots and seedlings by treatment and analyzed moments

Hibri-ds	Treatment	Length of primary root (average) [cm]				Length of plantlet (shoot) (average) [cm]			
		„initially"	„12 months"	„24 months"	„36 months"	„initially"	„12 months"	„24 months"	„36 months"
Turda 200	untreated	24.66	24.00	23.33	22.66	12.33	12.33	11.66	11.00
	Controlled env.	24.66	20.00	15.66	11.33	12.33	12.00	8.00	8.00
	Fungicide	25.33	26.66	25.00	24.00	12.66	13.00	13.00	11.33
	Fungi.+insecticide	26.33	26.66	16.33	14.33	12.66	12.66	8.33	8.00
Turda 165	untreated	24.33	24.00	23.66	23.00	12.00	11.66	11.00	11.00
	Controlled env.	24.33	18.66	10.33	10.66	12.00	10.33	6.00	6.00
	Fungicide	26.00	27.00	23.33	19.33	12.33	12.00	11.00	10.33
	Fungi.+insecticide	26.33	23.00	11.33	10.00	12.66	11.00	6.66	6.66

Turda 201	untreated	25.33	24.66	23.33	21.00	13.00	12.00	11.33	10.66
	Controlled env.	25.33	18.33	11.00	9.00	13.00	10.00	6.66	6.00
	Fungicide	26.33	26.66	23.00	20.0	14.33	14.00	12.33	11.33
	Fungi.+insecticide	26.66	22.00	12.66	10.33	15.00	12.66	7.00	6.66
Turda Star	untreated	24.33	25.00	24.33	23.33	12.33	12.00	11.66	12.00
	Controlled env.	24.33	20.66	13.66	10.00	12.33	12.00	9.00	8.33
	Fungicide	25.00	25.00	25.00	21.00	14.33	14.00	12.00	11.66
	Fungi.+insecticide	26.00	25.66	16.00	14.00	13.66	13.33	10.00	9.00
Turda Favorit	untreated	24.00	24.00	23.00	22.33	11.66	12.00	11.33	11.00
	Controlled env.	24.00	20.00	10.00	10.33	11.66	9.66	6.66	6.00
	Fungicide	26.00	25.66	22.00	21.33	13.33	13.33	11.33	11.33
	Fungi.+insecticide	26.66	22.33	11.00	10.33	13.33	12.00	7.66	6.33

Seeds with dynamic and uniformity of germination ensure uniformity of emergence as well as a rapid rise, which means a short time out of any stresses caused by unfavorable conditions

In the "*before sowing*" phase, very small differences are recorded between the values of Speed germination index (**SGI**), in case of all hybrids. (Figure 4). Starting with the "after 12 months" stage and as the retention time increases, there are obvious differences between hybrids, with drops in their value after 36 months to 13.3% (untreated seed variant) for some hybrids. The combined action of speed germination and slow growth rates has consequences on slow and unevenly emergence in the field, even under favorable conditions.

From the comparison table in the experiment, it was shown that there are significant differences between germinations of hybrids from the start. Appreciating the quality of seed lots, in compliance with Vigour index-I **(SVI)**.(Table 5) and taking into account that the limit difference is ***DL5%=178.3,*** determined by trifactorial ANOVA of İndex, it is noted that there ***are no significant differences***, at this stage, in terms of quality appreciated by vigour indicators. (Vigour index-I). Seed deterioration is a natural phenomenon *that can not be stopped*; seeds even kept under normal conditions tend to decrease in viability and vigour with the increase of storage duration.

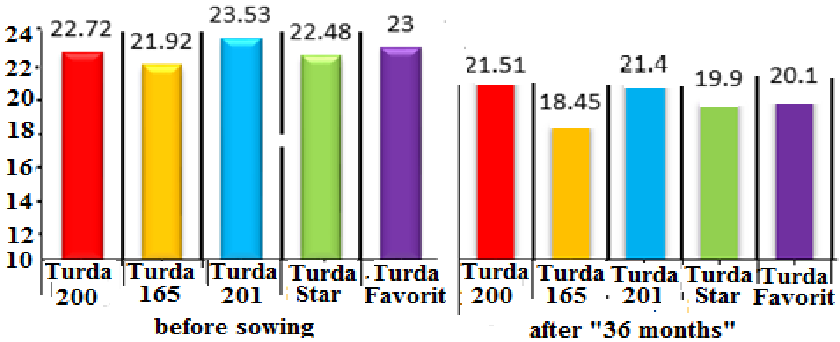

Fig. 4 - Speed germination index (**SGI**)

Analyzing the hybrids after the standard germination parameter.,for example in the "*after 24 months"* step in the standard version (Table1), we can say that all hybrids record lower germination values than the initial values, but these values do not restrict the practical use of seed lots in consensus with the seed law. Law 266/2002-republished.

Table 5

Variability of the distribution of results in the vigour – Index analysis

Treatment/hybrid		„initially” $\bar{I}_{index} \pm t_{5\%} * s_i$	”12 months” $\bar{I}_{index} \pm t_{5\%} * s_i$	”24 months” $\bar{I}_{index} \pm t_{5\%} * s_i$	”36 months” $\bar{I}_{index} \pm t_{5\%} * s_i$
		$[min - max]$	$[min - max]$	$[min - max]$	$[min - max]$
untreated	Turda 200	3425.3 ÷ 3810.7	3312.2 ÷ 3711.2	3132.5 ÷ 3567.5	3019.2÷ 3447.4
	Turda 165	3165.2 ÷ 3521.4	3091.3 ÷ 3518.7	2742 ÷ 3258	2392 ÷ 2908
	Turda 201	4788.6 ÷ 5137.8	3333.5 ÷ 3735.1	2942 ÷ 3458	2523 ÷ 3110.4
	T. Star	3368.3 ÷ 3724.3	3518.5 ÷ 3791.5	3079.9 ÷ 3653.5	2928.5 ÷3504.9
	T.Favorit	3201.8 ÷ 3580.2	3039.2 ÷ 3627.4	2802 ÷ 3398	2680.8 ÷ 3225.2

Controlled env.	**Turda 200**	3424.3 ÷ 3811.7	2769.2 ÷ 3246.8	1909.2 ÷ 2455.4	1456.2 ÷ 2051.4
	Turda 165	3165.4 ÷ 3521.4	2304.5 ÷ 3012.3	954.9 ÷ 1724.5	830.2 ÷ 1623.2
	Turda 201	3491.7 ÷ 3841.7	2380.9 ÷ 3075.7	1129.1÷ 1898.9	639.1 ÷ 1408.9
	T. Star	3368.3 ÷ 3724.3	2882.9 ÷ 3356.1	1726.6 ÷ 2406.8	1263.7 ÷ 1936.3
	T.Favorit	3201.8 ÷ 3580.2	2207.7 ÷ 2925.7	1009.3 ÷ 1768.7	852.7 ÷ 1647.3
Fungicide	**Turda 200**	3505.2 ÷ 3864.8	3577.2 ÷ 4017.6	3448.6 ÷ 3885.4	3126.6 ÷ 3573.4
	Turda 165	3376.8 ÷ 3769.8	3447.6 ÷ 3884.4	2853.7 ÷ 3337.1	2225.4 ÷ 2746.6
	Turda 201	3717.4 ÷ 4104.6	3676.6 ÷ 4130	3067.5 ÷ 3638.5	2600.2 ÷ 3171.2
	T. Star	3638.2 ÷ 3985.8	3572 ÷ 3994	3298 ÷ 3720	2797.9 ÷ 3244.7
	T.Favorit	3509.9 ÷ 3946.7	3418.5 ÷ 3989.5	2810.6 ÷ 3366.6	2718.1 ÷ 3313.9
Fungicid + Insecticide	**Turda 200**	3663.5 ÷ 3936.5	3544 ÷ 3966	2041.8÷ 2631.6	1781.9 ÷ 2387.5
	Turda 165	3437.2 ÷ 3834.4	2634.2 ÷ 3239.8	996.1 ÷ 1740.9	665.8 ÷ 1460.2
	Turda 201	3764.2 ÷ 4235.8	3099.7 ÷ 3720.3	1448.5 ÷ 2218.1	1043.4 ÷ 1862.6
	T. Star	3646.8 ÷ 4019.2	3459.9 ÷ 3906.7	2127.1 ÷ 2722.9	1789.7 ÷ 2410.3
	T.Favorit	3542 ÷ 3964	2607.5 ÷ 3178.5	1222.7 ÷ 1977.3	860.8 ÷ 1672.6

Analyzing seed quality in the stage "after 24 months" according to Vigour index-I, it is noted that there are large differences between the initial values and the values recorded at this stage for this indicator. Values of the variability coefficient **(C_v)** of İndex. increase with the growth of the storage duration, which explains the continuous, cumulative deterioration process of the seed of hybrids studied, in terms of physiological manifestation. However, most values of the coefficients of variation are under **10%,** which shows that experiment has been carried out correctly and the results have scientific value.

The evolution of Vigor index-I during storage. represented by its mean values. on each treatment. was graphically represented. (Figure 5).

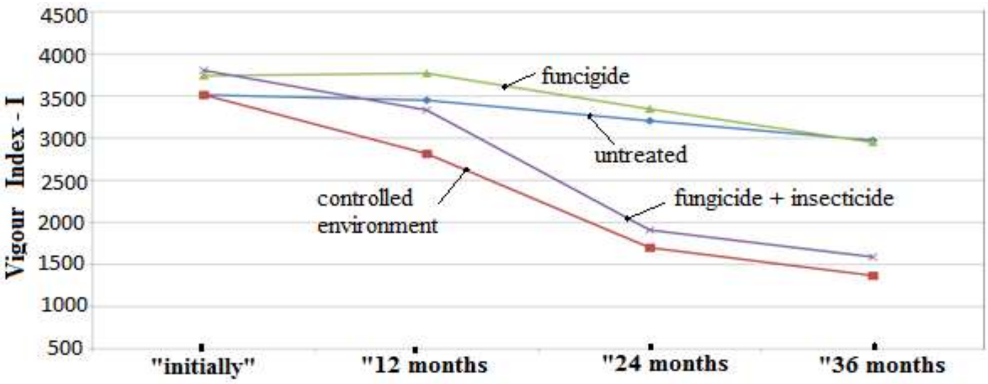

Fig. 5 - Variation of hybrids Vigour index-I during storage duration

We note very low values, a drop, a "break" of the values recorded for the ***Vigour index-I*** between the "*after 12 months*" and "*after 24 months*" stages for all variants. The decline seed is a natural process that involves changes in physical, biochemical and physiological characteristics of the seed with consequences on the viability and vigour, and is carried out with an intensity that depends on the genetic particularities of each *species, genotype or variety*. The mechanisms involved in the deterioration of the seed and the possible transformations taking place, differentiate between the seed lots. Therefore, the *Vigour index-I* **(SVI)** and *Speed germination index* (**SGI**). provide additional information on the quality of the seed lot and the recommendations on the use of the lot may be altogether different from those outlined only by the *standard germination* **(G)** indicator.

CONCLUSION

- High variability (almost 30%) of the germination value recorded during storage for the “orthodox” seeds belonging to studied hybrids indicates the different conservation capacity of the initial seed features of each genotype and that is a genetic feature of each, influenced differently by the duration and storage conditions.

- The intensity of seed decline may be reduced by *controlling and directing the fundamental parameters* that characterize the storage conditions.

- The results show that the ***fungicide treatment*** of stored seeds reduces the rate of seed decline, which means increasing the seed lot longevity, for example by treating the hybrid Turda Favorit with fungicide, the decline rate decreases more than doubled, from **$d=4.5x10^{-4}$** decreases to **$2.0x10^{-4}$.**

- Through combined protection against both diseases and pests, seed treated with fungicide + insecticide. ***it is recommended to be used in the current year.***

- Appreciating the seed quality of the hybrids according to the standard germination indicator, even after a 36-month storage, some hybrids still have high germination values. Taking into account the values of the indicators that characterize seed vigour, in most cases, it is recommended to use the seeds until the ***24-month*** storage period.

- In practice and with wide use, the conservation of the seed quality of hybrid maize(*Zea maize* L.) seeds at a high level for a longer period of time can be done if the seed at the time of storage has moisture below **12%**. and the storage store is a dry, well-insulated building, without special facilities, only with the possibility of aeration, thus ensuring an average annual relative humidity below **55%**. and an average annual temperature below **18 ° C** with a variation between **0-35°C**, depending on the season.

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NUMERICAL SIMULATION OF THE DYNAMIC BEHAVIOUR OF A MULTIFUNCTIONAL MOTOR VEHICLE EQUIPPED WITH A PRIMARY ADJUSTMENT HYDROSTATIC TRANSMISSION
/
SIMULAREA NUMERICĂ A COMPORTĂRII DINAMICE A UNUI AUTOVEHICUL MULTIFUNCȚIONAL DOTAT CU O TRANSMISIE HIDROSTATICĂ CU REGLAJ PRIMAR

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Keywords: *hydrostatic transmission, closed circuit, technological speed, multifunctional motor vehicle.*

ABSTRACT

The article analyzes the solution of implementing a hydrostatic transmission in the kinematic chain of a mechanical transmission of a multifunctional motor vehicle. In this regard, the request came from a company activating in road maintenance, to develop a special transmission that allows achieving low speeds during working operations with increased torque and minimal wear of mechanical transmission. The product is developed under a research project between a company and INOE 2000-IHP, an institute specialized in hydraulic and pneumatic drives. There are presented: the construction and operation of the transmission, its scheme and structure and the numerical simulation of the main functional parameters of the multifunctional motor vehicle.

REZUMAT

În articol este analizată soluția implementării unei transmisii hidrostatice în lanțul cinematic al transmisiei mecanice a unui autovehicul multifuncțional. In acest sens. a apărut solicitarea din partea unei firme din domeniul întreținerii drumurilor pentru realizarea unei transmisii speciale care să permită realizarea vitezelor reduse în timpul operațiilor de lucru cu un cuplu sporit și o uzură minimă a transmisiei mecanice. Produsul este realizat în cadrul unui proiect de cercetare între o firmă și institutul INOE 2000-IHP specializat în acționări hidraulice și pneumatice. Sunt prezentate: construcția și funcționarea transmisiei, schema și structura transmisiei hidrostatice și simularea numerică a parametrilor funcționali principali ai autovehiculului multifuncțional.

INTRODUCTION

Multifunctional vehicles are trucks where technological equipment is implemented to carry out road-related works such as snow removal, scrapping, sweeping and sprinkling of streets, mowing of public roads, or dressing trees.

Multifunctional motor vehicles have two working modes.

● Marching mode - the vehicles move quickly, from one location to another. Engine torque is small and the travel speed is high.

● Technological mode - the vehicle is moving at a low speed (maximum 5 km / h) imposed by the equipment technology attached to the truck. The torque on the motor wheels is high and the travel speed is small. The traditional mechanical transmission (gearbox, cardan coupling, differential) is effective in fast-moving (high speed) but cannot achieve and maintain low travel speeds. To achieve and maintain a low travel speed with an increased torque on the wheel there is used a hydrostatic transmission, which, besides high power density, also offers increased mobility. Practically the vehicle has two types of independent transmission: mechanical and hydrostatic. Switching from one transmission to the other is done by simply switching a button. Mechanical transmission is used in marching mode, i.e. high-speed travel mode and hydrostatic transmission - in "technological mode". Electronic control of the hydrostatic transmission ensures a smooth start with a continuous speed control and safe braking.

MATERIAL AND METHOD

- CONSTRUCTION AND OPERATION OF HYDROSTATIC TRANSMISSION

The constructive and functional scheme of hydrostatic transmission is shown in Figure 1. In Figure 1.a. one can notice that in the case of mechanical transmission, the torque supplied by the MT motor is transmitted to the RM drive motors via the CV gearbox, the AC shaft and the DF differential *(Baseley S. et al. 2007)*.Implementation of hydrostatic transmission is achieved by introducing the MH hydraulic motor into the kinematic chain of the mechanical transmission, as shown in Figure 1.b., the PH pump being driven from the power outlet of the MT motor.

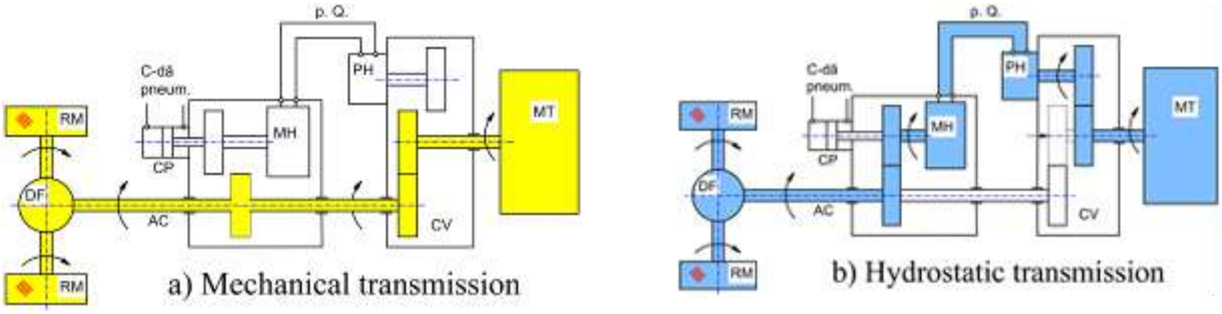


Fig.1 - Constructive and functional hydrostatic transmission scheme

Connecting or disconnecting the MH hydraulic motor from the AC shaft is carried out with the pneumatic cylinder CP powered by the compressed air network of the vehicle. The hydraulic PH pump is driven from the power outlet of the truck directly or via a cardan shaft.

Activating the hydrostatic transmission is done as follows (figure 1b): change the CV gearbox to neutral to deactivate the mechanical transmission. This disengages the MT motor from the AC shaft; the power take-off for the pump PH is coupled; engage the hydraulic motor MH with the AC shaft with the pneumatic cylinder CP.

The kinematic chain of the hydrostatic drive has two branches: • Hydraulic power generation kinematic chain: MT-CV-PH; • Hydraulic power use kinematic chain: MH-AC-DF-RM. The energy flow of the hydrostatic transmission undergoes two energy conversions: a) The hydraulic pump PH converts the mechanical power (torque x speed) received from the MT motor via the CV gearbox in hydraulic power (pressure x flow) which it transfers to the hydraulic engine MH; B) The hydrostatic MH converts the hydraulic power received from the PH pump into mechanical power (torque x speed) which it transfers to the drive wheels via the AC shaft and the DF differential.

- DIAGRAM AND STRUCTURE OF HYDROSTATIC TRANSMISSION

The hydrostatic transmission shown in Figure 2 consists mainly of: hydrostatic pump 1, hydrostatic motor 2 and refreshment (vent) valve 3 (Bălășoiu V. et al. 2007). These components together form a closed hydraulic circuit (Axin M. 2013).

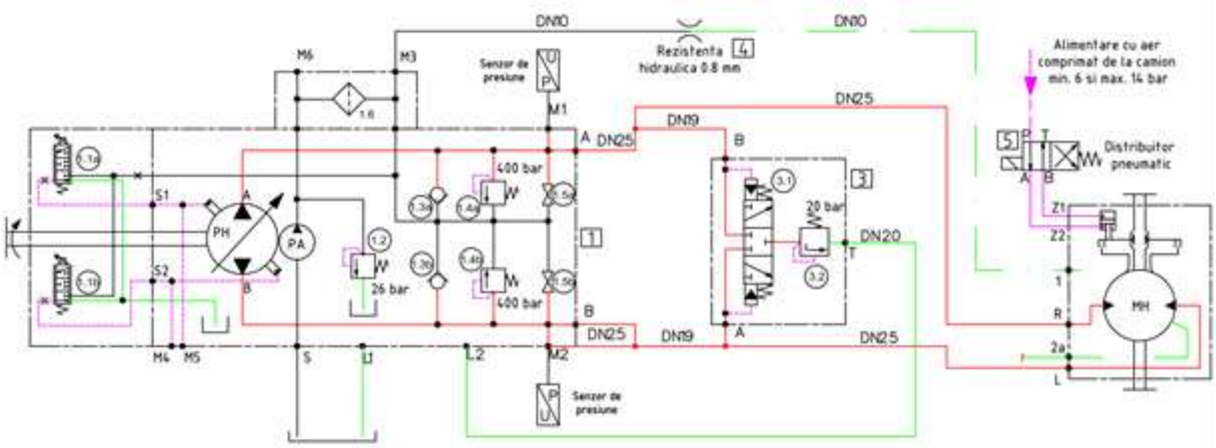


Fig.2 - Constructive and functional hydrostatic transmission scheme

The main PH pump supplies hydraulic power to the MH engine. (Do H.T.et al. 2013) The PA auxiliary pump compensates for the internal losses of the two hydraulic machines and introduces cooled and filtered oil into the closed hydraulic circuit. Reversing the discharge direction and changing the flow rate of the PH pump is achieved by proportional electric valves 1.1.a and 1.1.b. The safety valve 1.2 protects the PA overpressure pump. The sensing valves 1.3.a and 1.3.b direct the flow rate of the PA pump into the low pressure branch of the closed circuit. The pressure valves 1.4.a and 1.4.b protect against overpressure the two branches A and B of the closed circuit. The 1.5.a and 1.5.b valves open when the truck is towed and the MH hydromotor becomes a pump. Filter 1.6 ensures filtering of oil pumped into the system. The valve 3.1 removes an oil quantity (about 10% of the PH pump flow) from the low-pressure branch of the closed circuit that comes from the hydromotor. The extracted oil is replaced with "fresh" oil supplied by the PA pump through the filter 1.6 and the sensing valves 1.3.a or 1.3.b. Pressure valve 3.2 maintains a pressure of approx. 20 bar on the closed circuit low pressure branch. Part of the flow rate of the PA pump is routed through the resistor 4 to the MH hydromotor in order to lubricate and cool it in the fast movement phase. The pressure sensors transmit information to the electronic controller of the transmission. The pneumatic valve 5 connects / disconnects the MH hydromotor from the cardan shaft.

- ENERGY EFFICIENCY IN THE TECHNOLOGICAL MODE

The thermal motors fitted to multifunctional motor vehicles operate at maximum efficiency in the speed range of 1200 to 1800 rpm, as shown in Figure 3.

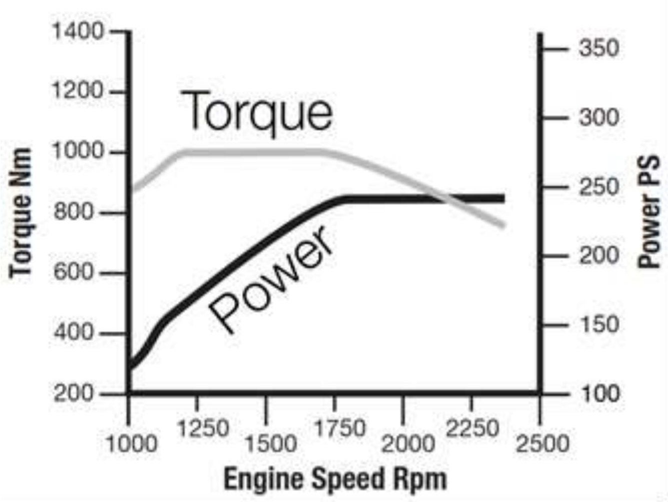


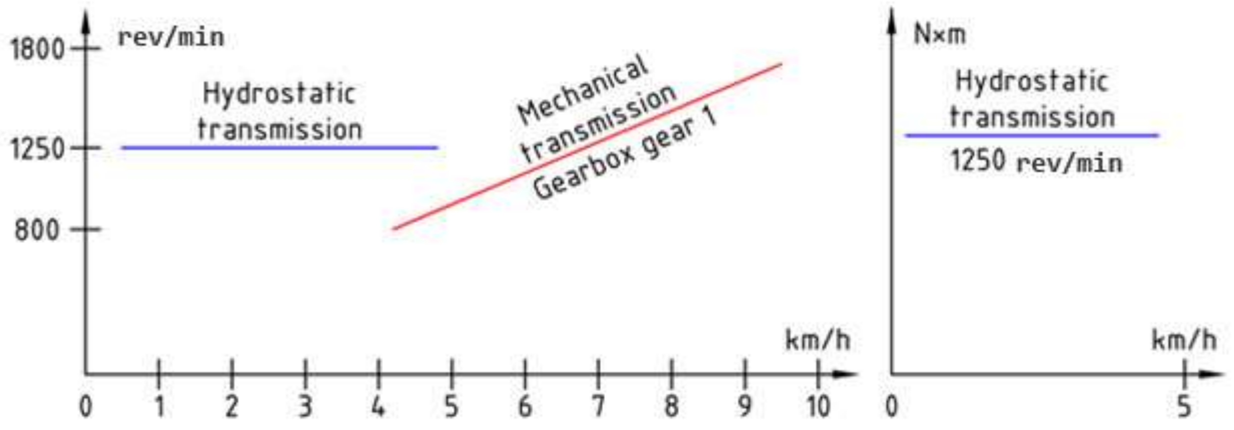
Fig.3 – Torque, power and speed diagram of the thermal motor (MAN TGM. 2011)

In the maximum efficiency range the torque developed by the engine is constant; using the thermal engine at speeds below 1200 rpm. the ratio of power / torque supplied and the fuel consumption is maximum. i.e. its maximum energy efficiency.

In order to achieve the very low travel speeds required by the technological needs of multifunctional equipment, one needs to remove the thermal engine from the working range with maximum efficiency.

Hydrostatic transmission offers what the mechanical transmission cannot accomplish: low travel speeds with the thermal engine operating in the maximum efficiency range. This can be seen from the diagrams shown in Figure 4.

It results from this figure that the hydrostatic transmission ensures that the vehicle is driven at very low speeds (0.5 ÷ 5 km / h) at an engine speed of 1250 rpm located in the maximum efficiency range (Cristescu C. et al. 2015). (Drumea P. et al. 2016). (Drumea P. et al. 2016). The mechanical transmission cannot achieve low travel speeds in the efficient running range of the thermal engine.



a) Velocity and speed diagram b) Speed and torque diagram

Fig.4 - Comparative diagrams: mechanical transmission - hydrostatic transmission

- NUMERICAL SIMULATION OF THE MAIN PARAMETERS OF HYDROSTATIC TRANSMISSION

The numerical simulation of the main parameters of the hydrostatic transmission has been performed using the AMESim simulation environment (Popescu T.C. et al. 2017). (Popescu T.C. et al. 2010). (Radoi F. et al. 2014).

The simulation scheme is shown in Figure 5.

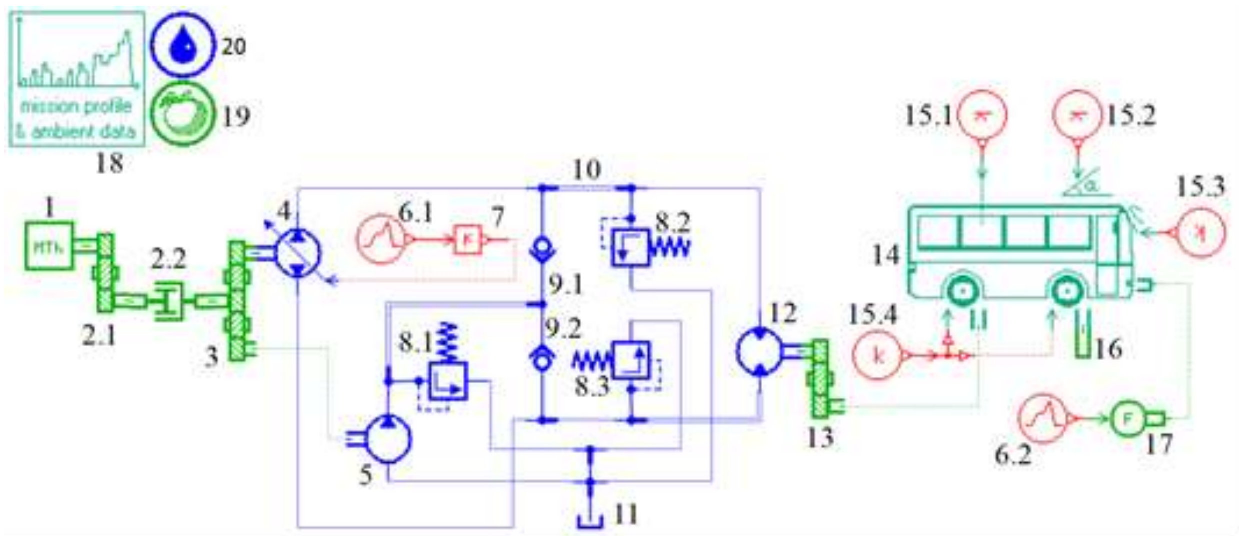


Fig.5 - Simulation scheme

1 Thermal engine. 2.1 Mechanical speed reducer. 2.2 Elastic couplings. 3 Mechanical node. 4 Variable flow pump. 5 Compensation pump. 6 User-defined signal source. 7 Gain. 11 Hydraulic tank. 12 Hydraulic motor. 13 Mechanical speed reducer. 14 Variable load vehicle without slip. 15 Constant signal source. 16 Zero torque source. 17 Conversion of signal input into a force [N]. 18 Mission profile and ambient data.

Table 1

The main parameters of the simulation:

Thermal engine	1250 rpm and 1000 Nm
Variable flow pump	75 cc/rev
Hydrostatic engine	1000 cc/rev
PTO	1524 rpm and max. 600 Nm
Compensation pump	1 cc/rev
The weight of the loaded vehicle	18 t

RESULTS

The goal of hydrostatic transmission implementation is to achieve travel speeds of values between 0.5 and 5 km / h.

The charts resulting from numerical simulation are shown in Figure 6. They show the evolution of the main parameters and the dynamic behaviour of the multifunctional motor vehicle.

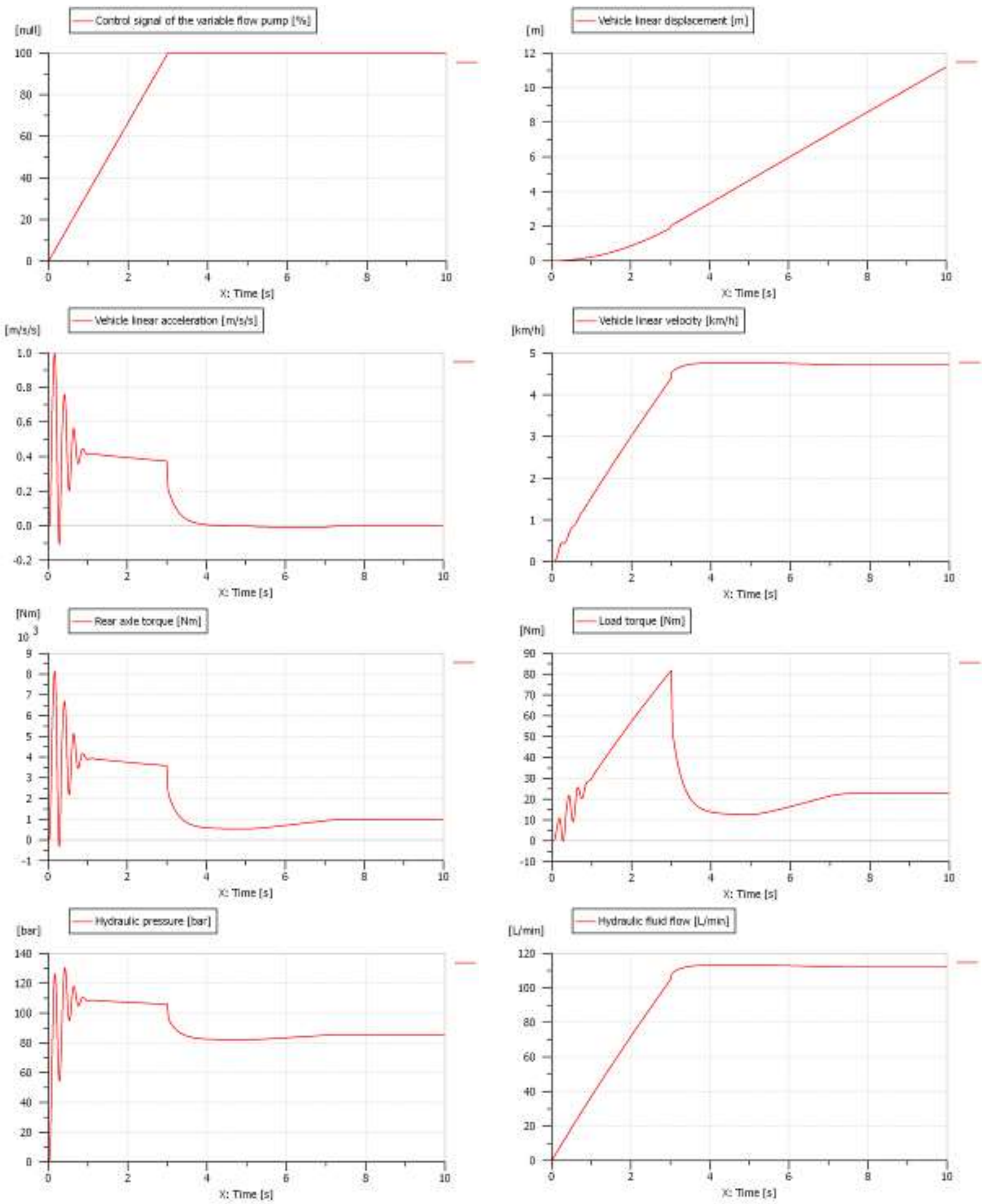


Fig.6 - Variation of the main parameters of the simulated system

Figure 6 shows the response of the system to the ramp signal. For the start the displacement occurs slowly and becomes stable at a constant speed of 4.8 km / h. In the first phase, there is a variation in the acceleration which is rapidly attenuated, having small amplitude relative to the mean value. The other parameters do not exceed the limit values.

After obtaining the physical model and testing it, the results obtained by the simulation will be compared with the experimental ones, which will lead to the validation of the simulation model.

CONCLUSIONS

Following the analysis of the proposed solution it can be concluded that the use of hydraulic transmission in the technological travel regime has the following advantages:

a) The truck can achieve lower travel speeds than those it can achieve with mechanical transmission;

b) The thermal engine operates in the maximum efficiency range even at these very low speeds.

The hydrostatic transmission ensures for the multifunctional motor vehicle operation performances that the mechanical transmission cannot achieve: very low travel speeds at the maximum energy efficiency of the thermal motor.

Confirmation of these conclusions and the results obtained by numerical simulation will be done after the physical development and testing of the hydromechanical transmission model.

ACKNOWLEDGEMENT

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RECOVERY OF ORGANIC WASTE THROUGH COMPOSTING PROCESS
/
VALORIFICAREA PRIN COMPOSTARE A REZIDUURILOR ORGANICE

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Keywords: *waste treatment, composting methods, aerobic fermentation, organic waste .*

ABSTRACT

Waste treatment involves all chemical, physical and biological processes that have the role of modifying certain characteristics of the waste in order to reduce their volume and hazardousness, thus facilitating their recovery. Among the available technologies, composting is presented as one of the most promising options for recycling the organic fraction into a valuable organic fertilizer called compost. In the present paper are presented the main composting methods, namely: passive composting in piles, turned windrow composting, passive aerated windrows, aerated static pile and in – vessel composting.

REZUMAT

Tratarea deșeurilor implică totalitatea proceselor chimice, fizice și biologice care au rolul de a modifica anumite caracteristici ale deșeurilor, în scopul reducerii volumului acestora și caracterului periculos, facilitând astfel valorificarea acestora. Dintre tehnologiile disponibile. compostarea este prezentată ca fiind una dintre cele mai promițătoare opțiuni pentru reciclarea fracției organice într-un îngrășământ organic valoros numit compost. În lucrare sunt prezentate principalele metode de compostare, şi anume: compostarea pasivă în grămezi, compostarea în grămezi cu întoarcere și amestecare, compostarea în grămezi aerate pasiv, compostarea în grămezi statice aerate forțat şi compostarea în containere închise.

INTRODUCTION

Today, the most urgent environmental problem is global warming, the main challenge in the waste management sector being waste avoidance. Solid waste management, especially the organic fraction, has become one of the major challenges of the 21st century from an economic, social and environmental protection point of view (*Fernandez et al..* 2016). Organic waste, such as agricultural and forestry residues and municipal solid waste, has become a major issue in both developed and developing countries (*Rashad et al.. 2010*). Waste treatment involves all the chemical, physical and biological processes which have the role to modify certain features of the wastes in order to reduce their volume and hazardous character, thus facilitating their recovery *(Căpățână and Simonescu. 2006)*. According to Eurostat statistics, at the level of EU member states, 15% of the municipal wastes generated by one person in 2013 were treated by composting (*http://ec.europa.eu/eurostat/documents/2995521/%206757479/8-26032015-AP-EN.pdf/a2982b86-9d56-401c-8443-ec5b08e543cc*).

Among the methods of biological waste treatment, composting is the simplest and most efficient technology for treating the organic fraction. Composting can be defined as an aerobic process of biochemical decomposition of organic matter resulting in a stable product without pathogenic germs, that can be used in agriculture (*Haug*. *1993*; *Zhang and Sun. 2014*). The substrate used in the composting process consists of different sources of organic waste, such as: biodegradable waste collected from dwellings and households (kitchen waste, garden waste - cut grass, leaves, tree bark, debris from trimming trees and hedges, animal manure). residues from the processing of vegetables and fruits, residues from meat and fish processing, biodegradable municipal waste (sludge from wastewater treatment plants, newspapers, cardboard), waste from wood processing (sawdust, wood chips) and residues from agricultural crops (*Francou et al..2005*).

Transformation of organic matter during the composting consists of two complex processes, namely: *degradation* and *humification*. Over time, special attention has been given to the humification process, especially the formation of humic substances (humic and fulvic acids), due to their efficiency in improving soil fertility and stimulating plant growth (*Fornes et al.. 2012; Zhao et al. 2016*). During the first phase of the process, the simple organic carbon compounds are easily mineralised and metabolised by the microorganisms, producing CO_2, NH_3, H_2O, organic acids and heat. The optimum temperature range for composting is 40–65˚C but temperatures above 55˚C are required to kill pathogenic microorganisms. The temperature variation during composting plays an important role in the development of microbial communities. During the various stages of the biodegradation phase, the organic compounds are decomposed into CO_2 and NH_3. with O_2 consumption (*Bernal et al.. 2009*). In fig. 1, it can be seen the temperature curve during the composting process.

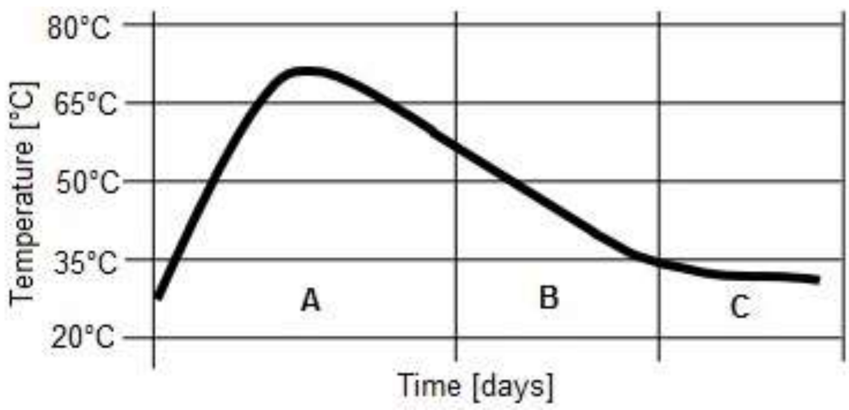

Fig.1 – The temperature curve during the composting process (*Bachert et al.. 2008*)
A – degradation; B – transformation; C – maturation

The pH level of the raw materials used in composting pile is also very important. The optimum pH range for microbial activity is between 6.5 and 8.0 (*Graves et al.. 2010*). Water is another important parameter for the survival of composting micro-organisms.The moisture content of the compost pile fluctuates during the composting as water is lost in evaporation process. If the substrate subject to composting is too dry, sprinkling with water must also be ensured during the decomposition process (*Paraschiv et al.. 2017*, *Graves et al.. 2010*).

Aeration is another key factor in the composting technology. A correct aeration controls the temperature, eliminates excess humidity and CO_2 and provides the O_2 required for biological processes. Optimal O_2 concentration is between 15 - 20% (*Bernal et al.. 2009*).

Maturation phase of substrate is the most important operation in the composting technique. The process is taking place in several phases and is decisively influenced by the composition, homogeneity and humidity of the organic substrate used and by the amount of air used in the decomposition process. The start-up phase of the maturing phase is the production of raw compost, the purpose of the operation being on the one hand ventilation and on the other hand the mixing of the raw materials at different stages of decomposition. In this phase, fresh compost is in a state of advanced decomposition, being semi mature. The mature compost is obtained after all organic components have been transformed into soil and humus aggregates, appearing in the form of black, loose and fine soil *(http://www.icpa.ro/documente/Ghid%20 compostare%20deseuri%20menajere.pdf).*

Properly storing the finished compost product is the final step of the composting process. The finished compost should be stored in a manner that prevents dust or odours from developing and prevents contamination of the product from weeds, leachate or other contaminants (*http://www.compost.org/English/PDF/Technical_Document_MSW_Organics_Processing_2013.pdf*).

This paper was aimed to present the main composting methods used for organic waste treatment, namely: passive composting in piles, turned windrow composting, passive aerated windrows, aerated static pile and in – vessel composting.

MATERIAL AND METHOD

Composting methods differ in duration of decomposition, the potential for stability and maturity, depending on the type of substrate used (*Mengistu et al.. 2017*). The main five methods of composting developed for use in large-scale are passive composting piles, turned windrow composting, passive aerated windrows, aerated static pile and in-vessel systems.

RESULTS

Passive composting pile is the simplest form of composting and does not require special equipment, being used in principle for composting the leaves. The compost pile should be periodically turned for determining the porosity of the substrate. Aeration is done by passive air movement through the compost pile (fig. 2). This method requires that the pile be small enough to allow the passive air movement, otherwise the anaerobic zones will form (*Graves et al.. 2010*).

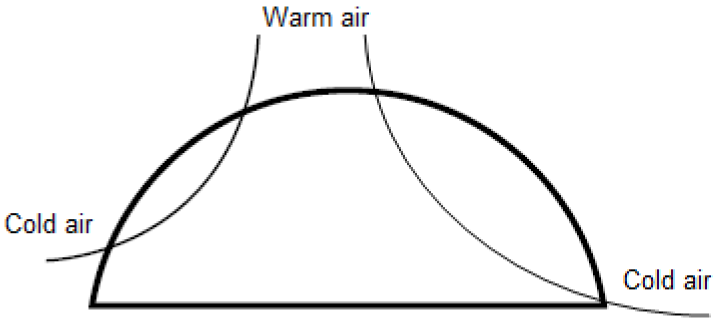

Fig.2 - Passive composting in pile (*Graves et al.. 2010*)

Turned windrow composting involves arranging the substrate in long and narrow furrows. The width of the compost pile is established depending on the size of the machine used to turn the organic material. The time required to finish the active phase of composting process using the windrow method ranges from 3 to 9 weeks (depending on the composted material), after that the maturation phase begins (fig. 3) (*http://esrd. alberta.ca/waste/composting-at-home/documents/MidscaleCompostingManual-Dec1999.pdf*. *http://www.swrcb.ca.gov/rwqcb5/board_decisions/tentative_orders/0705/dairies/dairies-baykeeper-att-g-7.pdf*).

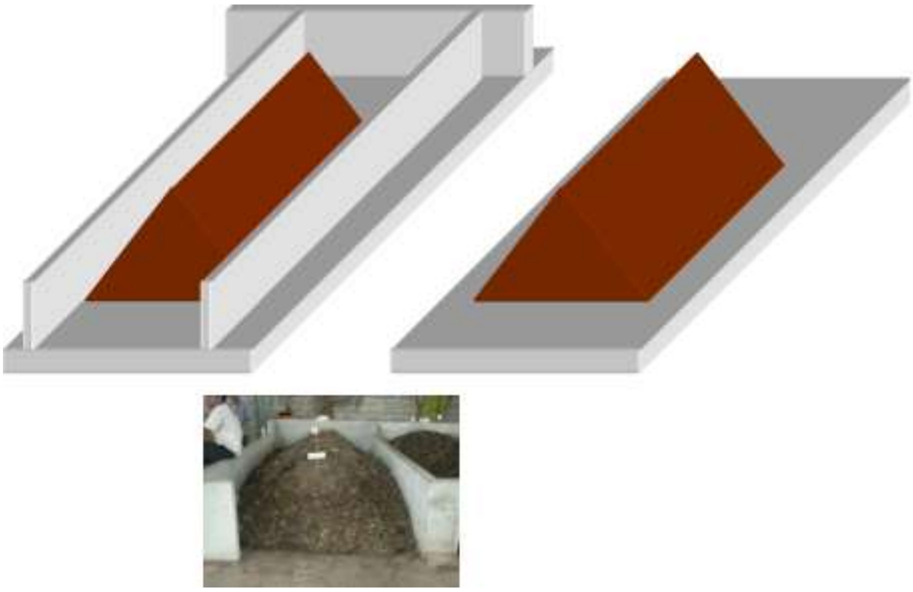

Fig.3 - Turned windrow composting (*Bachert et al.. 2008*)

Passive aerated windrows does not require turning, the aeration being accomplished by passive air movement through the perforated pipes placed in the porous layer (peat moss, straw or matured compost) at the base of the pile (fig. 4). The porous layer can have a height of 15-20 cm and a width of 3 m. The main feature of this porous layer is to allow a uniform distribution of air in the pipes, but also to insulate the pile, which will ensure the optimum temperature during substrate degradation. The top layer (aprox. 15 cm) consists of peat moss or matured compost, which has the role of retaining moisture and unpleasant odors released during the decomposition process (*Graves et al.. 2010; http://esrd.alberta.ca/waste/composting-at-home/documents/MidscaleCompostingManual-Dec1999.pdf).*

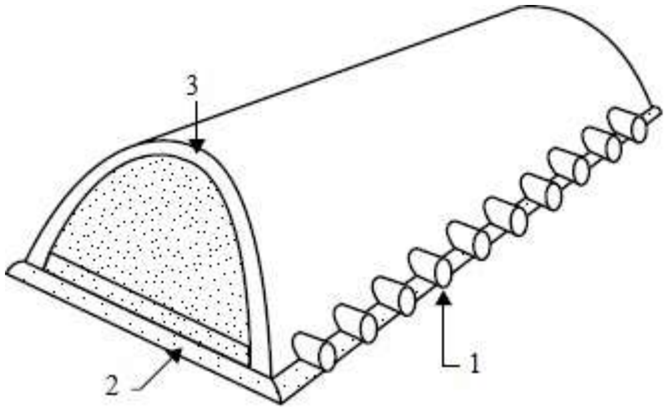

Fig.4 - Passive aerated windrow (*Graves et al.. 2010*)
1 – perforated pipe; 2 – base layer (compost. peat moss or straw base); 3 – coating layer (compost or peat moss)

Aerated static pile is one of the most used methods for composting and can last from 3 to 6 months, depending on the substrate used (fig. 5). The main difference between passive aerated windrow and aerated static pile is that the aerated static pile uses blowers that either suction air from the pile or blow air into the pile using positive pressure (*Stentiford. 1996*).

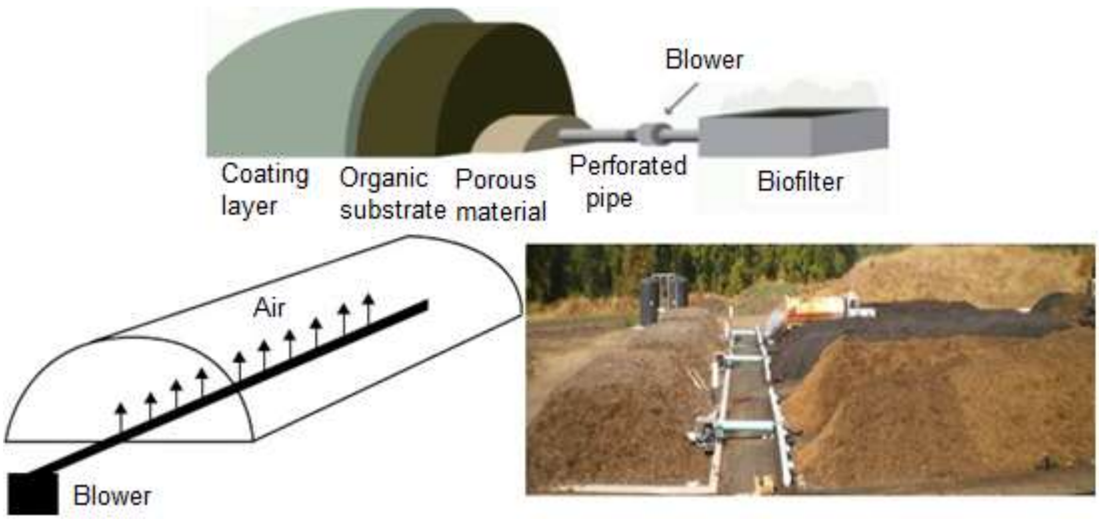

Fig.5 - Aerated static pile (*Graves et al.. 2010; http://compostingtechnology.com/aerated-pile-systems/aerated-static-pile-asp-system/*)

At the base of the composting pile there are located perforated pipes for aeration connected to blowers that introduce or suck air from the composted substrate. The pipes are covered with a porous material made of wood chips or straw to allow a uniform air distribution in the pile. The final coating layer (15 cm) of the compost pile is often made of mature compost or sawdust to absorb unpleasant odors and moisture (*Graves et al.. 2010; http://compostingtechnology.com/aerated-pile-systems/aerated-static-pile-asp-system/)*. In this case, the composting pile is not turned. The dimensions of such a compost pile are: height between 1.5 and 2.5 m, the width of 3 – 5 m, while the length of the pile is limited by the air distribution in the pipes, but it should not be more than 21 - 27 m.

In – vessel composting involves the closure of organic waste in a container. Composting process can be done in bins (fig. 6) provided with aeration systems similar to those of aerated static piles or in bins without aeration systems to which it is necessary the regular turning of the substrate in order to maintain the aerobic conditions (*Graves et al.. 2010).*

Another in – vessel systems are represented by rectangular agitated bed and rotating drum composting (fig. 7). The rectangular agitated bed system uses long and narrow beds where the composting taking place and an automated turner for periodic turning. In the case of rotating drum, the composting time is reduced to 2 – 3 weeks. These two systems require less work than windrows because they use an automated turning process or a self-turning mechanism (*Graves et al.. 2010*).

Fig.6 – Composting process in bins (*Storino et al.. 2016*)

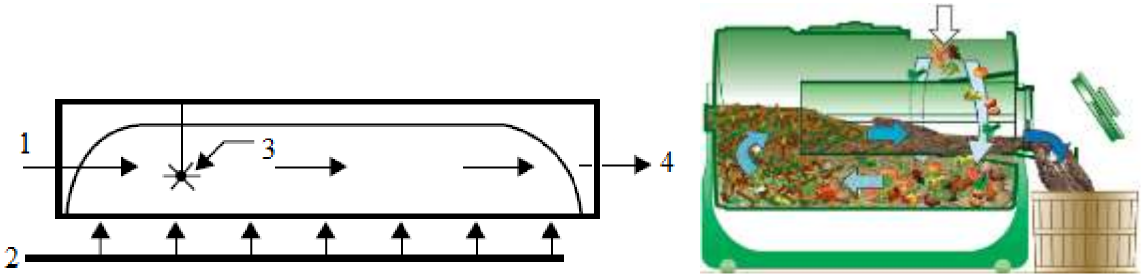

Fig.7 - Rectangular agitated bed (*Graves et al.. 2010*) **and rotating drum composting**
(http://mtlion.com/gardencomposter/technology.html)
1 – organic substrate; 2 – air; 3 – turning device; 4 – compost

CONCLUSIONS

Composting cannot be considered a new technology. but amongst the waste management methods it is gaining interest as a suitable option for organic waste with economic and environmental benefits. This process reduces the risk of spreading pathogens and weed seeds and the final product. called compost. can be used to improve soil quality and fertility.

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FACTORS THAT INFLUENCE THE MATHEMATICS CURRICULUM IN THE UK / *FACTORII CARE INFLUENȚEAZĂ CURRICULUM-UL MATEMATICII ÎN REGATUL UNIT*

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Keywords: *education system, economy, social climate.*

ABSTRACT

The wider social and economic context in which the UK's education system performs, has suffered significant changes in recent years. The rapid economic change has dramatically influenced the job market and generated a high unemployment rate amongst young people.

REZUMAT

Contextul social și economic mai larg în care funcționează sistemul educațional al Regatului Unit a suferit schimbări semnificative în ultimii ani. Schimbările economice rapide au influențat dramatic piața muncii și au generat o rată ridicată a șomajului în rândul tinerilor.

INTRODUCTION

There are a number of forces that contribute to the curriculum development and a change of social, political and economic factors may influence the curriculum's relevance and value.

The research conducted by *Wolf* (2011) stressed the significant role that mathematical skills, accounted as maths GCSE (A*-C) qualifications, play for labour market entry and employment and for further career progression and earning. For example, the way in which the maths curriculum is going to change, giving priority for post-16 students to re-sit the exams to achieve maths GCSE (A*-C) qualifications is partly influenced by the Wolf Report, which highlighted the ineffectiveness of previous key skills and more recently functional skills arrangements. Moreover, the Roberts report (2002) *SET for Success* brought attention to a serious shortage in the UK economy of people qualified in science, technology, engineering and mathematics (STEM).

Subsequently, the Smith report (2004) *Making Mathematics Count* stressed the national need for more young people to study mathematics and suggested that this could be achieved by wider recognition of the importance of mathematics and changes in the curriculum and qualifications pathways so as to provide appropriate progression for all students (*Brown* et al.. 2007).

Another factor that may be considered when analysing their influence on the maths curriculum is the group of stakeholders, who represent a wide range of people, organisations and institutions that have legitimate interest in the educational process, for example, the awarding bodies such as AQA. Pearson Edexcel and City and Guilds may influence, through their curricular documents, the content of the study programme, the recommended assessment strategies, or mandatory learning and teaching activities (*Tummons*. 2009). Not only should the awarding bodies be taken into account when planning to deliver the maths curriculum, but also other stakeholders such as the internal and external verifiers including managers and Ofsted inspectors. Moreover, in order to evaluate how well a curriculum is delivered, the government and government bodies, employers, teachers, learners, parents and funding agencies are all involved in the examination process.

The forms in which the educational provisions could be politically influenced may refer to changes required by the government in terms of the targets that should be met or the sources of funding allocated; currently the further education sector is relying mainly on the Skills Funding Agency (*BIS*. 2012).

An important aspect that should be highlighted is the economic influence on the curriculum. Due to the fact that colleges are run as businesses, they seem to be over-managed and the teachers' workload has increased considerably. Recently, the general secretary of the Association of Teachers and Lecturers has claimed that "a growing number of teachers are going part-time to manage their full-time workload" and the education of students might suffer because of this issue (*Binns*. 2017. p.1-2).

In addition, the rapid growth of information technology has generated both an industry and an area of study and training. Therefore, embedding Information Communications Technology (ICT) in maths curriculum became essential in order to keep learners up-to-date and to be responsive to the labour market realities.

MATERIAL AND METHOD

For many reasons, the integration of technology into the teaching-learning process offers opportunities for improving the understanding of mathematics by adult learners (*Lawrence*. 2000). Firstly, being surrounded by technology on a daily basis provides an obvious rationale for promoting the introduction of the educational technology to support the learning of mathematics. Secondly, it seems that technology may offer learners flexibility, privacy and control over their individual learning, making them more responsible for their own development as well as promoting inclusiveness and diversity. Moreover, *Swan* (2005) emphasises the effectiveness of the use of technology in teaching mathematics by encouraging learners' originality and improving their decision-making skills. Thirdly, the teaching process may benefit from technology through a more dynamic and rapid assessment process. Subsequently, adaptive technologies provide accessibility for people who cannot attend courses because of personal difficulties such as family commitments, illnesses, or sight or movement impairments.

By contrast, there are authors that argue that new technology does not automatically lead to increased attainment (Lawrence. 2000). Therefore, it is at the practitioners' latitude to reflect on the appropriateness of integrating technology as an additional support, which can have a positive effect on improving the learning experience.

RESULTS

The views in the use of technology to support learning are varied (*DfES*. 2006), thus, on the one hand it can be seen as programmes that help students enhancing their skills and aptitudes, and as learning platforms or interactive whiteboards used by educators to enrich the content of the session and engage learners, on the other hand. An example of how new digital technology can be integrated in maths classes with the purpose of providing formative assessments through interactive quizzes is the Kahoot! platform (Figure 1. *Brand* et al., 2017).

Fig. 1 - A snapshot of a formative assessment on the Kahoot! Platform

There are other virtual learning environments such as ActiveLearn and ActiveTeach (*Pearson Education*, 2015), which are powerful teaching tools through the functions they can accomplish. For example, the integrated 'Homework. Practice and Support Service' is developed as an engaging and supportive e-learning resource that can be used in classrooms or at home by learners who are preparing to take GCSE and A level maths (Figure 2), providing differentiation by task in response to the learners' diverse levels of ability.

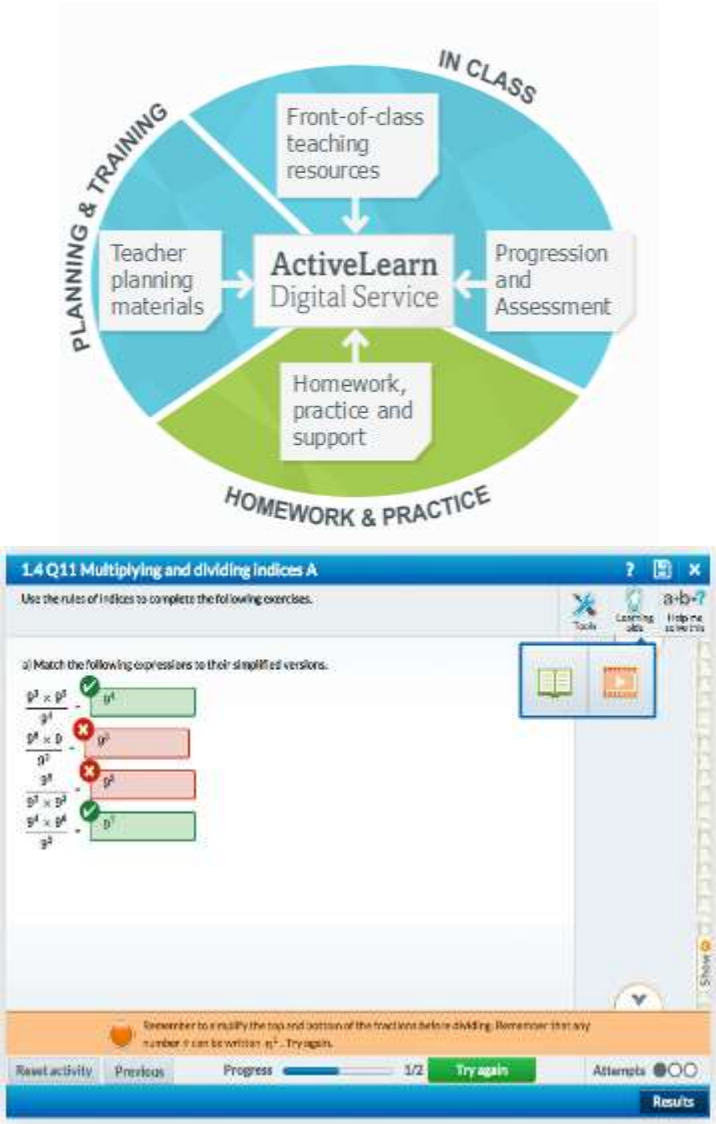

Fig. 2 - A screen-printed image of the ActiveLearn platform

The ActiveTeach platform is built for supporting learners through explanatory videos (Figure 3), whilst teachers can benefit from accurate reports on learners' progress, as can be seen in Figure 4.

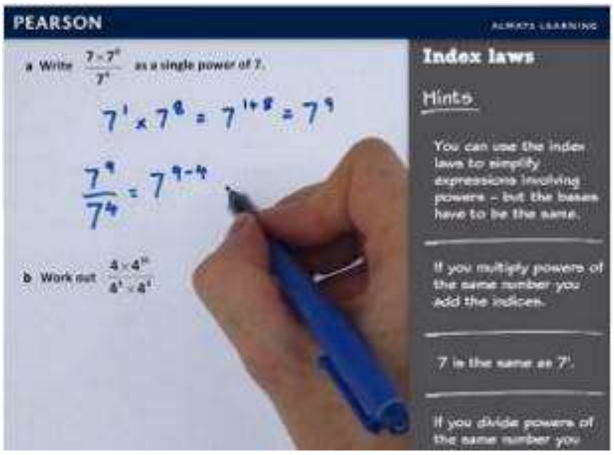

Fig. 3 - Offering support for learners

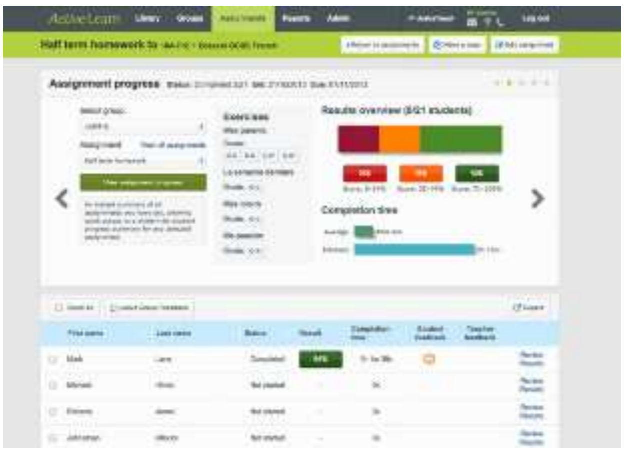

Fig. 4 - Progress tracking

A study conducted by Laurillard and Deepwell (2014) revealed that for the group of students considered in the research the usual experience of e-learning was to facilitate traditional lecture-based curricula. whilst tutors considered e-learning as a useful tool for doing research on the Internet and for preparation and presentation purposes as well.

Some barriers identified in the BECTA report (2003) that worked against the use of learning technology were the lack of credit and recognition, and organizational, for example, when integrating learning technology, teachers may need support and time to become proficient in the use of the new technology and understand how it may be used effectively for learning (EEF. n.d.).

CONCLUSIONS

The national curriculum for mathematics has been designed to raise standards in maths, with the aim that the large majority of students will achieve mastery of the subject. Research emphasises the effectiveness of the use of technology, allowing learners to make decisions and encouraging creativity and originality. Moreover, in order to provide effective teaching it is advisable to make use of suitable resources that will enhance students' learning experience.

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COMPUTER SCIENCE IN RENEWABLE ENERGY / *INFORMATICA ÎN DOMENIUL ENERGIEI REGENERABILE*

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Keywords: *sources, energy, growth, alternative.*

ABSTRACT

The aim of this paper is to illustrate how Computer Science could help companies increase their position and reputation in the energy sector, specifically in the renewable energy field.

REZUMAT

Scopul acestei lucrări este de a ilustra modul în care informatica ar putea ajuta companiile să-și mărească poziția și reputația în sectorul energetic. în special în domeniul energiei regenerabile.

INTRODUCTION

Recent years have seen an increasing interest in alternative sources of energy that are friendly to the environment. Alternative energy, also known as renewable energy, became increasingly popular due to the global energy demand that scales with the population and economic growth of the world. It is believed that the energy demand across the globe will increase by as much as 41% until 2035.

Furthermore, the popularity of alternative energy is growing more and more because even though there is enough energy that can be generated from conventional sources to fulfil the increasing demand, the amount of carbon dioxide and other greenhouse gases that are emitted by fossil fuel should be reduced [1]. The type of renewable energy presented in this paper that can be augmented by Computer Science techniques is wind energy.

Wind power has been widely used around the world for a long period of time. Initially, it was used to propel ships with sails; afterwards, it was converted to mechanical energy with the help of windmills. Nowadays wind energy is used to generate electricity through wind turbines [2]. In countries in which the government offers substantial support to companies that wish to develop wind farms to exploit this source of energy, wind power has already become an important electricity source that can be comparable to conventional ones.

According to the "*Handbook of renewable energy sources*" created as part of the ENER SUPPLY project funded by the European Union [3], the cost of generating electricity from wind energy was roughly 0.05-0.08 EUR /kWh at the time the report was written, in 2012, and it was predicted that it would decrease to approximately 0.04 EUR /kWh. This decrease in cost can be attributed to the rapid growth of the wind energy industry in the recent years.

MATERIAL AND METHOD

Wind speed can vary significantly over the course of a year, in different seasons, meaning that the annual mean wind speed of a region could indicate a lower energy production potential, even though, in reality, the potential may be much higher than indicated. Because of this phenomenon, it is important to also take into account how the wind speed is distributed across the year. This can be determined by meteorological measurements, or even measurements taken on site using sensors for a longer period of time.

A method that could help companies increase their renewable energy portfolio would be the development of wind power maps that would highlight the most suitable areas on the globe where wind farms can be built based on a number of factors which will be presented in the following paragraphs. Getting reliable wind speed data is crucial to determining the feasibility of wind turbines in a particular location [4]. Therefore, smart software can make wind farms more efficient and responsive.

RESULTS

First of all, computer models can predict wind speed and control the number and capacity of turbines in operation to meet energy demand by taking into account historical data of wind power and direction in different areas [5]. Based on these predictions, the computer system would be able to identify trends in the wind direction and speed in order to estimate the energy production generated by wind turbines. Furthermore, it would be possible to compute the mean wind speed in different seasons to accurately predict the energy production potential of each region.

When considering wind speeds in different areas, it is necessary to adjust the wind speeds from standard databases and wind maps to take into account the effect of buildings and trees on reducing the wind speed [4]. Moreover, low-vibration designs would enable turbines to run more smoothly, avoiding expensive costs generated by the replacement of faulty gearboxes or other components.

Therefore, controlling wind turbines with data-driven software could, models show, increase energy production by at least 10% and gains of 14–16% are possible. Increasing the maximum running speed could easily add another 10%. Wind-farm maintenance costs could be cut by 10% with a data-driven health-monitoring system [5].

Secondly, another important factor that needs to be taken into account when building a wind farm is the impact it may have on the local wildlife. The computer system would be able to identify potential issues that may arise during the wind energy exploitation, such as birds that would pass through the turbine network.

An efficient method would be to install thermal sensors on the wind turbines to detect when a bird would approach the blades and automatically stop them. A system capable of identifying birds near wind turbine interactions is the real-time optical detection system DTBird [6]. The system uses machine vision object tracking software to monitor the wind turbine's surroundings. Detection is made with four high definition cameras [7]; they provide a 360° view of blades and nacelle from their fixed positions located on the tower (Figures 1 and 2).

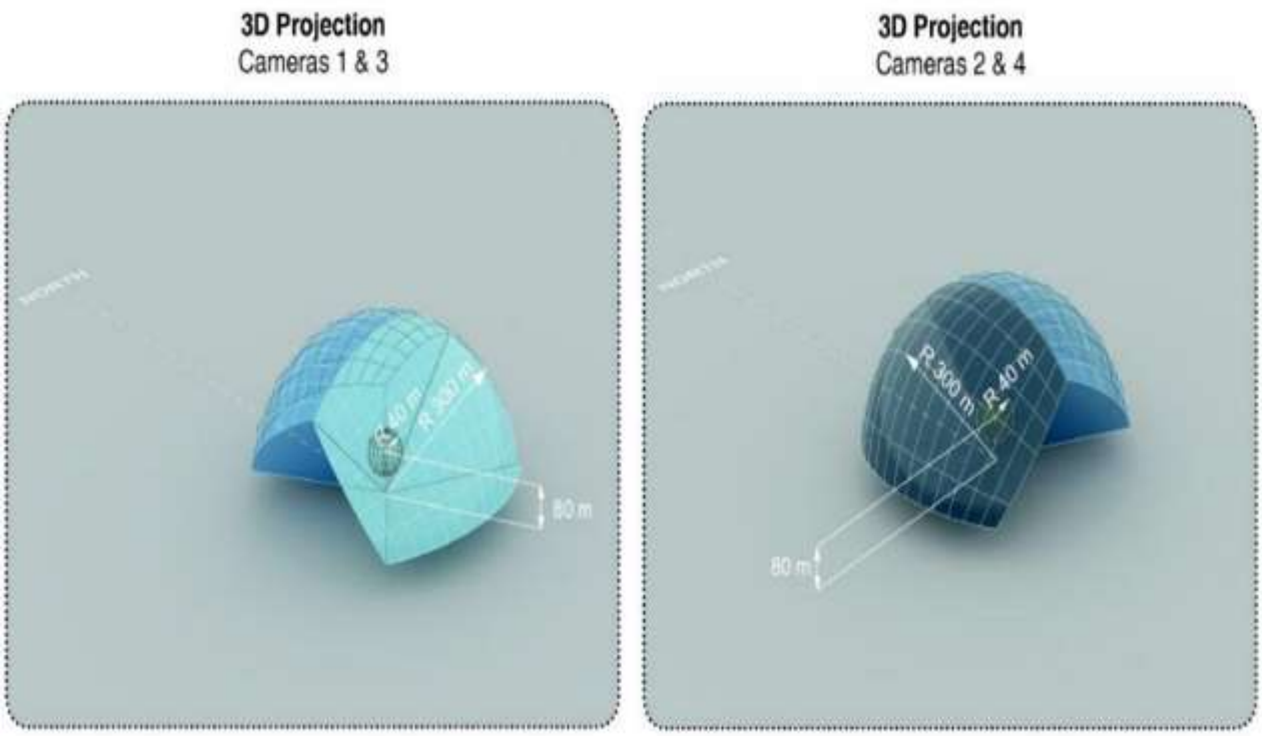
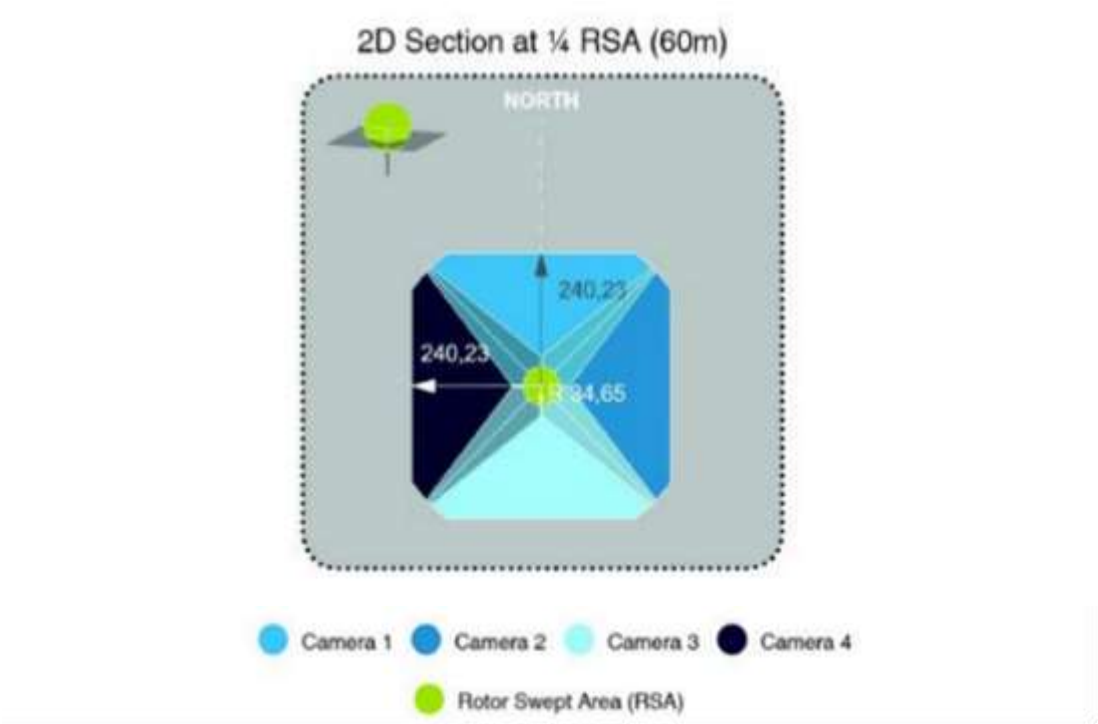
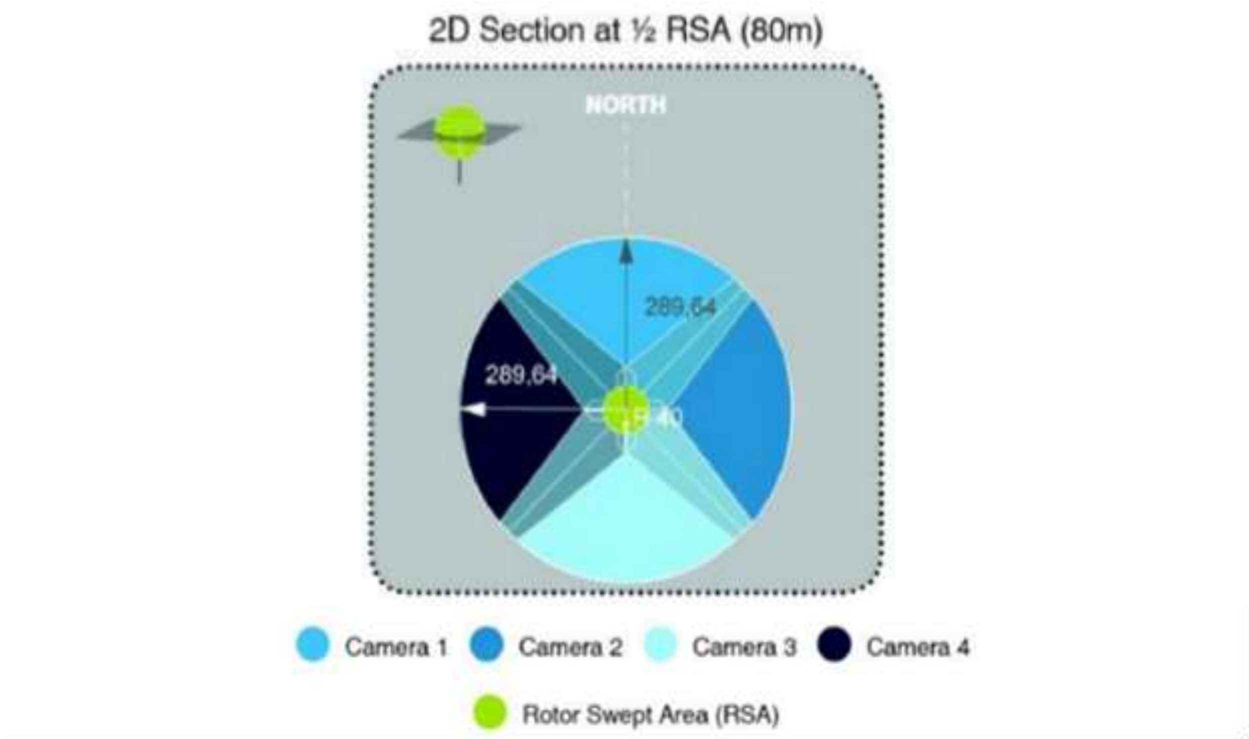


Fig. 1 - DTBird detection Module V4

Finally, in order to better estimate the cost and return of the wind farm investment, the system would take into consideration the government support offered in each country for the development of alternative energy exploitation methods.

The support from the government is essential in the expansion of wind power [8]. For example, production tax credit is an incentive for developing renewable energy facilities by offering financial support to companies that intend to generate energy from alternative sources [9].





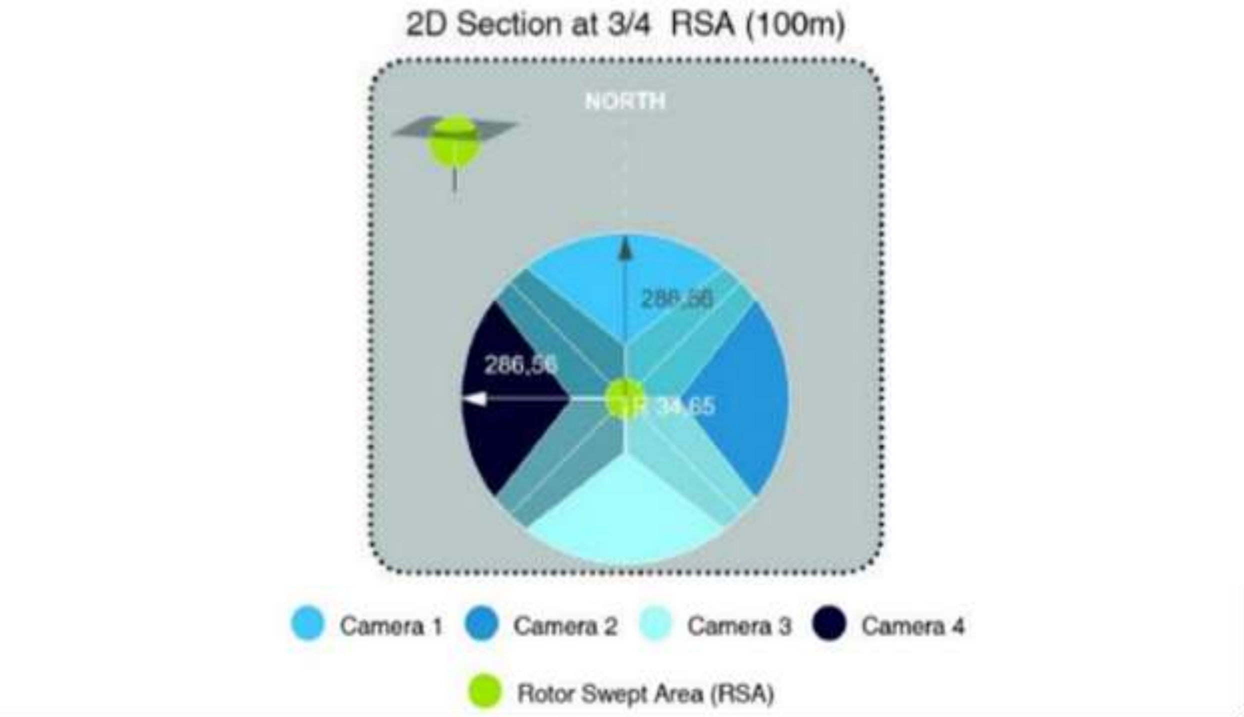


Fig. 2 - 2D Sections at ¼. ½ and ¾ of the Rotor Swept Area height (RSA)

These factors would be taken into consideration to compute a yield index for each area which could be used to compare different possible wind energy exploitation locations and help the companies decide which areas would potentially produce more energy through wind farms while keeping the building and running cost at a minimum.

CONCLUSIONS

To summarize, from the above points it can be seen that Computer Science can have a crucial role in the exploitation of wind power by helping identify areas which are favourable for building wind farms and provide the best return of the investment.

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EXPERIMENTAL RESEARCHES REGARDING THE QUALITATIVE WORKING INDEXES OF A NEW TECHNICAL EQUIPMENT DESIGNED TO ESTABLISH AGRO-FORESTRY BELTS FOR IMPROVING THE AGRICULTURAL CROPS VEGETATION ENVIRONMENT

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CERCETĂRI EXPERIMENTALE PRIVIND INDICII CALITATIVI DE LUCRU AI UNUI ECHIPAMENT TEHNIC NOU DESTINAT TEHNOLOGIEI DE ÎNFIINȚARE A PERDELELOR AGROFORESTIERE PENTRU AMELIORAREA CONDIȚIILOR MEDIULUI DE VEGETAȚIE A CULTURILOR AGRICOLE

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Keywords: *technical equipment, planting, agro-forestry seedlings, improving the environment.*

ABSTRACT

The paper presents the experimental researches performed by INMA Bucharest in order to determine the working qualitative indexes of a new machine designed to establish agro-forestry belts for ameliorating the vegetation environment conditions of agricultural cultures. Results obtained have generated valid solutions for achieving a high-performance equipment for planting agro-forestry seedlings and make available a competitive product to Romanian economic agents interested in manufacturing technical machines and equipment for agriculture..

REZUMAT

Lucrarea prezintă cercetările experimentale efectuate de INMA București pentru determinarea indicilor calitativi de lucru ai unei mașini noi destinată tehnologiei de înființare a perdelelor agroforestiere pentru ameliorarea condițiilor mediului de vegetație a culturilor agricole. Rezultatele obținute generează soluții valide pentru realizarea unui echipament tehnic performant pentru plantat puieți agroforestieri și oferă un produs competitiv agenților economici din România interesați în domeniul fabricării de mașini și echipamente tehnice destinate agriculturii.

INTRODUCTION

The devastating effect of climate changes has become more and more obvious through the activities performed in industry and agriculture. Observations have demonstrated the existence of severe effects produced on soil and crop plants development because of the wrong agricultural technologies applied, through pollution, draught, heat, torrents, tempests, landslides, floods, etc.. that may destroy the agro-ecosystems. Long standing researches on climate factors have shown the tendency of global warming: starting with 1900 the global average temperature increased by 0.8°C (Hansen et al., 2006). and the most 12 hot years registered at world level beginning with 1880, were between 1990 and 2005. Since 2003, a drastic evolution of climate changes has been noticed and these changes are expected more often in the future (Schär și Jendritzky. 2004). Forecast studies as well as prognoses made at a large scale by international organizations, governments, companies and non-governmental organizations regarding the effects of climate change for Europe have indicated that, by 2100, temperatures will increase approximately between 2°C in Ireland and Great Britain, up to 3°C in Central Europe and with 4…5°C in north Boreal and certain areas of Mediterranean regions (Christensen et al., 2007).

In Romania, according to sustainable development in agriculture, long standing studies and researches on factors enabling crop productivity increment, biodiversity preserving, environment protection and bio-resources utilization, were performed with good results at European and world level (Baicu, 1996; Berca, 2006).

For example, for obtaining a sustainable agriculture in Transylvnia. the system of integrated management of agricultural cultures includes, as an important link, the measures of utilization of biodiversity within agro-ecosystems, that are also related to agro-forestry belts planting (Popescu, 1993) such as one of the anti-erosion forestry belts in Cean-Bolduț (fig. 1), that is located in a typical area of Romanian Plain in

Transylvania. with natural. geo-morphological, lithological, climatic, edafic and phytocenosis characteristics. Geographic coordinates of the area in Cluj county, for the Cean-Bolduț, farm of agro-forestry belts are: latitude 46o36'00"/longitude 23o56'30" (Malschi Dana et al. 2009).

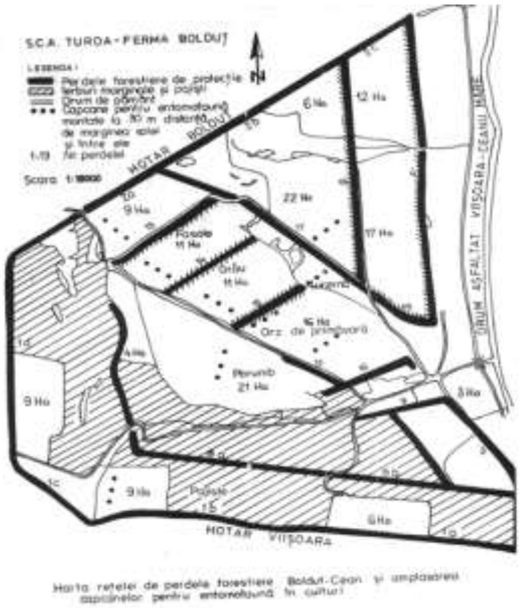

Fig. 1 -The map of agroforest belts network in Cean-Bolduţ farm of A.R.D.S. Turda

At European level, EURAF (European Agroforestry Federation of farmers that are using the agro-forestry technology) aims at implementing this technology to 50% of European farms, by 2020. EURAF comprises about 280 de members from different European countries. Agro-forestry belts contain a multitude of species of different size, the most encountered being: acacia, honey locust, poplar, ash, elm, oak, sycamore, linden tree, wax cherry tree ,wild cherry, crab apple tree, crab pear tree, elder tree, hawthorn, sloe, wild rose, Russian olive. Agro-forestry technology that aims at integrating trees and forest covered surfaces within the agricultural lands has significant environmental-friendly and economic benefits. This intermission between forestry and farming represents a great opportunity, because of the imperative necessity of more efficient and ecological food technologies and it has the following benefits: (https://forestrydegree.net/agroforestry-resources/) :

- preventing soil erosion;
- protecting the crops against damages brought by wind;
- assuring a suitable drainage;
- ensuring carbon security;
- allowing to cultivate different crops in the same plot of land.

Forestry belt technology frames within the modern strategy and legislation of our country in compliance with the European requirements; integrated management of environment for a sustainable agricultural development includes the conservation and sustainable use of bio-resources and biodiversity, restoring the agro-ecosystems, goals that can be reached by planting agro-forestry belts (Emergency Decree of Government 195/2005 on environment protection, Law no. 289/2002 on protection forestry belts. Law no. 46/2008. (Forestry Code).

Within this context, within *ADER 16.3.1.project "Researches on influence of applying new conservative systems and technologies of agricultural mechanized works for fighting against draught effects, preserving soil fertility and quantitatively and qualitatively increasing the yield of main species of plants cultivated.,*. INMA Bucharest has designed, achieved and partially tested a functional model of such an equipment for establishing forestry belts that works in aggregate with wheeled tractors of 80…120 HP, for mechanically planting seedlings of forest trees aiming to establish forestry belts. (http://www.madr.ro/cercetare-inovare/ader-2015-2018/ader-16/204-ader-16-3-1.html)and control draught and desertification phenomena.

MATERIAL AND METHOD

The experimental researches were performed in different environment conditions with technical equipment for establishing forestry belts (fig. 2). It works in aggregate with wheeled tractors of 65…80 HP for mechanically planting seedlings of forest trees, aiming to establish agro-forestry belts designed to control drought and desertification.

Fig. 2 –Technical equipment for establishing agro-forestry belts

The technical equipment for establishing forestry belts comprises the following main sub-assemblies: frame,share, planting mechanism, compaction system, parking leg, operator seat, tracing device left/right, but also seedling boxes. The main technical characteristics of this equipment are shown in table 1.

Table 1

Main technical characteristics

Type	Carried behind the tractor
Share type	Prism-shaped construction with tapered angle
Type of ditch	Trapezium-shaped
Number of planting sections	1
Planting mechanism	Disc type with gripping arms and pincers for forestry seedlings of low size (50…70 cm)
Number of planting arms	3
Overall dimensions, mm - length - width -height	 2400 2600 1555
Mass, kg	840
Distance between two seedlings (along the line), cm	75. 100. 150
Ditch depth, cm	30
Speed in work. km/h	1
Speed in transport. km/h	7

The experimental researches in laboratory-field conditions aiming at finding the working qualitative and energetic indexes were performed on experimental plots of INMA Bucharest, SCDA Brăila and C.C.D.P.C.P.N. Dăbuleni during September-November 2016.

Before beginning the laboratory-field experiments the following verifications have been performed:

- appropriate coupling of equipment to tractor and assuring security against decoupling;
- horizontality of technical equipment in cross-sectional and longitudinal plan;
- tightening the screws, nuts and replacing the damaged ones.

Species of seedling planted:

Honey locust (fig. 3) is a tree similar to acacia, having thorny branches, small greenish flowers and husk fruits, being cultivated for protection belts.

Fig. 3 – Honey locust- seedling species planted

The working qualitative indexes determined were:

- distance between seedlings in row, in cm was determined by a tape measure by measuring the distance from one seedling to another. Measurements were performed in three points, at a forward speed of first step of aggregate made of agricultural wheeled tractor of 65 HP and technical equipment for establishing agro-forestry belts and for planting mechanism with three arms. Based on these, the average distance between the seedlings in row, was calculated;

- coefficient of variation (c_v) of distance between seedlings in row (*d*) has been calculated as the ratio between standard deviation – *S and* average distance between seedlings in row– d_m;

Average distance between seedlings in row is given by the relation (1):

$$d_m = \frac{\sum_{i=1}^{n} d_i}{n}, cm \tag{1}$$

Standard deviation is given by the relation (2):

$$S = \sqrt{\frac{\sum_{i=1}^{n}(d_m - d_i)^2}{n-1}}, cm \tag{2}$$

Variation coefficient is given by the relation (3):

$$c_v = \frac{S}{d_m} \times 100, \% \tag{3}$$

- seedlings planting depth was determined by measuring with a furrow measuring device the distance from the level of soil resulted after planting till the furrow's bottom. Measurements were performed in 5 points, at a running speed of first step of aggregate made of agricultural wheeled tractor of 65 HP and technical equipment, for establishing agro-forestry belts and for planting mechanism with three arms. Based on these, the average depth of the seedlings planting was calculated;

- coefficient of variation (c_v) of planting depth (a) has been calculated as the ratio between standard deviation – *S and* average planting depth – a_m;

Average depth was calculated with relation (4):

$$a_m = \frac{\sum_{i=1}^{n} a_i}{n}, cm \tag{4}$$

Standard deviation is given by the relation (5):

$$S = \sqrt{\frac{\sum_{i=1}^{n}(a_m - a_i)^2}{n-1}}, cm \tag{5}$$

Variation coefficient is given by the relation (6):

$$c_v = \frac{S}{a_m} \times 100, \% \tag{6}$$

- force of extracting the seedlings after planting, in N, was measured by dynamometer. Measurements were made in 5 points. Based on them, the average force of extracting the seedlings after plantation, was calculated (relation7)*;*

$$F_m = \frac{\sum_{i=1}^{n} F_i}{n}, N \tag{7}$$

Energetic indexes determined were:

- Real working speed V_e. in km/h was calculated as the ratio between the space covered between two stakes and time measured between the first stake that marks the beginning of timing and the second stake marking the end of timing;

- Traction force F_t. in kN. was determined with a device with tensometric transducers made of a system of data amplifying and acquisition of MGCplus type with16 channels of analog input and 16 channels of digital output and amplifying module ML455 HBM. In order to register the data directly on a computer Toshiba, a software CATMAN specialized in data acquisition and processing was used. The supplying source for MGCplus system was a battery with lead accumulators with de 12 V voltage. Soft CATMAN specialized in data acquisition and processing enabled to filter the signals received from transducers and determine their minimum and maximum values.. Signals registered and saved in computer within the files of ASCII type were processed and displayed by the data acquisition system, as graphics made in compliance with time (oscillograms). Oscillograms obtained were processed for finding the average values of traction forces for steady working regimes (by eliminating the transitory regimes from the beginning and the end of the tests);

- The theoretical capacity of work W_{ef}.in ha/h was calculated with relation (8) as for the distance between the seedling rows of 1.5 m (Caba et al. 2013):

$$W_{ef} = 0{,}1 \times B_l \times V_e \text{ . ha/h.} \tag{8}$$

where B_l is the working width of equipment, in m. and V_e – the actual working speed in km/h.

RESULTS

In table 2 are shown the results obtained in the three experimental plots regarding the average distance between the seedlings in row, the standard deviation and variation coefficient of distance between seedlings in row.

Table 2

Qualitative working indexes found by measuring the distance between seedlings in row

	Experimental plot INMA	Experimental plot C.C.D.P.C.P.N. Dăbuleni	Experimental plot SCDA Brăila
Average distance between seedlings in row d_m. cm	1296	1292	1302
Standard deviation S. cm	38.64	16.64	66.91
Variation coefficient c_v. %	2.98	1.29	5.14

In table 3 are shown the results obtained in the three experimental plots regarding the average distance between the seedlings in row, the standard deviation and variation coefficient of distance between seedlings in row.

Table 3

Qualitative working indexes determined after measuring the planting depth

	Experimental plot INMA	Experimental plot C.C.D.P.C.P.N. Dăbuleni	Experimental plot SCDA Brăila
Average depth between seedlings in row a_m. cm	27.20	25.80	26.80
Standard deviation S. cm	1.66	1.52	2.39
Variation coefficient c_v. %	6.12	5.90	8.92

In table 4 are shown the results obtained in the three experimental plots regarding the force of extraction of seedlings after planting, standard deviation and variation coefficient of distance between seedlings in row.

Table 4

Qualitative working indexes determined after measuring the extraction force of seedlings after plantation

	Experimental plot INMA	Experimental plot C.C.D.P.C.P.N. Dăbuleni	Experimental plot SCDA Brăila
Average force of extraction seedlings after plantation F_m. N	31.2	31.4	55.0
Standard deviation S. cm	2.39	1.75	4.80
Variation coefficient c_v. %	7.67	5.59	8.72

In figure 4 are presented certain aspects during the field test of technical equipment designed to establish agro-forestry belts in experimental plots of INMA Bucharest, C.C.D.P.C.P.N. Dăbuleni and SCDA Brăila.

a. b.

c.

Fig. 4 – Aspects during the test of technical equipment designed to establish agro-forestry belts
a. experimental plot INMA; **b.** experimental plot C.C.D.P.C.P.N. Dăbuleni; **c.** experimental plot SCDA Brăila

After the experiments performed in laboratory conditions with the equipment according to standards in force. it has found that the qualitative working indexes frame within the agro-technical requirements necessary to forestry seedlings plantation (coefficients of variation are below 10%). and the best qualitative indexes have been obtained in the experimental plot C.C.D.P.C.P.N. Dăbuleni. in a sandy land.

In figure 5 is presented the graphic of time variation of traction force determined by means of the device with tensometric transducers for the aggregate made of the equipment for establishing agro-forestry belts and wheeled tractor of 80 HP. in field. on experimental plot INMA Bucharest. The minimum value of traction force was 11.56 kN. and maximum value of -16.93 kN. and actual working speed was of 1.02 km/h.

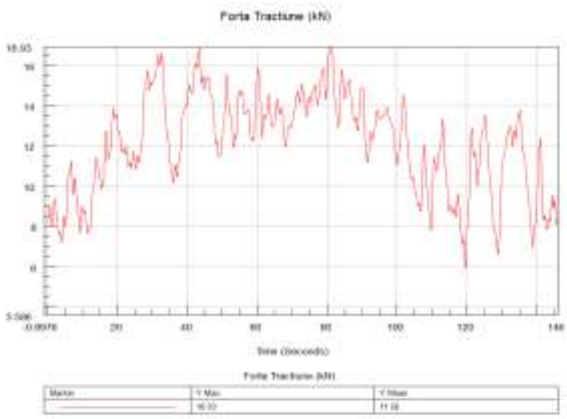

Fig. 5 – Variation in time of traction force for the aggregate made of technical equipment for establishing agro-forestry belts and wheeled tractor of 80 HP determined in experimental plot of INMA Bucharest

In figure 6 is shown the graphic of time variation of traction force determined by means of the device with tensometric transducers for the aggregate made of the equipment for establishing agro-forestry belts and wheeled tractor of 65 HP. in field. on experimental plot SCDA Brăila. The minimum value of traction force was of 17.59 kN. the maximum value of 34.01 kN. and actual working speed was of 0.94 km/h.

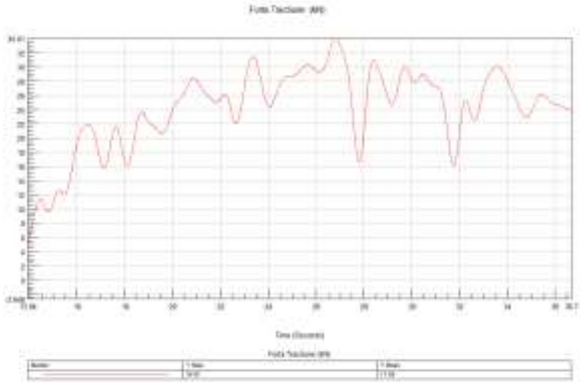

Fig. 6 -– Variation in time of traction force for the aggregate made of technical equipment for establishing agro-forestry belts and wheeled tractor of 65 HP determined in experimental plot of SCDA Brăila

In figure 67 is shown the graphic of time variation of traction force determined by means of the device with tensometric transducers for the aggregate made of the equipment for establishing agro-forestry belts and wheeled tractor of 65 HP, in field, on experimental plot of C.C.D.P.C.P.N. Dăbuleni. Minimum value of traction force was of 7.07 kN, the maximum value- 14.3 kN and actual working speed was of 1.26 km/h.

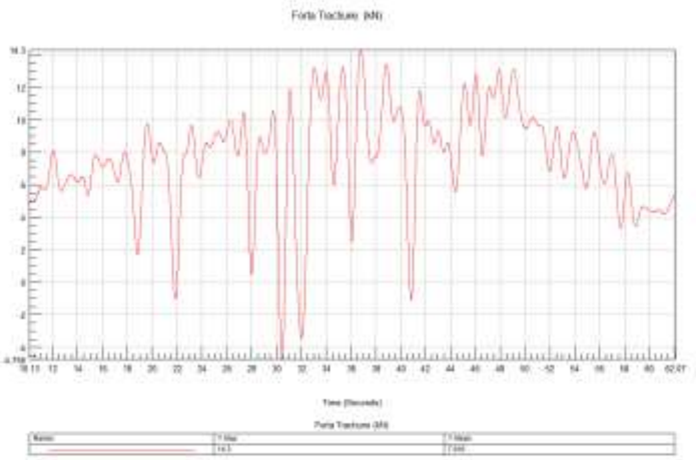

Fig. 7 - Variation in time of traction force for the aggregate made of technical equipment for establishing agro-forestry belts and wheeled tractor of 65 HP determined in experimental plot of C.C.D.P.C.P.N. Dăbuleni

After analyzing the graphics above, it was noticed that aggregate made of the equipment for establishing agro-forestry belts and wheeled tractor of 65 HP has obtained the biggest traction force of 4.01 kN in experimental plot of SCDA Brăila and the smallest traction force of 7.07 kN in experimental plot of C.C.D.P.C.P.N. Dăbuleni, because of the type of soil at SCDA Brăila, namely a saline soil, and in case of C.C.D.P.C.P.N. Dăbuleni, a sandy soil.

The energetic indexes obtained after testing the technical equipment in the three experimental plots are given in table 5.

Table 5

Energetic indexes obtained in the three experimental plots

Determined parameters	Value		
	Experimental plot INMA	Experimental plot C.C.D.P.C.P.N. Dăbuleni	Experimental plot SCDA Brăila
Running speed, km/h	1.02	0.94	1.26
Theoretical working capacity W_{ef}, ha/h	0.153	0.141	0.189

The energetic indexes obtained during the tests with equipment for establishing agro-forestry belts have framed within the agro-technical requirements appropriate to each relevant operation.

CONCLUSIONS

- Experimental researches aiming to determine the qualitative working indexes and energetic indexes in different soil and climate conditions have enabled to technically capitalize the solutions tackled when designing the components of technical equipment for establishing agro-forestry belts;
- The experimental results allowed to drawn up useful recommendations for farmers that apply the technology of establishing agro-forestry belts for improving the conditions of vegetation environment of agricultural crops.

ACKNOWLEDGEMENT

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METHODS OF BIOGAS PURIFICATION – A REVIEW
/
METODE DE PURIFICARE A BIOGAZULUI – REVIEW

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Keywords: *biogas,purification,methane.*

ABSTRACT

Biogas is a product of anaerobic ferment of organic products (Bejan M. et al., 2007). Among the fuels from vegetal biomass, biogas has a great importance and can successfully replace fossil fuels for obtaining electricity and heat; the use of biogas exists for a few years also in the field of transport. Biogas formed in the methane fermentation process contains about 50÷60% of methane. Other ingredients such as carbon dioxide, hydrogen sulfide,. water, water vapour and small amounts of nitrogen and oxygen are compounds that lower the energy value of biogas (Krischan J. et al.,2011) In this paper are presented the main methods of biogas purification.

REZUMAT

Biogazul este un produs al fermentării anaerobe a produselor organice. Dintre combustibilii din biomasa vegetală. biogazul are o importanță deosebită și poate înlocui cu succes combustibilii fosili pentru obținerea energiei electrice și a căldurii; utilizarea biogazului există de câțiva ani și în domeniul transporturilor. Biogazul format în procesul de fermentare cu metan conține aproximativ 50 ÷ 60% din metan. Alte ingrediente. cum ar fi bioxidul de carbon. hidrogenul sulfurat, apa, vaporii de apă și cantități mici de azot și oxigenul sunt compușii care scad valoarea energetica a biogazului. În această lucrare sunt prezentate principalele metode de purificare ale biogazului.

INTRODUCTION

A major concern for most people these days is the use and availability of energy. People spend a large portion of their earnings on gas, propane and oil. These fossil fuels are being continuously used to a large extent. Because these forms of energy are non-renewable, their availability will continue to decrease and costs will continue to go up. This has led to a search for new energy sources. One excellent source of energy is *biogas*.

Biogas originates from bacteria in the process of bio-degradation of organic material under anaerobic (without air) conditions. The natural generation of biogas is an important part of the biogeochemical carbon cycle. Methanogens (methane producing bacteria) are the last link in a chain of micro-organisms which degrade organic material and return the decomposition products to the environment. In this process biogas is generated, a source of renewable energy.

Biogas is a mixture of gases that is composed chiefly of:
- *methane* (CH_4): 40-70 vol.%
- *carbon dioxide* (CO_2): 30-60 vol.%
- *other gases*: 1-5 vol.% including
- hydrogen (H_2): 0-1 vol.%
- hydrogen sulfide (H_2S): 0-3 vol.%

Like those of any pure gas. the characteristic properties of biogas are pressure and temperature-dependent. They are also affected by the moisture content. The factors of main interest are:
- change in volume as a function of temperature and pressure.
- change in calorific value as a function of temperature, pressure and water-vapor content and
- change in water-vapor content as a function of temperature and pressure

The calorific value of biogas is about 6 kWh/m^3 - this corresponds to about half a litre of diesel oil. The net calorific value depends on the efficiency of the burners or appliances. Methane is the valuable component under the aspect of using biogas as a fuel (*Thomas H. et al.. Biogas Digest Volume II Biogas - Application and Product Development).*

Biogas offers a diversity of options for use. e. g. the decentralised production of electricity and heat, the distribution via heat networks, the feed-in of upgraded biogas into the natural gas grid and its follwing use as a natural gas substitute for energy, as fuel or in the chemical industry – figure 1. Independently of the use selected, the objective is to make the energy utilisation as efficient as possible.

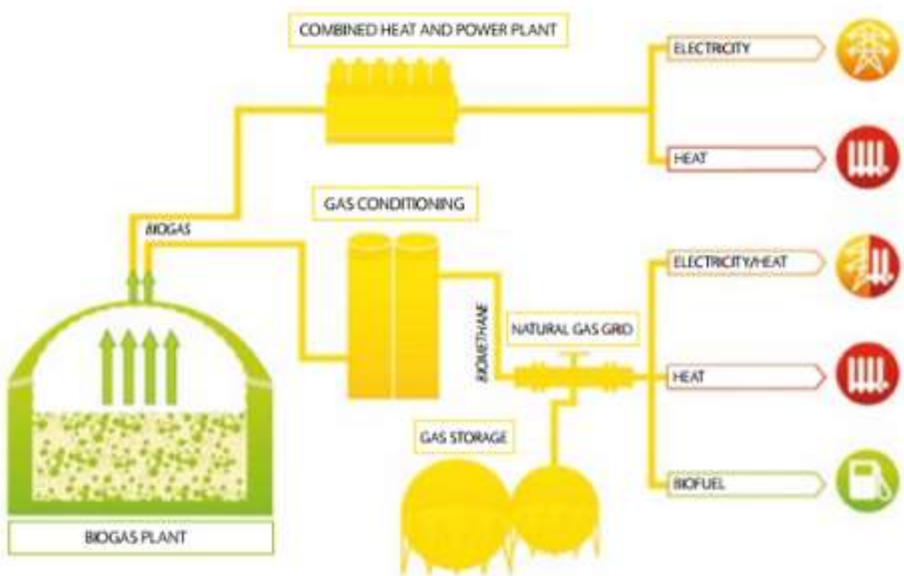

Fig.1 - Various options for using biogas

MATERIAL AND METHOD

Biogas is a product of anaerobic fermentation of organic products. Of the biomass fuel, biogas is of particular importance and can successfully replace fossil fuels for electricity and heat. In order to obtain biogas in a productive and profitable way, it must be processed before use. Thus, prior to use, raw biogas is subjected to conditioning (purification) operations, resulting in the properties required by users.

Biogas purification is the operation of retention of unwanted biogas components before it is used in the combustion process. Whatever the ultimate way of using biogas, it is impossible to use it in the raw state. The only recyclable component is methane. To enable the use of biogas by cogeneration, the substances to be eliminated are: water, organohalogen, carbon dioxide and sulfur *(Ioan B. and Minciuc E., 2003).*

The most important reasons for improving the quality of biogas include the need to meet the requirements of the installations in which it is used (engines, boilers, fuel cells, etc.). increasing its calorific value but also for standardizing the quality *(*Krzysztof B. *et al..2011).*

There are small amounts of biogas present in certain compounds that due to their oxidising or incombustible properties have to be eliminated to favor a good combustion process. During the conditioning process, these compounds that inhibit the combustion process are reduced in quantity or totally eliminated, depending on the final use of biogas.

Figure 2 shows the most commonly used methods of biogas conditioning: pressure adsorption, biogas purification with water under pressure, physical and chemical absorption, membrane separation and cryogenic separation. These methods largely involve the removal of hydrogen sulfide, carbon dioxide and water vapor.

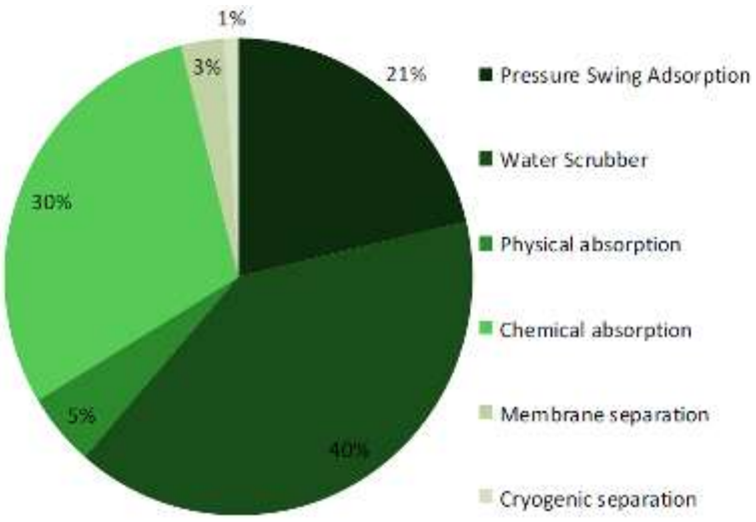

Fig. 2 - Methods of biogas conditioning

Biogas can be used as a substitute for household and industrial gas or can be used as a renewable and sustainable energy source to produce heat or electricity in co-generation units (CHP) ((*Krischan J. et al.,2011)*.

Table 1 highlights biogas components that are removed depending on how they are used.

Table 1

Removal of biogas components according to its final use

Use	H_2S	CO_2	H_2O
Gas station (boiler)	< 1000 ppm	No removal required	No removal required
Stove	Removal required	No removal required	Removal required
Cogeneration of heat and electricity	< 1000 ppm	No removal required	Removal required
Fuel for cars	Removal required	Removal required	Removal required
Fuel for the gas network	Removal required	Removal required	Removal required

The method of conditioning the raw biogas must be determined from the construction of the biogas plant for the fact that it may require some specific details in the construction of the plant.

RESULTS

Raw biogas needs to be cleaned to remove toxic and harmful constituents (e.g.. hydrogen sulfide, ammonia, VOCs. Halides, moisture, siloxanes, particulates, AB 1900 COCs, etc.) to meet regulatory and technical standards. The principle of cleaning techniques used currently include adsorption, biofiltration, water scrubbing (an absorption process) and refrigeration.

Biofiltration

Biofiltration relies upon the natural biological metabolism of sulfur-oxidizing bacteria species to convert hydrogen sulfide into elemental sulfur or sulfate. These systems are designed to ensure a high-density microbial community and maximize contact between the microorganisms and the feed gas *(Y. Zhu, 2001).*

A biological filter combines water scrubbing and biological desulfurization. As with water scrubbing, the biogas and the separated digestate meet in a counter-current flow in a filter bed. The biogas is mixed with 4% to 6% air before entry into the filter bed.

Biofiltration systems can be set up in three different configurations: bioscrubber, biofilter, and biotrickling filter (Figure 3).

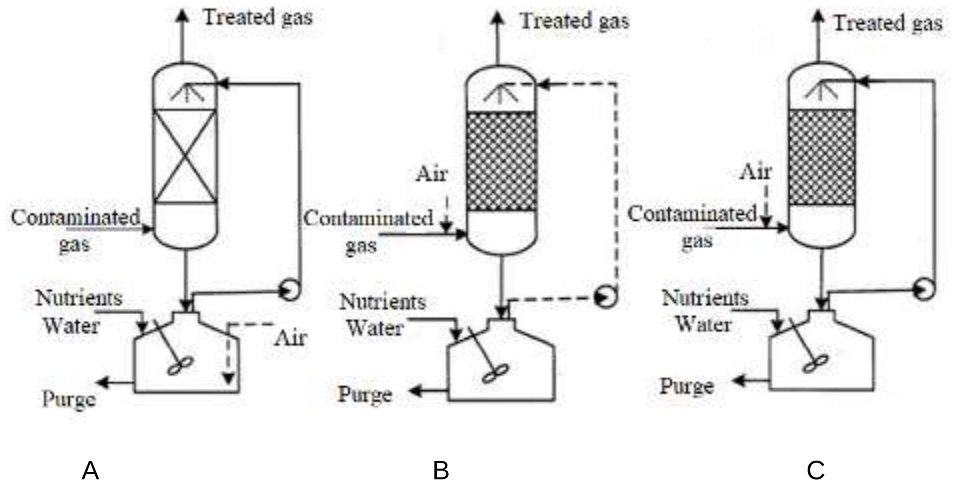

Fig. 3 - Biofiltration Process Schematic

A) Bioscrubber. B) Biofilter. C) Biotrickling Filter

In a bioscrubber, pollutants are absorbed into liquid flowing counter-currently through an absorption column, similar to a water scrubber. The liquid is then sent to a bioreactor for microbes to degrade the contaminants.

A biofilter consists of a packed bed of organic material that stimulates biofilm growth through which humidified biogas is pumped. Contaminants in the biogas contact absorb and adsorb into the biofilm and interact with the microbes.

Biofiltration systems are effective for treating low and high H_2S concentrations from 50-100 ppm to 2000-4000 ppm, resulting in a H_2S removal of 89-99.9% at a rate of 20-125 g H_2S / m3 / h. Most bacteria grow and function optimally at a temperature of about 35 ° C and a neutral pH.

Adsorption

Adsorption is the adhesion of compounds onto a solid surface. When biogas is flushed through an adsorbent bed, contaminant molecules will bind to the adsorbent's surface, removing the contaminants from the gas stream. Effective adsorbents are generally highly porous with high surface area which greatly increases their removal capacity.

Pressure swing adsorption (PSA) is a method for the separation of carbon dioxide from methane by adsorption/desorption of carbon dioxide on zeolites or activated carbon at alternating pressure levels. Commonly used adsorbents are zeolite, carbon molecular sieve, silicagel and activated carbon, due to their low cost, large specific area and pore volume and excellent thermal stability (*Siriwardane RV. Et al., 2003).* These adsorbents are designed to have a specific pore size thus enabling selective adsorption of molecules that are smaller than the designed pore size. Figure 4 shows a four-vessel swing adsorption adsorption system using carbon molecular sieves that circulate between absorption and regeneration *(Zhao Q. ei al.. 2010).*

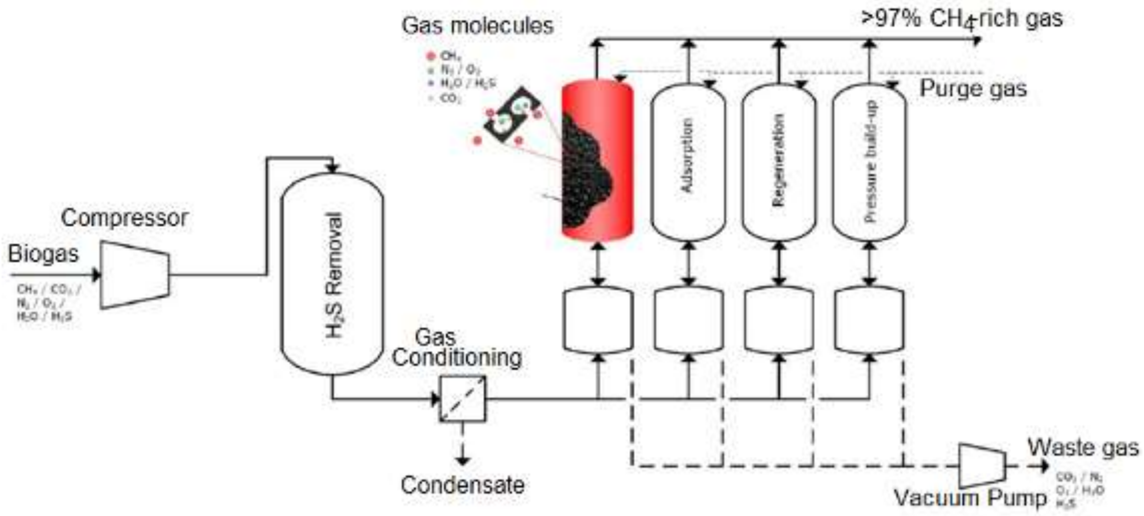

Fig. 4 - Pressure Swing Adsorption Process Diagram

The adsorbent must be replaced once it is filled or can be regenerated a limited number of times. This contributes to operational cost.

Pressurized Water Scrubbing

Purification of biogas by pressure water is one of the most widely used biogas treatment methods. Pollutant compounds can be physically adsorbed (or dissolved) in a liquid solution.

A schematic diagram of this method is shown in figure 5. To enhance the absorption of CO_2 and H_2S, biogas is usually compressed to 900–1200k Pa and a high surface area packing media is used.Inside the scrubber,biogas flows counter- currently to water that is sprayed from the top of scrubber and the absorption primarily occurs on the surface of the packing media. The raw biogas is introduced at the bottom of the column and flows upward, while fresh water is introduced at the top of the column, flowing downward over a packed bed. The packed bed (typically a high-surface-area plastic media) allows for efficient contact between the water and gas phases in a countercurrent absorption regime.

It is important that the H_2S be removed prior to the removal of the CO_2. as H_2S is highly corrosive and would result in decreased life and higher maintenance of the subsequent compressors required in the CO_2-removal step. Cleaned biogas can contain > 96% CH_4 after drying (*Liangcheng Y. et al., 2014*).

The disadvantage of water scrubbing is that it is less efficient than other processes, both in terms of CH_4 loss and energy. However, some of the energy inefficiency of the process may be offset by the use of a single-pass water scrubbing system, since other processes require a regeneration stage. Water scrubbing is the most applicable CO_2 scrubbing process for use in an agricultural setting because of its simplicity, low cost and low toxicity.

Another advantage of water scrubbing over some other processes is that water is fairly easy to dispose of whereas the chemicals used in some of the other processes may require special handling and disposal when spent.

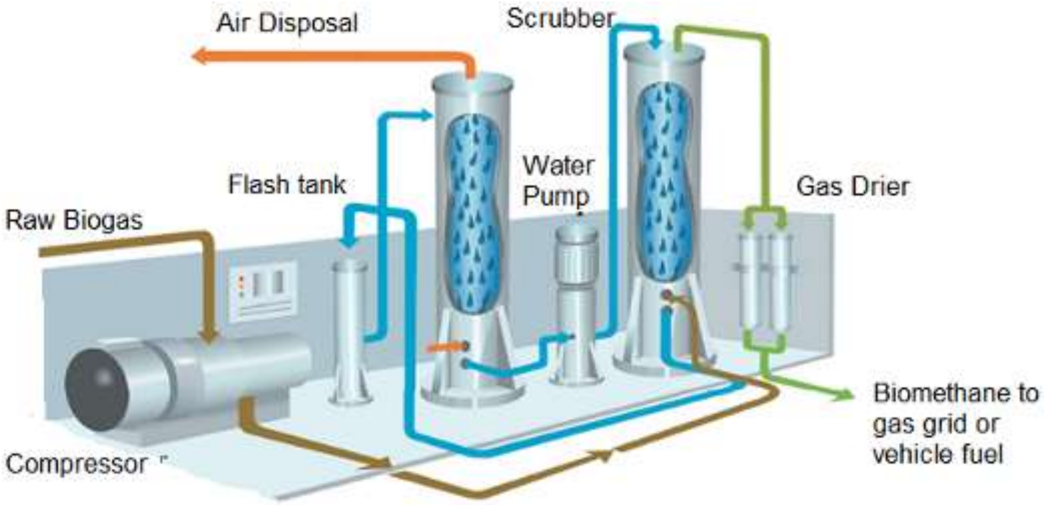

Fig. 5 - The process of purifying biogas in a pressurized water system

Refrigeration/Chilling

Refrigeration, or gas cooling.provides a simple means for removing moisture from biogas. When the gas is cooled (typically to between -18 – 2 °C), water vapor condenses on the cooling coils and can be captured in a trap. Some ammonia will also be removed given the high solubility of ammonia in water. Insignificant trace amounts of other compounds may also be absorbed into the water. At lower temperatures of < -73 °C. VOCs will condense and can be removed too. At -70 °C. 99% removal of siloxane can be achieved as well, but it is costly to operate at such low temperatures.

H_2S should be removed prior to refrigeration to significantly lengthen the life of the refrigeration unit.

Raw biogas contains a variety of compounds aside from methane. These include hydrogen sulfide (H2S), oxygen (O2), nitrogen (N2), volatile organic compounds (VOCs), siloxanes and moisture (H2O). To remove these contaminants, adsorption, water scrubbing, biofiltration and/or refrigeration processes are employed *(Matthew D. et al.. 2014*).

Next, a comparison is made between three methods of eliminating undesirable compounds from the biogas composition. Each of these technologies is able to treat different contaminants in different degrees (Table 2).

Tabel 2

Contaminants removed by different biogas cleaning technologies

Biogas Cleaning Process	*H_2S*	*O_2*	*N_2*	*VOCs*	*NH_3*	*Siloxanes*	*H_2O*
Adsorption	**	/	-	**	*	**	**
Water Scrubbing	**	--	--	**	**	**	--
Biofiltration	**	--	--	**	/	/	--
Refrigeration	/	-	-	/	**	*	**

Legend: ****** High removal (intended) ***** High removal (pre-removal by other cleaning technology preferred) **/** Partial removal **-** Does not remove **--** Contaminant added **R** Must be pretreated

CONCLUSION

Biogas is a product of anaerobic ferment of organic products. Among the fuels from vegetal biomass, biogas has a great importance and can successfully replace fossil fuels for obtaining electricity and heat; the use of biogas exists for a few years also in the field of transport. Biogas formed in the methane fermentation process contains about 50÷60% of methane. Other ingredients such as carbon dioxide, hydrogen sulfide, water, water vapour and small amounts of nitrogen and oxygen are compounds that lower the energy value of biogas.

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Raw biogas needs to be cleaned to remove toxic and harmful constituents (e.g.. hydrogen sulfide, ammonia, VOCs, halides, moisture, siloxane, particulates,. etc.) to meet regulatory and technical standards.

The principle cleaning techniques used currently include adsorption, biofiltration, water scrubbing (an absorption process) and refrigeration.

The method of conditioning the raw biogas must be determined from the construction of the biogas plant for the fact that it may require some specific details in the construction of the plant.

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CONVENTIONAL AND NEW BIOLOGICAL METHODS IN THE ASSESSMENT OF MICROBIAL POPULATIONS IN BIOGAS PRODUCING – A REVIEW
/
METODE TRADITIONALE SI NOI PENTRU EVALUAREA POPULATIILOR MICROBIENE IN PRODUCEREA DE BIOGAZ - REVIEW

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Keywords: *methods, microbial populations, biogas.*

ABSTRACT

The current status in monitoring and control of anaerobic biogas reactor is reviewed in this paper, considering that the AD process is dynamic and requires regular supervision. The monitoring of biogas producing is an important part of anaerobic fermentation process because this makes it possible to detect problems before the process deteriorates. The microorganisms involved in biogas synthesis are extremely sensitive to substrate composition and growth conditions. In order to best understand and explain the metabolism and behavior of microbial populations which produce anaerobic fermentation and methane synthesis, the cultural-based molecular biology and genetic techniques are described.

REZUMAT

Lucrarea prezinta situatia actuala in monitorizarea si controlul reactoarelor anaerobe de biogaz. avand in vedere ca procesul DA este dinamic si necesita o supraveghere continua. Monitorizarea productiei de biogaz este o componenta importanta a procesului de fermentatie anaeroba deoarece face posibila detectarea problemelor aparute inainte ca procesul sa se deterioreze. Microorganismele implicate in sinteza de biogaz sunt foarte sensibile la compozitia substratului si conditiile de mediu. Pentru a intelege si a explica metabolismul si comportamentul populatiilor microbiene care produc fermentatia anaeroba si sinteza de metan sunt prezentate cateva metode culturale. de biologie moleculara si genetica.

INTRODUCTION

Due to the environmental problems caused by solid waste generation, during the last decades solid waste management has become a major concern around the world. Biogas production by anaerobic digestion represents a recognized as an efficient technology for treatment of different types of waste, offering many environmental and economic benefits, such as renewable energy production, nutrient recycling, reducing of organic waste.

Efficient production of biogas relies on a multiphase and complex microbiological process. Specific microbial populations accomplish various biochemical reactions in the characteristic stages of methane biosynthesis, namely hydrolysis, acidogenesis, acetogenesis and methanogenesis. All these microbial strains are dependent on the composition and concentration of nutrients, toxic compounds and physical parameters in the reactor. To ensure maximum yield by controlling the biogas process in an efficient manner it requires multidisciplinary knowledge on microbial metabolism and growth.

Methanogens differ from the other organisms in the biogas process, because they are not common bacteria. Instead, methanogens are part of a group of organisms called *Archaea*. The *Archaea* are a separate group of organisms that have evolved in parallel with the bacteria (prokaryotes) and fungi (eukaryotes). The fact that methanogens do not resemble other organisms also means that they are not as robust as many other microbes in the process. The methanogens are often the first to be affected by various disturbances such as pH changes or the presence of toxic compounds such as heavy metals or organic pollutants. Because these organisms are also of great importance to the function of anaerobic oxidation, inhibition/disruption of methanogens can seriously affect the entire process (Schnurer et al., 2010).

Numerous methods have been developed over the past 30 years, since Van den Berg et al. (1974) measured methanogenic activity. by using a manometric device equipped with a photoelectric sensor to quantify the gas production. Both the growth and the metabolic activity of methanogenic bacteria represent the rate limiting factor in the biogas process. Their activity is correlated with the measurement of gas flowrate or other manometric and volumetric methods that monitor the production of methane (Rozzi, 2004).

Operation of stable and efficient anaerobic digestion (AD) processes mostly calls for monitoring control protocols. The monitoring is needed to observe microbial imbalances in the system. When problems occur, the monitoring allows the prediction and prevention of process disturbances.

In general, the main parameters in monitoring purposes of AD are the number and composition of microbial populations, pH, partial and total alkalinity, volatile fatty acids (VFA; both total concentration and individual species) as well as ammonium levels, TS (total solids)/VS (volatile solids), TOC (total organic carbon) or BOD (biochemical oxygen demand) and COD (chemical oxygen demand). Some of these parameters should ideally reflect the status of methanogenic system and show early shifts in microbial activity representing warning signals for any increased or decreased concentrations of key substances (Karlsson et al., 2014).

The sampling procedure at the site is very important. Independent of the monitoring system used, representative sampling must be assured. Samples should be taken from the storage tank, reactor and the storage post-treatment tank. The microbiological process can be examined in several places and appropriate sampling locations can be within the process (for example, at the inlets and outlets of the digester), from the substrate or sanitation tanks and from the post-digestion container. It is important that the sample be as representative as possible and that it be taken in the same way every time. The time intervals should be correlated with the importance of monitored parameter and with the rate of each biochemical transformation. It is usually better to sample at the time of mixing and pumping of the material, since otherwise there is a risk that the material is stratified and not sufficiently mixed if the sample is taken from an unstirred process. If some problems in microbial growth are suspected, the intervals of sampling should be as short as possible (Schnurer et al., 2010).

The parameters can be measured directly (e.g. as a level of VFAs or ammonia) or indirectly via microwave- or near infrared (NIR)-spectra. The indirect measuring methods demand extensive calibration/reference measurements and, in some cases, the validation of the method. For particular applications as the kinetic study of rate limiting microbial steps, specific reference procedures should be established (Karlsson et al. 2014; Rozzi. 2004).

At the present, there are some difficulties regarding the resistance of monitoring sensors to process conditions. The corrosive environment constitutes a large problem, the complex and shifting matrix is likely another and fouling of sensors is often a problem. Nowadays, there is a lack of commercial on-line methods for biogas monitoring and there seems to be a low interest from the suppliers of equipment (Karlsson et al., 2014).

This study was carried out in order to evaluate the main biological methods used for analysis of microbial communities in biogas production process.

MATERIAL AND METHOD

A variety of biological and biochemical methods can be used for monitoring the biogas production process in samples taken from the substrate tank, the reactor and the storage tank. Based on cultural, genetical or molecular techniques, the most important methods are the following: traditional cultural-dependent methods, screening and quantitative analytical methods, genetic and molecular methods – PCR. FISH, DGGE, MALDI-TOF and others.

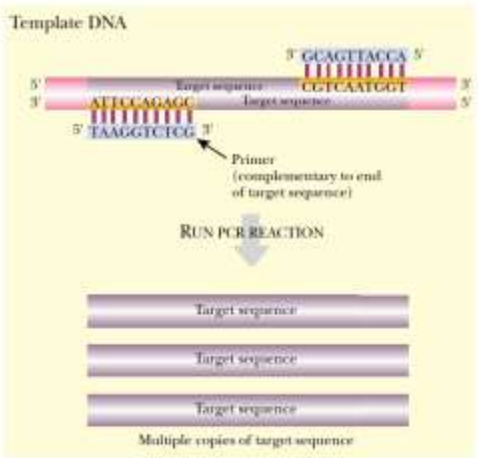
Different bacterial strains involved in the four stages of anaerobic digestion (hydrolysis, acidogenesis, acetogenesis and methanogenesis) can be counted and characterized in order to detect all the problems in the system. The genomic, proteomic and metabolomic techniques may be used to improve the biogas yield and the productivity of anaerobic digestion system.

RESULTS

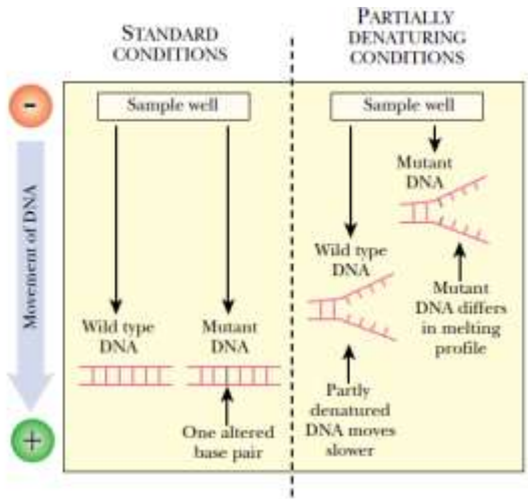
The majority of microorganisms in the anaerobic digestion process have not yet been cultivated and it is estimated that 5% or less of the microbial diversity in the biosphere is cultivable using standard cultivation techniques. Consequently, understanding of the microbial ecology and physiology associated with AD is most likely incomplete and biased. There are many factors that co-exist in this complex environment and affect microbial activity which cannot be studied when using culture-based methods. Moreover, functions related to competition and interaction between microorganisms are difficult to determine when using isolated microorganisms. Based on available genomic data, a variety of molecular methods have been invented and developed for use in further investigating the microbial community structures within AD processes.

Molecular biology techniques provide valuable tools for improved understanding of microbial communities and their function in connection with different aspects of AD, which in turn may help optimize the biogas production process more efficiently. A broad range of studies was published recently on investigations on microbial community structures in biogas reactors. The methodologies applied included analysis of total bacteria and archaeal community by targeting 16S rRNA using next generation sequencing (NGS) technique or terminal restriction fragment length polymorphism (T-RFLP); as well as detection and quantification of methanogenic *Archaea* by quantitative real time polymerase chain reaction (qPCR). qPCR is a commonly used method in microbial community studies to detect and quantify a targeted DNA sequence (Horváth et al., 2016; Govasmark et al., 2011).

The principle of qPCR (fig. 1) is very similar to that of conventional PCR. The target gene is amplified over a number of cycles. However, the conventional PCR allows only end point detection, whereas using a fluorescent dye or probe, the concentration of the target gene can be monitored after each cycle in qPCR. The detected change in fluorescence intensity reflects the concentration of the amplified gene in real time (Clark. 2005).



a)



b)

Fig. 1 – a) The Polymerase Chain Reaction (PCR); b) DGGE technique (Clark. 2005)

During PCR, two primers anneal to complementary sequences at either end of a target sequence on a piece of denaturate template DNA, DNA polymerase synthesizes ;DNA elongates the primers and makes two new strands of DNA, thus duplicating the original target sequence. In further cycles, the newly made DNA molecules are denaturated in turn and duplicated by the same sequence of events, resulting in multiple copies of the original target sequence (Clark. 2005).

Similarly, the denaturing gradient gel electrophoresis (DGGE) technique (Fig.1 b) is still among the promising methods to perform a preliminary analysis of the microbial community profile and to monitor the various experimental stages during the biogas production process (Sousa et al., 2007). The samples can be analyzed by 16S rRNA gene (*rrs*) sequence analysis combined with PCR-DGGE.

The traditional molecular biology technologies help with identifying only the most abundant microbial populations present in the reactor. Due to their high sequencing depth, the newly developed sequencing techniques make the determination of both the most abundant and also the minor populations possible. The NGS-based metagenomic approach enables following up changes in the microbial community structure starting from the very initial stage to souring of the digester. The mapping of different microbial communities and the study of their metabolic profile can be studied with the 454 pyrosequencing and NGS methods which work faster than the traditional genomic methods. In 2005, 454 Life Science launched the first next-generation DNA sequencer namely 454 pyrosequencing method.

Another method, the Ion Torrent PGM (Personal Genome Machine) technique, which was launched in 2011, provided the highest throughput compared with that of 454 NGS and it was recently used for microbial composition analysis. Investigations on the microbial community in full scale anaerobic digestion plants using 16S rRNA gene sequences showed that the bacterial community was always more abundant and more diverse than the archaeal community in all reactors.

A very used method is FISH (Fluorescence in Situ Hibridization) (Fig. 2) which allows the identification of bacteria using the DNA hybridization based on complementarity of chains. The FISH method has the following principle: a cell with intact DNA in its nucleus is treated to denature DNA, forming single-stranded regions. The fluorescently labeled DNA probe is added and the single-stranded probe can anneal with the corresponding sequence inside the nucleus. The hibrid molecule will fluoresce when the light from a fluorescence microscope excites the tag on the probe. This technique can localize the gene of interest to different areas of the nucleus or to individual chromosomes (Clark. 2005).

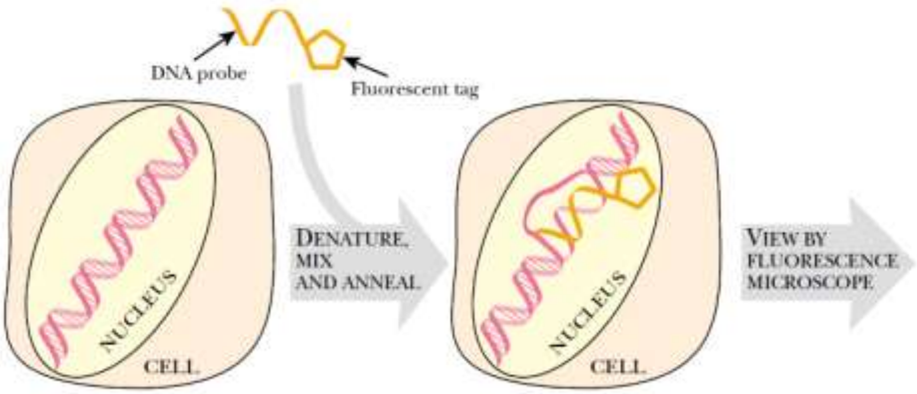


Fig.2 - Fluorescence in Situ Hibridization – principle of method (Clark. 2005)

Moreover, the high-throughput Illumina Miseq approach is also widely considered as a promising culture-independent method to perform microbial community analysis of AD systems. By the application of this method, the specific syntrophic relationships between acetogens and methanogens could be better understood, especially in terms of how it can be related to disturbances occurring in the biogas production process. Anaerobic digesters treating lipid-extracted microalgae residue at various inoculum-to-substrate ratios were investigated using Illumina Miseq analysis. Differences in the phylum distribution of the bacterial community were detected in accordance with the changes in inoculum to substrate ratios (Horvath et al., 2016).

Another method nowadays is MALDI/TOF mass spectrometry (Fig. 3), that allows the identification of bacterial species based on the spectrometric determination of molecular weight of specific cellular proteins. The proteins are cristallized in a solid matrix and exposed to a laser, which releases ions from proteins. These travel along a vacuum tube, passing through a charged grid, which helps separate the ions by size and charge. The time it takes for ions to reach the detector is proportional to the square root of their mass to charge ratio (m/z). The molecular weight of the protein can be determined from this data. Each complex of proteins is specific to a bacterial species (Clark. 2005).

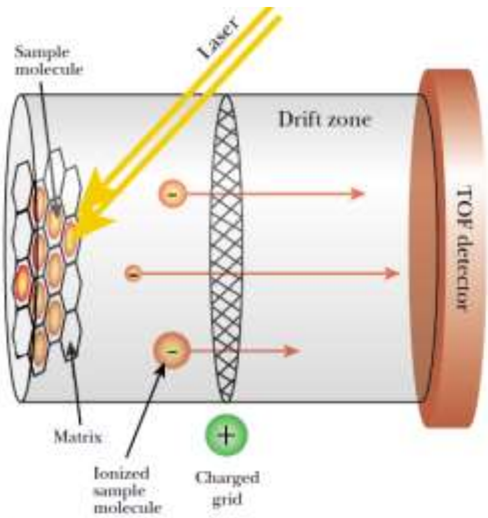


Fig. 3 - MALDI/TOF Mass Spectrometer (Clark. 2005)

Traditional culture-dependent methods

Traditional methods are cultural-dependent methods which include enrichment, selection, isolation and cultivation of microorganisms in pure culture. These are labour- and time-consuming work, but represent a fundamental and essential step in studying the morphology, physiology and genetics of specific microorganisms. Cultivation of microorganisms makes the development of molecular tools feasible, based on genomic information.

The cultivation of microbial populations involved in anaerobic digestion requires special equipment and techniques to provide an anaerobic environment. Specific nutrients and parameters required by microorganisms that accomplish the anaerobic fermentation should be known and used.

Isolation of bacteria

For isolating bacterial species, the samples must be homogenized and diluted in order to obtain isolated colonies. The pour agar plate technique is the most used technique due to the easy with which it is performed. The poured nutrient agar plates are incubated usually at 37°C for 24 to 48 hours. After incubation, the colonies grown on the plates are selected for biochemical test and further analyzed through selective media. For example, the selective media used for isolation of *Enterobacterium* is Eosin Methylene Blue agar, for *Pseudomonas aeruginosa* - Cetrimide agar, for *Bacillus subtilis* Nutrient agar, for *Clostridium* Bryant-Burkey Broth Base or anoxic brain heart infusion (BHI) medium. Bacteria belonging to genera *Methanospirillum, Methanosarcina, Methanobrevibacter, Methanococcus* grow on complex media (Gopinath et al., 2014).

Bacteriological analysis

The bacterial species isolated from different waste substrates or from the fermentor can be detected by standard bacteriological identification procedures. Morphological characters examined include Gram staining, shape and motility and others. Biochemical tests can be performed by inoculating broth culture of the isolates into a series of media such as Triple Sugar Iron. Sugar fermentation (glucose, sucrose and lactose) media for calitative assessment of hydrolases (Gopinath et al., 2014).

Different Enzymatic Assay of Consortia

The first step of anaerobic digestion is represented by the hydrolysis of substrate macromolecular compounds performed by bacteria and fungi that produce specific enzymes able to break down the structure of vegetal material. The characteristic enzymes produced as primary metabolites in bacterial cells belong to hydrolases class: cellulases, amylases, proteases, lipases, pectinases. A high specific enzyme from oxidoreductases class is the laccase (enzyme that catalyzes the oxidation of a variety of phenolic compounds, diamines and aromatic amines). Laccase is able to degrade the structure of lignin, a major compound in plant material (Liu et al. 2017).

In general, the enzyme-producing microorganisms can be analyzed by quantitative screening methods that use culture media supplemented with a specific indicator for each enzyme: starch for amylases, casein or gelatin for proteases, cellulose for cellulases, tween for lipase, guaiacol for laccase.

Cellulase assay: Cellulase activity is assayed by incubating the enzyme extract with carboxy methyl cellulose (CMC), prepared in sodium phosphate buffer (pH 9.0) at 50°C for 30 min. Released reducing sugar is measured by dinitrosalicylic acid (DNS) method and the colored compound is measured spectrophotometrically. The enzyme activity is expressed as IU/ml.

Lipase assay: Lipase activity is assayed titrimetrically at pH 8.0 with a standard tributyrin as substrate. One unit of activity was defined as the amount of enzyme which liberated 1μM butyric acid per min under standard conditions.

Protease assay: The enzyme extract is assayed using casein as the substrate. The reaction is stopped by addition of TCA. Folin & Ciocalteu's (phenol reagent) reagent is than added and kept in dark to develop the blue color, estimated spectrophotometrically at 660nm against tyrosine as standard. One unit of protease activity was defined as the amount of enzyme required to liberate1 g tyrosine per milliliter in 1 min under the experimental conditions used.

Amylase assay (DNSA 3. 5 dinitro salicylic acid methods): The starch solution is incubated with different dilutions of the enzyme extract and the reaction was stopped by adding DNS and the absorbance is recorded against glucose as the standard. One unit of enzyme activity is defined as the amount of enzyme, which releases 1μmole of reducing sugar as glucose per minute, under the assay conditions (U/ml/min) (Xia et al. 2012).

Laccase assay The enzyme sample is added to guaiacol solution in acetate buffer and the absorbance is read at the spectrophotometer (Ziemin et al. 2012).

CONCLUSIONS

The monitoring and control of biogas production process is a fundamental requirement in order to obtain maximum and reproducible amounts of biogas. Nowadays there are a multitude of physical, chemical and microbiological methods which may be used to analyze the state of the process and to ensure a high production. Traditional cultural methods, genetic and molecular techniques like PCR, DGGE, FISH, MALDI-TOFF, different enzymes assay, performed with classic and high technology equipment would ensure an adequate control of biogas process.

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ANALYSIS OF POLYPHENOLS, FLAVONOIDS AND MINERAL CONTENT FROM DRIED HERB OF *Lophanthus anisatus*
/
ANALIZA POLIFENOLILOR. FLAVONOIDELOR ȘI CONȚINUTULUI DE MINERALE DIN HERBA USCATĂ DE Lophanthus anisatus

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ABSTRACT

View the great importance of melliferous and medicinal plants for bee farmers and cultivators of medicinal plants, the researchers from Vegetable Research and Development Station (VRDS) from Buzau have succeeded to acclimatize in Romania Lophantus anisatus, an aromatic plant that keeps flowering for a period of 6 months, starting with June till the froze coming, namely in October-November. Lophanthus anisatus is a plant originated from Minor Asia, although it is cultivated in the whole world. It is an important plant to bees, being considered by the American specialists within the first 4 melliferous plants in the world. Besides its melliferous characteristics, Lophantus Anisatus is also a medicinal plant, having therapeutic and calming properties, its flavour being a mixture of anise and fennel that gives its uniqueness and distinction.

The paper presents the physico-chemical characteristics in terms of content in polyphenols, flavonoids and minerals from dried aerial part (dried herb) of Lophanthus anisatus under the conditions of culture in Romania, in south-east area, as well as, in terms of biologically active substances from plant volatile oil, obtained by distillation with a forefront role as natural active ingredients of vegetal origin, in pharmaceutical industry, food supplement industry, food industry and industry for body care products and cosmetics.

REZUMAT

Avand in vedere importanta plantelor melifere si medicinale pentru crescatorii de albine si pentru cultivatorii de plante medicinale, cercetatorii de la Vegetable Research and Development Station (VRDS) from Buzau au reusit sa aclimatizeze in tara noastra Lophantus anisatus, o planta aromatica care ramane inflorita timp de 6 luni de zile. din iunie pana la venirea inghetului, si anume octombrie – noiembrie. Lophanthus anisatus este o planta originara din Asia Mica, fiind insa cultivata pe aproape tot globul. este o planta deosebita pentru albine, fiind cotata de specialistii americani in primele 4 plante melifere din lume.Pe langa caracteristicile melifere. Lophantus Anisatus este si o planta medicinala. avand proprietati terapeutice si de calmare, aroma plantei este una impletita, intre anason si fenicul, o aroma care ii da unicitate si distinctie.

Lucrarea prezinta caracterizarea fizico- chimica din punct de vedere al continutului in polifenoli, flavonoide si minerale din partea aeriana uscata (herba uscata) de Lophanthus anisatus în condițiile cultivarii in Romania, in zona de sud- est. cat si al substanțelor biologic active din uleiul volatil al plantei. obtinut prin distilare, cu rol important ca ingredienti activi naturali de origine vegetala, in industria farmaceutica, a suplimentelor alimentare, alimentelor, produse pentru ingrijire corporala si cosmetice.

INTRODUCTION

Lophanthus anisatus (figure 1) study was taken from Vegetable Research and Development Station (VRDS) from Buzau, Romania, where was cultivated in 2010.

In the world is known under several names (*Agastache Foeniculum*. *Lophantus Agastache*) or lofant popular (Vînătoru C. et al., 2015). Lophanthus is a genus of plants in the Lamiaceae family, first described in 1763. It is native of central and southwestern Asia from Turkey to Mongolia, with many of the species endemic to Iran [11]. *Agastache* is a small genus of Lamiaceae, comprising 22 species of perennial aromatic medicinal herbs. This is a multi-purpose plant, in the world it is known as a medicinal aromatic, spicy plant and even ornamental and melliferous (*Vînătoru C. et al.. 2015*).

Lophantus anisatus blossoms in early June and preserves its flowers until frost coming, that is why beekeepers can maintain the beehives in the same place. *Lophantus* honey is very expensive in Europe. because as the plant has its anti-depressive, anti-stress and immunology benefits, the honey obtained has high medical qualities due to rich content of antioxidants and specific essential oil. At the same time, it contributes to eliminate toxins from human body, in Tibetan medicine being renowned as a plant maintaining youth.

Besides its valuable medicinal properties, the plant may successfully complete flower bouquets,. having a beautiful colour. [12].

Fig. 1 –Crop of *Lophanthus anisatus* [9.12]

The paper (*Kotyuk L.. 2016*) studies the quantitative and qualitative composition of the major components of plan materials and essential oils of *Lophanthus anisatus Adans*., grown in Woodlands (Polissya) of Ukraine. It has been researched that *L. anisatus* contains 24.95±0.52% of dry matter. 29.06±0.59% of fiber, 18.84±1.27% of protein, 2.25±0.26% of fats, 8.09±0.81% of tannins, 0.46±0.05% of total sugars, 174.12±249 mg % of ascorbic acid and 426.67±17.29 mg % of potassium. In the essential oil 30 components were identified: pulehon (59.18%), izomenton (14.34%), bicyclogermacrene (3.20%), germacrene D (3.01%), β-caryophyllene (2.99%), limonene (2.45%), menton (2.20%), 1.6-hermakradiyen-5-ol (1.50%), izopulehon (1.40%), α-kardinol (0.97%), piperitenone (0.92%), 1-octen-3-ol (0.70%), bicycloelemene (0.67%) and piperitone (0.62%). The research results show that the biochemical study of lofant anise introduced in Ukrainian Polissia, confirm its high nutritional value and application in phyto-medicine food industry and cosmetics, therefore indicating the need for cultivating this type of plant.

In the paper review (*Zielińska S. and Matkowski A., 2014*) was discussed the recent advances of the phytochemistry, bioactivity, molecular biology and biotechnology of *Agastache*, with an emphasis on the following species: *A. foeniculum*, *A. Mexicana*, *A. rugosa*, *A. scrophulariifolia* and *A. urticifolia*. *Agastache* is a small genus of Lamiaceae, comprising 22 species of perennial aromatic medicinal herbs. The phytochemical profile of all Agastache species studied is generally similar, consisting of two main metabolic classes - phenylpropanoids and terpenoids. In the relatively variable essential oils, most populations of different *Agastache* species contain over 50 % of a phenylallyl compound - estragole. Also, other volatile compounds (methyleugenol, pulegone, menthone, isomenthone and spathulenol) were reported in various proportions. Major non-volatile metabolites belong to phenolic compounds, such as caffeic acid derivatives, especially rosmarinic acid as well as several flavones and flavone glycosides like acacetin, tilianin, agasta-choside and a rare dimeric malonyl flavone (agastachin). Two unique lignans - agastenol and agastinol - were also isolated.

The autors of the paper (*Myadelets M. A. et al. ,2013*) studied the composition of essential oils inherent in five species belonging to genus *Agastache* cultivated under the conditions of the Middle Ural. In the oil composition of the samples under investigation there have been 29 compounds identified. The main components of essential oil of the aerial parts of plants *A. rugosa* are presented by menthone (31.8 %), isomenthone (12.3 %), pulegone (8.5 %), methyl eugenol (4.8 %), spathulenol (2.1 %), methyl chavicol (1.9 %) and pi peritone (1.7 %). The main components of oil inherent in *A. urticifolia* are presented by menthone (23.0 %). isomenthone (9.9 %). pulegone (5.6 %). methyl eugenol (3.6 %). spathulenol (5.4 %). methyl chavicol (1.0 %) and piperitone (0.6 %). The oil of *A. foeniculum* is characterized by prevailing menthone (34.3 %), isomenthone (14.4 %), pulegone (9.1 %), methyl chavicol (3.2 %), methyl eugenol (3.1 %), piperitone (1.2 %) and spathulenol (0.9 %). *A. mexicana* is typically characterized by the same dominant components such as menthone (42.2 %), isomenthone (18.8 %), pulegone (7.3 %), methyl chavicol (3.8 %), methyl eugenol (1.1 %) and spathulenol (0.9 %). Oil species inherent in *A. scrophulariifolia* are characterized by prevailing menthone (34.7 %), isomenthone (15.8 %), pulegone (8.8 %,. methyl chavicol (8.1 %), methyl eugenol (1.7 %), piperitone (1.5 %) and spathulenol (1.1 %).

Based on the results of analyses performed, this paper aims to evaluate the fact that *Lophanthus anisatus* plant can be a source of minerals and antioxidants and the essential oil (*Popescu C. V.. 2013*), rich in estragol (92.87 %), is a phenylpropen, a natural organic compound with an important role in composition of pharmaceutical products, *food* supplement industry, food industry and industry for body care products,

antiseptics and cosmetics as raw material of vegetal origin cultivated in indigenous flora; therefore the plant has also an economic importance (law price and available raw material, easy to procure).
The present paper's goals were to identify and dose the content of total polyphenols expressed in chlorogenic and respectively caffeic acid, total flavonoids expressed in rutin and essential oil components expressed in lophant. Ethanol extracts of *Lophanthus anisatus* were obtained from the dried aerial part (herb) in order to identify the bio-chemical composition of plant.

MATERIAL AND METHOD

Leaf sections (figure 2 a) have edges, sharp tip, slightly porous surface, similar to the *Urtica dioica*. Number of stamens in flower (figure 2 b) are 4 including two long and two short. The blooming period is very long and is made in instalments from June until the coming of frost and the plant is ranked among the top bee plants in the world. Potential production per unit area is very high, of over 600 kg/honey per hectare.

Plant is not pretentious as soil type, but after cutting the shoots it is better to wet it for enhancing the recovering of foliar system. As multiplying method, the direct sowing in not advisable, because the seeds of Lophantus anisatus are very small, so the sowing should be done by shoots. They may produce in March and planting in field can be achieved to the end of April, in warmer areas. The planting scheme should keep 70 cm between rows and 30-35 cm between plants, in row. Because a single plant may produce seeds for a whole hectare (figure 2 c). Lophantus anisatus has the capacity of producing enough seeds for establishing one hectare of culture.

a) Leaves detail [4] **b) Flower details [4]** **c) Seeds details [10]**

Fig. 2 – Details of plant Lophanthus anisatus

Lophanthus anisatus plant used to be studied was cultivated and harvested in an experimental plot at Vegetable Research and Development Station from Buzau, being purchased as dry plant.

The physico-chemical characterization of plant and essential oil were made at the Laboratory of Quality Control of S.C. HOFIGAL EXPORT IMPORT S.A., Bucharest, owner of EU GMP Cerificate.
Methods of analysis used:

1. Content of total polyphenols expressed in caffeic acid and/ or chlorogenic acid.

Product behavior in terms of total polyphenols expressed in caffeic acid, % and/or chlorogenic acid is very important to be determined, as their content is directly proportional with the products drying method and total polyphenols content (giving the non-enzyme antioxidant features) increases along with drying, controlled by stages. This test was performed in compliance with the method developed in S.C. HOFIGAL EXPORT IMPORT S.A. laboratory by spectrophotometry UV - VIS [6].

Working technique: At 5.0 mL test solution are added 5 mL sodium phosphor-wolframate solution R. are agitated and filtered; the first 2 mL of filtered solution are removed, 2.5 mL of filtrate are diluted by sodium carbonate solution R 200 g/L at 25 mL in a graded balloon. The solution absorption is determined at 660 nm, using as compensation liquid a solution prepared of 2.5 mL filtrate and 25 mL water in a graded balloon. Total polyphenols concentration of sample to be analyzed is calculated by means of a calibrating curve. working with: 1.0; 1.5; 2.0; 2.5; 3.0; 3.5; 4.0; 4.5 mL standard solution of chlorogenic acid or caffeic acid R 0.1 g/L. after that are added 4.0; 3.5; 3.0; 2.5; 2.0; 1.5; 1.0 and 0.5 mL water R and then 5.0 Ml sodium phosphor-wolframate solution R for each unit. From each units obtained. 2.5 mL are taken out and are graded and levelled in a balloon of 25 mL with sodium carbonate R 200 g/L freshly separated. The solution absorption is determined at 660 nm, using as compensation liquid a solution prepared from 2.5 mL out of each sample brought to level with water R in a graded balloon of 25 mL.

2.Determination in total flavonoids expressed in rutin

The procedure performed is in accordance with the analysis method CC-MFC 064, edition in force. within the dossier comprising the physico-chemical methods, elaborated by Romanian Pharmacopoeia [7].

edition in force, working with 1.0 g sample to be analyzed, the equipment used being the UV-VIS spectrophotometer.

Working technique: the test solution absorption is measured comparing to compensation solution after 20 minutes with spectrophotometer at 430 nm. in the vessel of 1 cm. When the solution extinction surpasses 0.3, the appropriate dillution should be performed.

Flavonoid quantity is calculated comparing to rutin standard curve, established as it follows: in three 25 mL graded balloons are dropped 1; 2 and 3 mL rutin solution 0.01% into methanol R. In each graded balloon, 5 mL of sodium acetate R, solution 100 g/L and 3 mL aluminium chloride R, solution 25g/L. are added, agitating after each reactive substance adding. The balloons are completed up to the mark with methanol R and they are strongly agitated. Solutions obtained are read at spectrophotometer at 430 nm in the vessel of 1 cm, comparing to methanol R.

3. Obtaining essential oil:

Method of obtaining the essential oil by vapours is according to Romanian Pharmacopoeia edition 9.0. chapter 2.8.. Methods in pharmacognosy''. subchapter 2.8.12. ..Determination of essential oils in herbal drugs" [8].

Equipment used was:

- apparatus for determining essential oils made of: (Figure 2.8.12.-1 from FE 9.0) ;

a) balloon with round bottom and narrow neck with an inner diameter of 29 mm ;

b) condenser with different parts comprised in a single part ;

- one cork K' and one tube K with sealed end with 10 mm diameter;
- one pear-shaped dilatation. J of 3 mL ;
- one tube JL graded of 0.01 mL ;
- one bulb-shaped dilatation L of 2 mL capacity ;
- one tap M with three ways ;
- junction B is by 20 mm higher than the highest grade ;

c) one heating source permitting a fine setting ;

d) one vertical support with horizontal ring.

Reactive substances used were: xylen R and water R.

Working technique: At 100 g sample to be analyzed are added ~ 1000mL water in distillation balloon, several china fragments and the installation is assembled. Water R is introduced into the tube N up to B level. The cork K' is removed and by means of a dropper a prescribed quantity of xylene R is introduced to the bottom of graded tube. The cork K 'is put assuring the tube sealing. The liquid is heated to boiling point and the distillation is made with a speed of 2 - 3 mL/min, when otherwise is not required.

In order to find out the distillation speed, the water minimum level is ensured by three way tap M till the meniscus reaches the lowest level. (b) (fig 2.8.12.-1.) . The tap is turned on and distillation continues by adjusting the heat intensity up to the desired rate. The distillation keeps going for 30 minutes. Heating is stopped and after at most 10 minutes the volume of xylene in the graded tube can be read.

Afterwards, a certain quantity of sample to be analyzed provided in Technical Specification is introduced in round bottom balloon and distillation continues as above. Then, the heat is stopped and after other 10 minutes, the volume of liquid collected in graded tube is read and the xylene volume previously found is subtracted. Difference obtained represents the essential oil quantity out of product mass. The result is calculated in mL/kg of product.

Calculus:

$$\text{Essential oil. mL/kg} = \frac{V_2 - V_1}{m} \cdot 1000$$

where: V1 = volume of xylene collected in graded tube before distillation, in mL;

V2 = volume of xylene collected in graded tube after distillation, in mL;

m = mass of sample to be analyzed, in g.

3. Chromatographique profile of essential oil of lophant *Lophanthus anisatus*

Working technique: 1µL of test solution is injected (analyzing sample is diluted with hexan, if necessary, it is dried on a small quantity of anhydrous sodium sulphate R and is filtered through a filter of 0.2µm) and reference solution (5 µL absinthin R are dissolved in 5 mL hexan R) and the retention time are registered with Gas Chromatography Equipment equipped with mass spectrometer.

Using the retention time obtained by reference solution chromatogram, its components are located in the chromatogram obtained with test solution. The percentage content of test solution components is determined by normalization procedure.

RESULTS

The chemical reaction of identifying the polyphenols and flavonoids was positive. The physical and chemical analysis of the four varieties consisted in determining the following parameters: residues by drying (%);

total polyphenols expressed in caffeic acid (%); total polyphenols expressed in chlorogenic acid (%); total flavonoids expressed in rutin (%) and mineral content (mg/100g) is shown in table 2.

Table 2

Physical and chemical analysis of aerial parts of *Lophanthus anisatus*

Den. No	Characteristics	Results										
1	Residues by drying. %	3.6										
2	Identification: - polyphenols (chemical reaction) - flavonoids (chemical reaction) - amino acids(chemical reaction)	 Positive Positive Do not give chemical reaction										
3	Content of : - total polyphenols expressed in caffeic acid /chlorogenic acid.% - flavonoids expressed in rutin. % -essential oil. %	 3.74 / 7.5 0.46 0.8										
4.	Mineral content, mg/100g	Ca	Mg	K	Na	Mn	Fe	Zn	Cr	Cu	Pb	Cd
		500	200	4000	90	1.8	20	ND	ND	<1	ND	ND

In oligoelements such as manganese, iron, copper can be found a very good content of minerals, sodium, potassium, calcium, magnesium. Residue obtained by drying offers an answer related to presence of minerals in product studied. It was noticed the existence of a good ratio between sodium potassium and respectively calcium and magnesium.

Another quality of the product is the fact that along with quality elements the product is safe, because it doesn't contain heavy metals such as lead and cadmium.

Related to analysis of essential oil, the qualitative and quantitative report of lophant extract is shown below in chromatogram obtained and presented in figure 3.

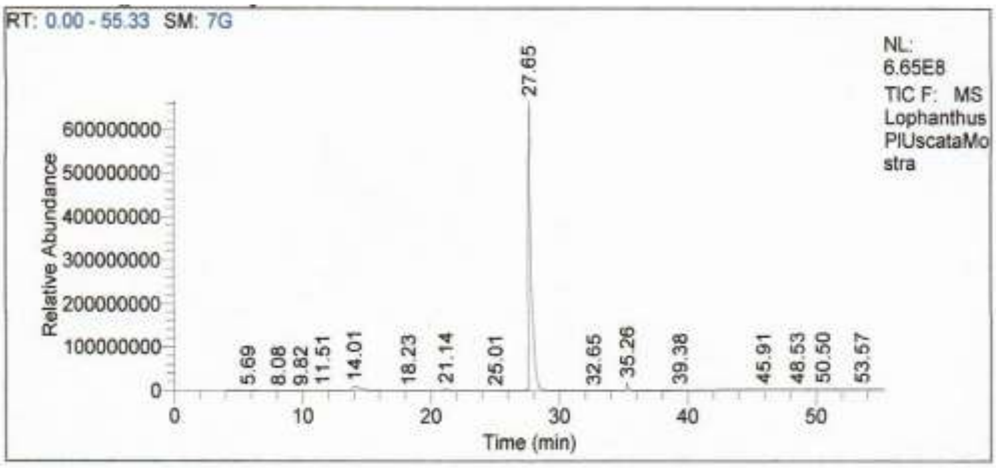

Fig. 3 - Chromatographic profiles of ethanol extract of *Lophanthus anisatus*

Chromatographic profiles achieved at lophant ethanolic extracts have emphasized 16 compounds in the essential oil analyzed (table 3).

Table 3

Chromatographic profiles of the ethanol extracts from *Lophanthus anisatus*

Den. No.	Volatile compound	Retention Time [min]	Area [%]	Peak Area	Peak Height	SIN
1.	Limonene	14.01	2.71	262290901	9740152	5605.21
2.	Octenol Acetate	21.14	0.84	81904424	5715923	3289.37
3.	Cariofilene	27.35	0.24	23593405	2286090	1315.59
4.	Estragol	27.65	92.87	9002953078	631429433	363371.57
5.	Elemene	30.14	0.19	18366613	1839794	1058.75
6.	Methyl Eugenol	35.27	1.58	153222952	16358368	9413.82
7.	Allyl methoxyphenol	38.61	0.11	10877384	1081808	622.55
8.	Cadinol	39.38	0.13	12572282	1512990	870.69
9.	Ethylene oxide cyclo	42.34	0.11	10602022	708689	407.83

Den. No.	Volatile compound	Retention Time [min]	Area [%]	Peak Area	Peak Height	SIN
10.	Ethylene oxide cyclo	44.69	0.25	24165810	1167515	671.88
11.	Hexagol	45.91	0.26	24839160	1405224	808.67
12.	Hexagol	47.10	0.22	21450292	1155857	665.17
13.	Octaethylene glycole	47.39	0.11	10500529	688915	396.45
14.	-	48.41	0.13	12444099	901744	518.93
15.	-	50.36	0.11	10647947	971575	559.12
16.	-	50.50	0.14	13723860	1024521	589.59

CONCLUSIONS

Lophantus anisatus is an aromatic plant considered among the first four melliferous plants in the world, brought in Romania where it was acclimatized for the first time by the researchers from Centre of Vegetable Research Buzău. The researches lasted 10 years and recently the plant was cultivated, being very valuable by its flowers long time in blossom, which could represent a continuous source of food for bees.

From *Lophanthus anisatus*, is used all the aerial part with multiple uses, the plant not having especial soil demands and presenting an increase resistance to illnesses and pests.

Lophanthus anisatus is used in natural medicine having numerous medicinal properties, such as: prevents and treats gastritis, gall-bladder affection,. Hepathitis, cerebral vascular accidents, increases body immunity, balances the metabolic processes..

The main plant contribution is given by the rich content of antioxidants and essential oil specific. In Tibetan naturist medicine it is known as the youth plant.

The main components of essential oil (0.8 %) of lofant cultivated in Romania were estragol (92.87 %), limonene (2.71 %), methyl eugenol (1.58 %), octenol acetate (0.84 %), hexagol (0.26),ethylene oxide cyclo (0.25 %), cariofilene (0.24 %), elemene (0.19 %), cadinol t (0.13 %), allyl methoxyphenol (0.11 %), octaethylene glycole (0.11 %). Estragole confers the most typically-described anise-like aroma to the plants and essential oils of *Lophanthus anisatus*

The non-volatile components identified in aerial dried parts of the plant were: total polyphenols expressed in caffeic acid (3.74 %) and chlorogenic acid (7.5 %), flavonoids expressed in rutin (0.46 %).

Results presented in this paper showed that the chemical and physical study of lofant introduced in culture in Romania has confirmed its value as raw material of natural origin, safe and with high quality volatile and non-volatile compounds with applications in pharmaceutical industry, food supplement industry, food industry, cosmetics, as phyto-sanitary treatments, as food source for bees.

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USING THE DELPHI METHOD FOR IMPROVING THE COST ALLOCATORS INSTALLATION SERVICE
/
UTILIZAREA METODEI DELPHI PENTRU ÎMBUNĂTĂŢIREA SERVICIULUI DE MONTARE A REPARTITOARELOR DE COSTURI

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Keywords: *Delphi method, economic forecast, cost allocators, installation service.*

ABSTRACT

This paper develops the method of intuitive economic forecast for improving service quality - Delphi Method. The case study consists in developping a forecast by using Delphi technique based on the company's desire to improve the elements of the service provided from a qualitative point of view. The service to be improved is the installation of heating cost allocators, so the Delphi method involves the following steps: 1) Preparing the questionnaire; 2) Selection of committee members based on the necessary expertise; 3) Distributing the questionnaire and analyzing the answers. In this respect, in elaborating the Delphi technique, it is necessary to have the answer to the questionnaire of the specialists within the organization, totaling 23. After analyzing the results of the committee members on the answers to the questionnaire applied to the 23 experts, it became clear that the results reached the level of convergence, with a share of over 50% for each question.

REZUMAT

Lucrarea de faţă dezvoltă metoda de prognoză economică intuitivă privind îmbunătăţirea calităţi serviciilor - Metoda Delphi. Studiul de caz constă în elaborarea unei prognoze prin utilizarea tehnicii Delphi ce are la bază dorința companiei de a îmbunătăți elementele serviciului furnizat din punct de vedere calitativ. Serviciul ce se dorește a fi îmbunătățit este reprezentat de montarea repartitoarelor de costuri pentru încălzire, prin urmare, elaborarea metodei Delphi presupune necesitatea parcurgerii următoarelor etape: 1) Pregătirea chestionarului; 2) Alegerea membrilor comisiei pe baza expertizei necesare; 3) Distribuirea chestionarului și analiza răspunsurilor. În acest sens, în elaborarea tehnicii Delphi. este necesar răspunsul la chestionar a specialiștilor din cadrul organizației, aceștia însumând un număr total de 23. În urma analizei rezultatelor membrilor comisiei privind răspunsurile la întrebările chestionarului aplicate pentru cei 23 de experți, a reieșit faptul că rezultatele au atins nivelul convergenței, acesta având o pondere de peste 50% pentru fiecare întrebare.

INTRODUCTION

Economic forecasting methods help to transpose data and information into strategies that can lead to obtaining competitive advantages. With the help of forecasting methods, realities are anticipated as a future action based on rationality, optimal criteria, these methods representing a way of research and knowledge of reality.[1]

The most commonly used economic forecasting methods are the intuitive ones and the Delphi method belongs to this category.

The Delphi method is based on the views of some experts. Persons with expertise in a particular field are required to answer a series of questions, but they mustn't interact with each other.[3]

In the case of an organization providing cost allocators installation services in Romania, the development of a forecast using Delphi technique is based on the company's desire to improve the elements of the service provided from a qualitative point of view.[5]

MATERIAL AND METHOD

The service to be improved is the installation of heating cost allocators, so the Delphi method involves the following steps: 1) Preparing the questionnaire; 2) Selection of committee members based on the necessary expertise; 3) Distributing the questionnaire and analyzing the answers.

Defining the topic and preparing the questionnaire

In the first stage we elaborated a questionnaire with 8 questions, 5 regarding the quality level of the service and the satisfaction of the clients' needs, while 3 refer to the team from *ista* Romania installating cost allocators.[6]

These questions ask respondents for opinions that can be quantified using a scale from 1 to 5 that reflects the agreement or disagreement with the topic presented.

The questions in the questionnaire are:

1) Is the heating cost allocators installation service provided by *ista* Romania considered a quality one?
2) Does the company service meet customer needs?
3) Is the installation team of *ista* Romania efficient?
4) Are the customers of *ista* Romania satisfied with the provision of heating cost allocators installation service?
5) Do the employees provide safety and trust to customers when providing the service?
6) Do the company employees have the necessary knowledge to respond promptly to customer needs?
7) Is the equipment used by the company's staff to provide the service of superior quality?
8) Does the heating cost allocators installation service provided by *ista* Romania comply with all quality dimensions (tangibility, trust, solicitude, safety and empathy)?

Selection of committee members based on the necessary expertise

Ista Romania wants to improve the heating cost allocators installation service in terms of quality. In this respect, in the elaboration of the Delphi technique, it is necessary to have the answer to the questionnaire of the 23 specialists within the organization.

Among the members of the committee are 4 people from the Human Resources department, 10 employees from the Sales Department, 4 employees from the Management, 1 representative from the Logistics Department and 4 persons from the installation team.

This committee was chosen taking into account the degree of involvement in the decision making of the employees within *ista* Romanian, decisions that can influence the company directly or indirectly on short, medium or long term.

Interpretation of results

After realeasing the questionnaire. we obtain a distribution of the answers of the following form, where 1 = totally disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = totally agree.

Table 1

Analysis of the answers to the questions in the Delphi questionnaire

Question	Answer variants				
	1-Totally disagree	2-Disagree	3-Neutral	4-Agree	5-Totally agree
1.	0 (0%)	0 (0%)	4 (17.4%)	17 (73.9%)	2 (8.7%)
2.	0 (0%)	1 (4.3%)	0 (0%)	18 (78.3%)	4 (17.4%)
3.	0 (0%)	3 (13%)	7 (30.4%)	13 (56.5 %)	0 (0%)
4.	0 (0%)	2 (8.7%)	5 (21.7%)	15 (65.2%)	1 (4.3%)
5.	0 (0%)	2 (8.7%)	15 (65.2%)	4 (17.4%)	2 (8.7%)
6.	0 (0%)	1 (4.3%)	14 (60.9%)	5 (21.7%)	3 (13%)
7.	0 (0%)	0 (0%)	1 (4.3%)	14 (60.9%)	8 (34.8%)
8.	0 (0%)	0 (0%)	3 (13%)	16 (69.6%)	4 (17.4%)

Question 1: Is the heating cost allocators installation service provided by *ista* Romania considered a quality one?

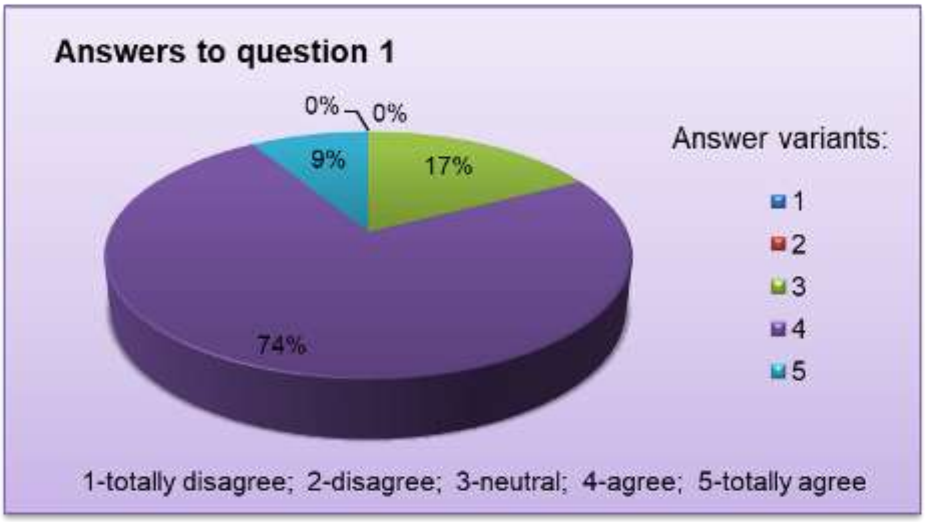

Fig. 1 - Analysis of the answers to question 1 in the Delphi questionnaire

Question 2: Does the company service meet customer needs?

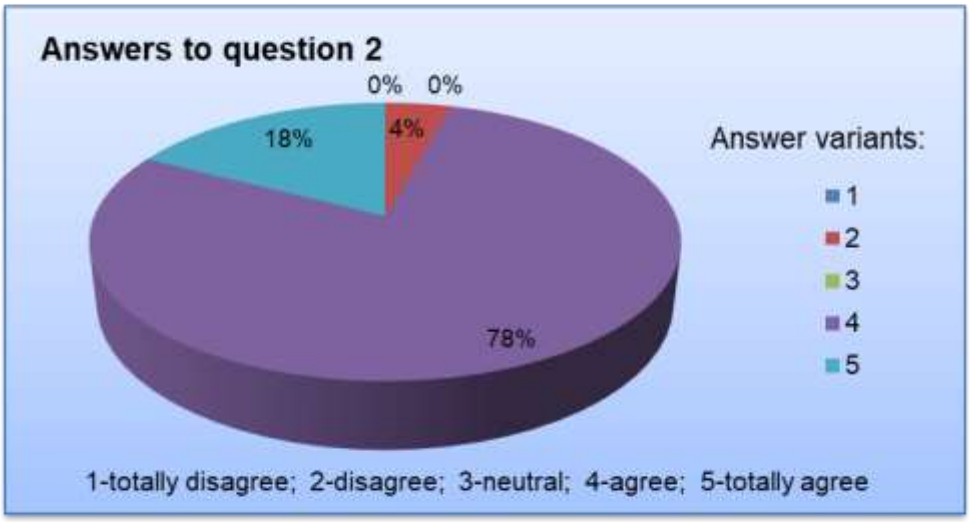

Fig. 2 - Analysis of the answers to question 2 in the Delphi questionnaire

Question 3: Is the installation team of *ista* Romania efficient?

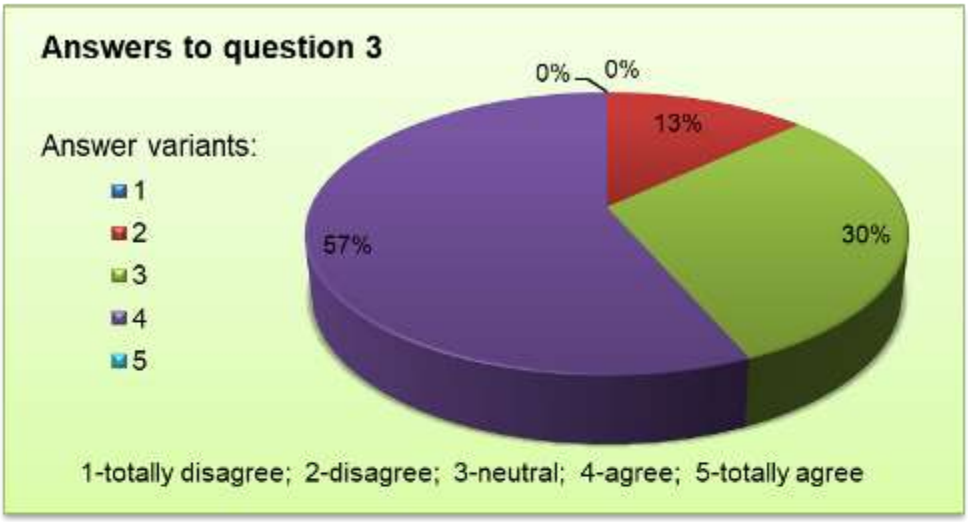

Fig. 3 - Analysis of the answers to question 3 in the Delphi questionnaire

Question 4: Are the customers of *ista* Romania satisfied with the provision of heating cost allocators installation service?

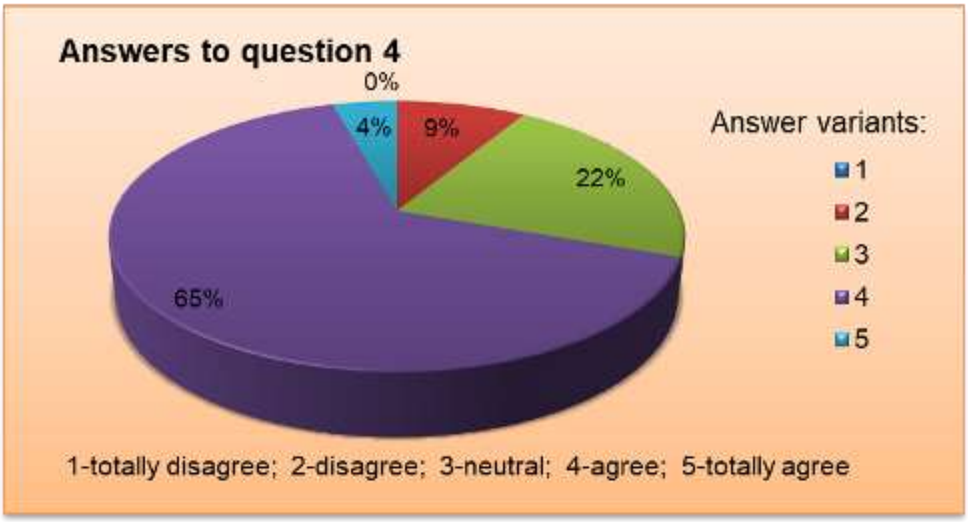

Fig. 4 - Analysis of the answers to question 4 in the Delphi questionnaire

Question 5: Do the employees provide safety and trust to customers when providing the service?

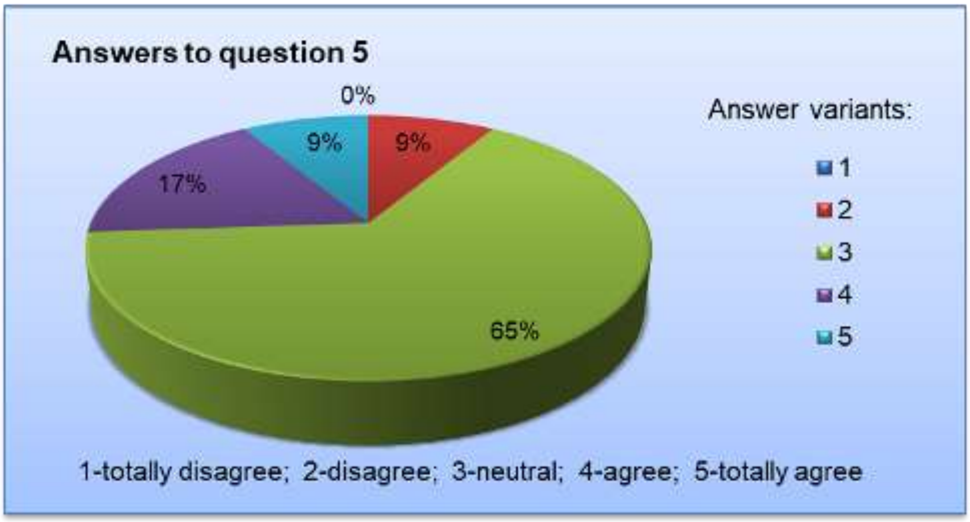

Fig. 5 - Analysis of the answers to question 5 in the Delphi questionnaire

Question 6: Do the company employees have the necessary knowledge to respond promptly to customer needs?

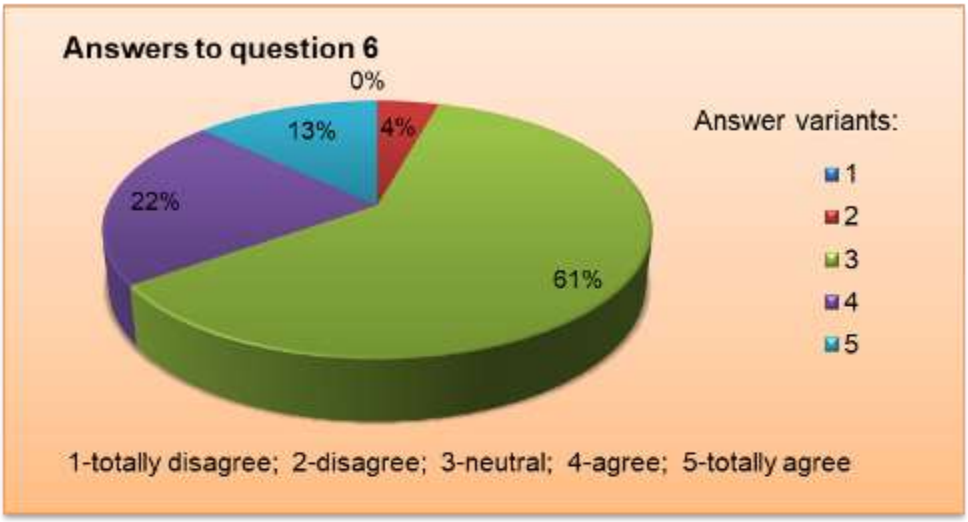

Fig. 6 - Analysis of the answers to question 6 in the Delphi questionnaire

Question 7: Is the equipment used by the company's staff to provide the service of superior quality?

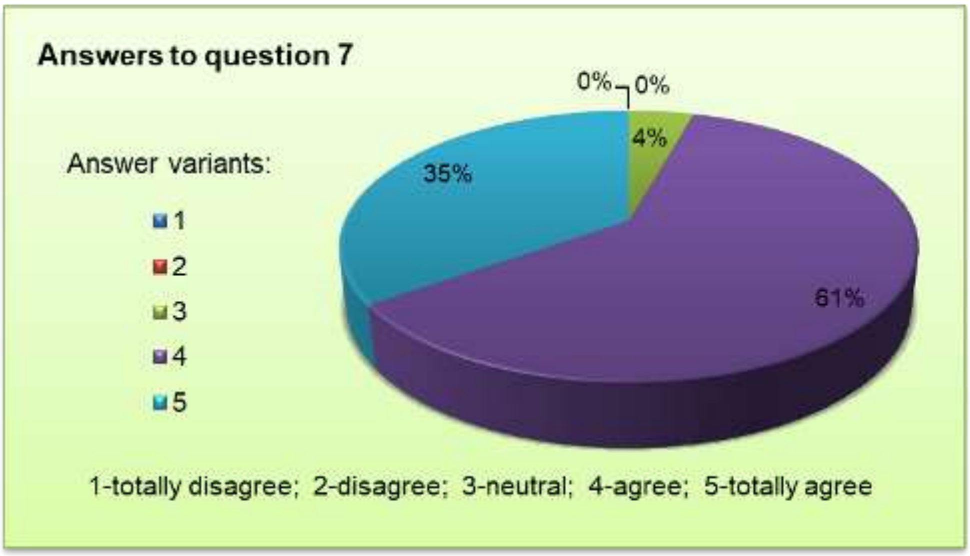

Fig. 7 - Analysis of the answers to question 7 in the Delphi questionnaire

Question 8: Does the heating cost allocators installation service provided by *ista* Romania comply with all quality dimensions (tangibility, trust, solicitude, safety and empathy)?

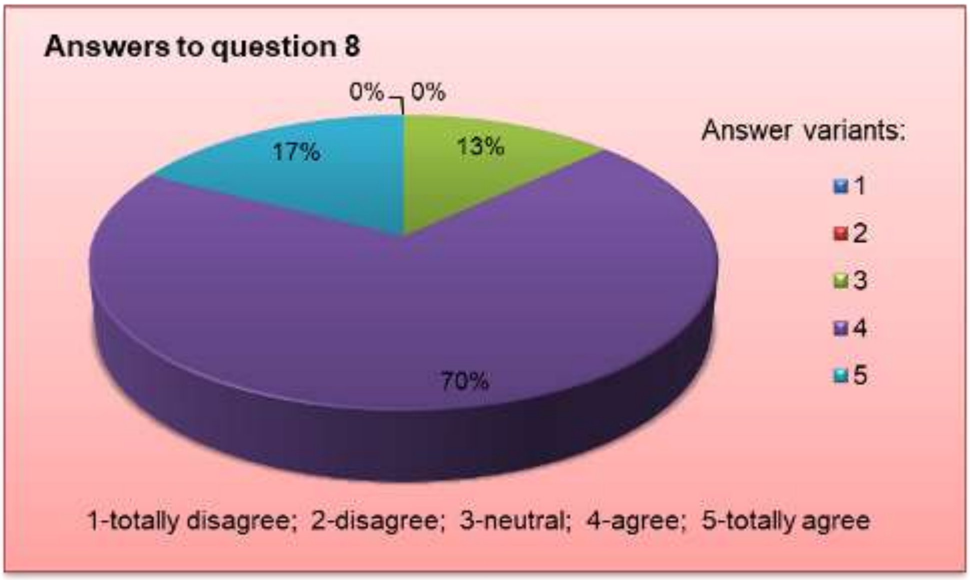

Fig. 8 - Analysis of the answers to question 8 in the Delphi questionnaire

CONCLUSIONS

Due to the fact that most of the 23 experts questioned opted for similar answers in a proportion of more than 50% for each question, the method does not require a repeat. Based on the calculation of medians, we obtained the following results on respondents' answers with the highest share for each question in the questionnaire:

- ✓ For question 1. the favored answer is "agree" in a proportion of 73.9%
- ✓ For question 2. the favored answer is "agree" in a proportion of 78.3%;
- ✓ For question 3. the favored answer is "agree" in a proportion of 56.5%;
- ✓ For question 4. the favored answer is "agree" in a proportion of 65.2%;
- ✓ For question 5. the favored answer is "neutral" in a proportion of 65.2%;
- ✓ For question 6. the favored answer is "neutral" in a proportion of 60.9%;
- ✓ For question 7. the favored answer is "agree" in a proportion of 60.9%;

- ✓ For question 2. the favored answer is “agree” in a proportion of 69.6%.

Taking into account the analysis of the committee members’ results regarding the answers to the questionnaire questions for the 23 experts, it turned out that the results reached the level of convergence with a share of over 50% for each question. In conclusion, the results obtained are the predicted values.

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INFLUENCE OF TIRE INFLATION PRESSURE AND WHEEL LOAD ON THE FOOTPRINT BETWEEN SOIL AND TIRE
/
INFLUENȚA PRESIUNII ÎN PNEU ȘI A ÎNCĂRCĂRII PE ROATĂ ASUPRA PETEI DE CONTACT DINTRE SOL ȘI PNEU

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Keywords: *compaction, tire inflation pressure, wheel load, footprint.*

ABSTRACT

Shape and size of the footprint and, thus the depth at which stresses are transmitted into the soil are influenced by wheel load and tire inflation pressure. A mesh - type sensor was used for measuring the contact pressure in the footprints corresponding to five tire inflation pressures and five wheel loads. For each test were obtained the 2D maps showing the shape of footprint and also the distribution of pressure at soil-tire interface. It was found that at minimum tire inflation pressure the shape of footprint tends to be rectangular and, by increasing tire inflation pressure to the maximum, the footprint has rather elliptical shape.

REZUMAT

Forma și mărimea petei de contact și. prin urmare. adâncimea la care tensiunile sunt transmise în sol sunt influențate de încărcarea pe roată și presiunea din pneu. În lucrare a fost utilizat un senzor de tip plasă pentru a măsura presiunea de contact în petele corespunzând a cinci presiuni în pneu și cinci încărcări pe roată. Pentru fiecare test s-au obținut hărți 2D ce prezintă forma petei de contact și distribuția presiunii la interfața pneu - sol. S-a constatat că la presiune minimă în pneu forma petei de contact tinde să fie dreptunghiulară, iar prin creșterea presiunii în pneu la maxim, pata de contact are o formă mai degrabă eliptică.

INTRODUCTION

With increasing world population, to cope with the demand for more food it became necessary to intensify the farming and cropping systems. Thus, heavier machines per soil area have become common worldwide, resulting in the artificial compaction of soil. Compaction is a form of physical degradation resulting in densification and distortion of the soil where biological activity, porosity and permeability are reduced, strength is increased and soil structure partially destroyed (*Abdel Rahman et al., 2016*).

The artificial compaction is human induced and is mostly due to technological errors in agriculture, such as excessive traffic on wet soils during agricultural works. All farm machinery operations, starting with the seedbed preparation, fertilizer and chemical applications and finally harvesting, increase the risk of degradation of agricultural soil through artificial compaction. Nowadays, the risk of soil compaction increased due to due to significant growth of agricultural machinery. In European agriculture, the weight of tractors increased from 3 tons (in 1940) to 7 tons (in 1998) and up to 20 tons (at present). Nevertheless, compaction is not a recent phenomenon, because it existed in the form of hardpans long before the advent of intense mechanized agriculture (*Batey T.. 2009*). Hardpans (or plough-pans) are compacted layers of soil with low thickness (2.5 - 5 cm). formed beneath the arable layer, usually due to repeated tillage at the same depth.

Human induced compaction is one of the twelve forms of soil degradation in the E.U. and is a serious threat to soil sustainability, with numerous environmental and agronomic negative effects (Figure 1). Important environmental effects of soil compaction are: reduced water and air infiltration, increased risk of surface runoff and floods, increased erosion and sediment transport, reduced pesticide decomposition and increased pesticide leaching into groundwater, accelerated pollution of surface water by organic waste and applied agrochemicals (*Keller and Lamandé. 2010*). Some of the agronomic effects of compaction are: increased soil strength and limited root penetration into the soil, which ultimately lead to poor development and yield reduction of most agricultural crops, and increasing resistance to plowing and consequently higher fuel consumption (*Manuwa. 2013; Mari G.R. and Changying J.. 2008; Rashidi et. al.. 2010*).

Agricultural soils in most regions of the world have compacted soils, but the negative economic of artificial compaction is most severe in countries most dependent on agriculture for their incomes (*Maheshwari D.K.. 2012*). It has been estimated that nearly 4% of soil throughout Europe suffer from compaction, but no recent and precise data are available. More than a third of the soils in Europe are highly susceptible to compaction in the subsurface layers. In Central and Eastern Europe, 25 million hectares are lightly compacted and 36 million hectares are severely compacted (*Soil compaction* - *Soil Atlas*).

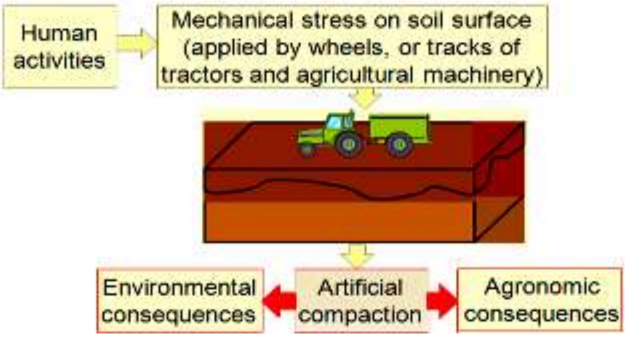

Fig. 1 – Simplified diagram of soil compaction

Figure 2 presents some of the important factors that have a great influence on soil compaction. Other factors are: contact pressure, speed of the agricultural vehicle, tire size, tire slippage, vibrations, respectively the repeated trampling by livestock and other animals around gateways and watering points (*Biriș et. al.. 2011*; *Ungureanu et. al.. 2015*).

Fig. 2 – Factors of great influence on soil compaction

“Contact area” is the portion of wheel or tire in contact with the supporting surface and is an important factor for the load capacity of the tire. “Static contact area” is the contact area between tire and a rigid or deformable surface, when the tire is loaded statically, without forwarding movement (*Wulfsohn D.. 2009*).

The footprint or contact area’s shape and size is influenced by: soil type, soil physical characteristics, type of tire (stiffness, tread), tire inflation pressure and load wheel. In contact with a dry hard soil, tires deform longitudinally and transversely and the footprint size and shape will be given by tire inflation pressure and wheel load. In this case, the footprint tends to have a rectangular shape with more or less rounded corners and is less probable to have an elliptical shape. In agricultural soils, due to higher tire pressures, smaller footprint areas are formed, soil deformation is larger and stress is distributed deeper into the soil. Deep compaction can persist for a long period of time and, therefore, is a serious threat to soil productivity for a long time (*Uceanu et. al.. 2008*). At lower tire inflation pressures, tire deforms more, footprint area increases, mean pressures in the footprint are lower, soil deformation is lower and stresses are distributed to shallower depths (*Biriș S. Șt.. 2010*).

Various mathematical models are used to determine the footprint area between tire and soil, taking into account different parameters. For example, the COMPSOIL model (*Cui K. et. al.. 2007*) is given by the following relation:

$$A = s_1 \cdot b \cdot d + s_2 \cdot Q + s_3 \cdot \frac{Q}{p_i} \quad [\mathrm{m}^2] \tag{1}$$

where Q – wheel load [kN]; b – tire width [m]; d – tire overall diameter [m]; p_i – tire inflation pressure [kPa]; s_1. s_2. s_3 – empirical parameters depending on soil stiffness.

Contact pressure at the soil-tire interface can be measured as a good indicator of the potential of compaction of agricultural soil (*Farhadi et. al.. 2013*). Although estimation methods are available to predict the footprint area of agricultural tires, determination of the real 2 D and 3D contact area in real-time is difficult and often relies on accurate methods for measuring of tire deflection. Knowing wheel load and footprint area, the contact pressure can be computed using the relation:

$$p_c = \frac{Q}{A} \quad \text{[kPa]} \tag{2}$$

Determining the shape and size (area) of the footprint is particularly important, both for auto vehicles and also for tractors and agricultural machinery. For the auto vehicles the importance falls primarily on the adhesion to the road, for tractors and agricultural machinery the importance is given to both adhesion and the pressure on soil (contact pressure), so that shallow and deep compaction to be minimized.

Prevention of soil compaction is a significant measure in order to maintain or improve soil quality. Soils with good physical properties are easier to process and this is a prerequisite condition for reducing the energy required for tillage. In view of the multiple negative consequences of compaction, tests are necessary to determine the footprint of each type of tire (with various constructive and functional characteristics) for the farmers to use the most adequate pressures and stresses for proper crop development and reduced energy consumption. At the contact with a hard soil can be established the shape of footprint and the geometrical dimensions of the footprint, and experimental tests should start with these, under the influence of wheel load and tire inflation pressure.

MATERIAL AND METHOD

Tests were carried out in laboratory conditions, at INMA Bucharest and the objective was to study the influence of tire inflation pressure and wheel load on the footprint area between hard soil and tire. It was tested the right side rear wheel of Romanian RM-5 biaxial trailer (Figure 3), with tires model Danubiana 11.5 / 80-13.5 profile D179 (tire width 290 mm, tire diameter 845 mm).

Contact pressure or the pressure measured at the interface between the tire and soil, respectively the size of footprint were determined using the most modern system for pressure measuring that is currently available on the market – namely the mesh type Tekscan Industrial Sensing sensor for measuring of contact pressure (with minimum size of sensitive surface 850 mm x 550 mm). The sensor (Figure 4) is formed of: connection to data acquisition system (1), sensels or sensitive elements (2) and connection wires between the sensels (3).

Fig. 3 – Biaxial transport trailer RM - 5

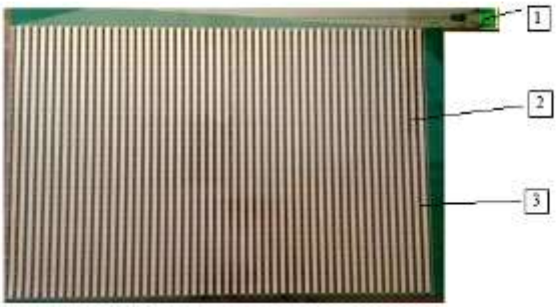

Fig. 4 – Mesh-type Tekscan Industrial Sensing sensor

The pressure sensor was covered with a protective polyester film (size 650 mm x 550 mm) against tensioning. Also, the sensor was connected to an electronic data acquisition system VersaTek Handle and to a laptop. Wheel load was varied by loading the trailer with metal weights and measured using an RW-10PRF weighing machine type platform with electronic indicator (4.56 kN; 9.22 kN; 12.8 kN; 17.11 kN; 21.18 kN). For each wheel load, the tire inflation pressure was also varied using a compressor and a pressure gauge (180 kPa; 210 kPa; 240 kPa; 270 kPa; 300 kPa), thus obtaining different footprint areas (Figure 5).

Fig. 5 – Aspects from the testing with the mesh type sensor

One of the great advantages of the Tekscan system is that the I-Scan software displays in real-time: 2D and 3D footprints, pressure distribution in the footprint, values of footprint area, contact pressure, maximum pressure, force and their variation in time.

RESULTS

Experimental data, both for the values of input and output parameters considered and analyzed in this paper are presented in Table 1.

Table 1

Values of measured and determined parameters

Wheel load Q [kN]	Tire inflation pressure p_i [kPa]	Footprint area A [m^2]	Footprint width b [m]	Contact pressure p_c [kPa]
4.56	180	0.0312	0.206	146.093
	210	0.0297	0.203	153.185
	240	0.0280	0.190	162.660
	270	0.0257	0.186	177.280
	300	0.0234	0.156	194.788
9.22	180	0.0497	0.242	185.479
	210	0.0445	0.220	207.158
	240	0.0416	0.208	221.544
	270	0.0401	0.205	229.513
	300	0.0369	0.203	249.236
12.8	180	0.0658	0.252	194.254
	210	0.0602	0.243	212.568
	240	0.0562	0.237	227.628
	270	0.0550	0.228	232.541
	300	0.0509	0.220	251.133
17.11	180	0.0867	0.288	197.343
	210	0.0766	0.267	223.237
	240	0.0728	0.239	234.930
	270	0.0699	0.236	244.638
	300	0.0664	0.220	257.402
21.18	180	0.0988	0.248	214.283
	210	0.0852	0.240	248.425
	240	0.0777	0.238	272.436
	270	0.0748	0.223	282.954
	300	0.0734	0.220	288.524

From the analysis of the footprints shown in Figures 6 - 9 it can be seen that as tire inflation pressure increases, footprint area decreases. Given that wheel load is applied in a smaller area, is obtained an increase in the contact pressure. As the wheel load increases, at constant tire inflation pressure is obvious the increase in the footprint area.

For the minimum wheel load of 4.56 kN corresponding to the empty trailer, at tire inflation pressures varying between 180 and 300 kPa., footprint area varies between 0.023 and 0.03 m^2 (Figure 6).

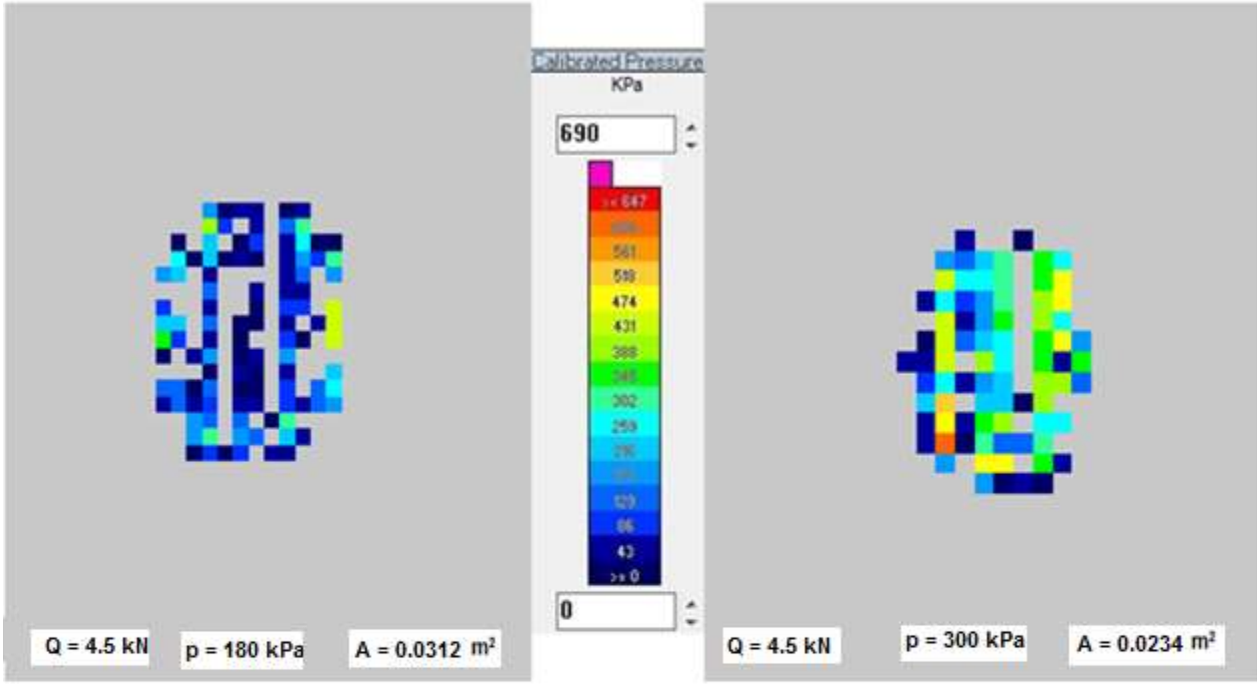

Fig. 6 - Footprint shape at 4.56 kN wheel load for minimum and maximum tire inflation pressure

For the second wheel load of 9.22 kN corresponding to the trailer loaded with one metal plate, at tire inflation pressures varying between 180 and 300 kPa, footprint area varies between 0.0497 and 0.0369 m^2 (Figure 7).

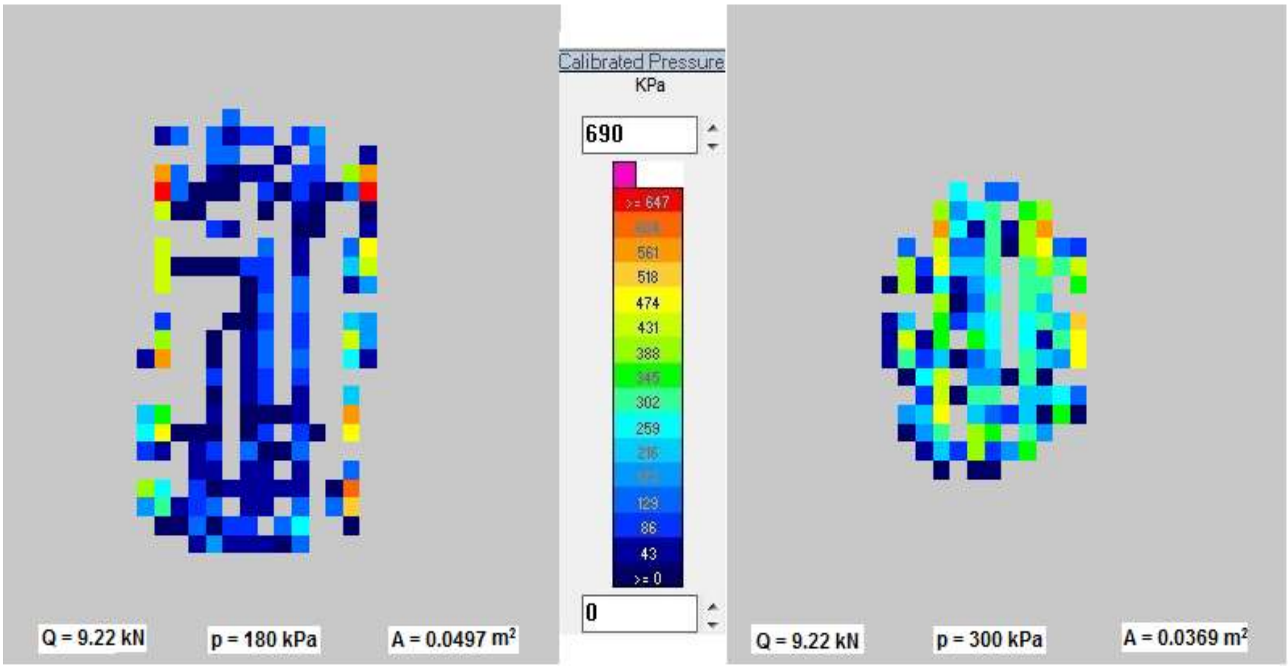

Fig. 7 - Footprint shape at 9.22 kN wheel load. for minimum and maximum tire inflation pressure

For the third analyzed wheel load of 12.8 kN. corresponding to the trailer loaded with two metal plates, at tire inflation pressures varying between 180 and 300 kPa, footprint area varies between 0.0658 and 0.0509 m^2 (Figure 8).

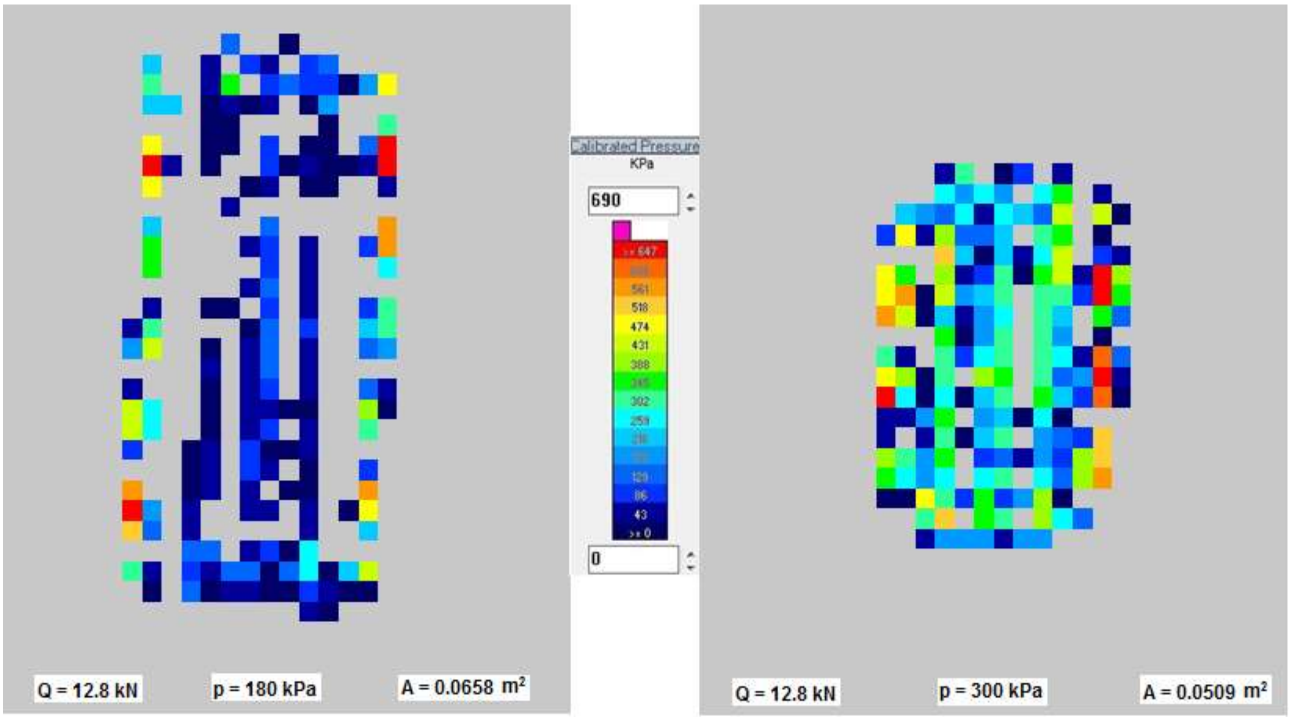

Fig. 8 - Footprint shape at 12.8 kN wheel load for minimum and maximum tire inflation pressure

For the third analyzed wheel load of 17.11 kN corresponding to the trailer loaded with three metal plates, at tire inflation pressures varying between 180 and 300 kPa, footprint area varies between 0.0867 and 0.0664 m^2 (Figure 9).

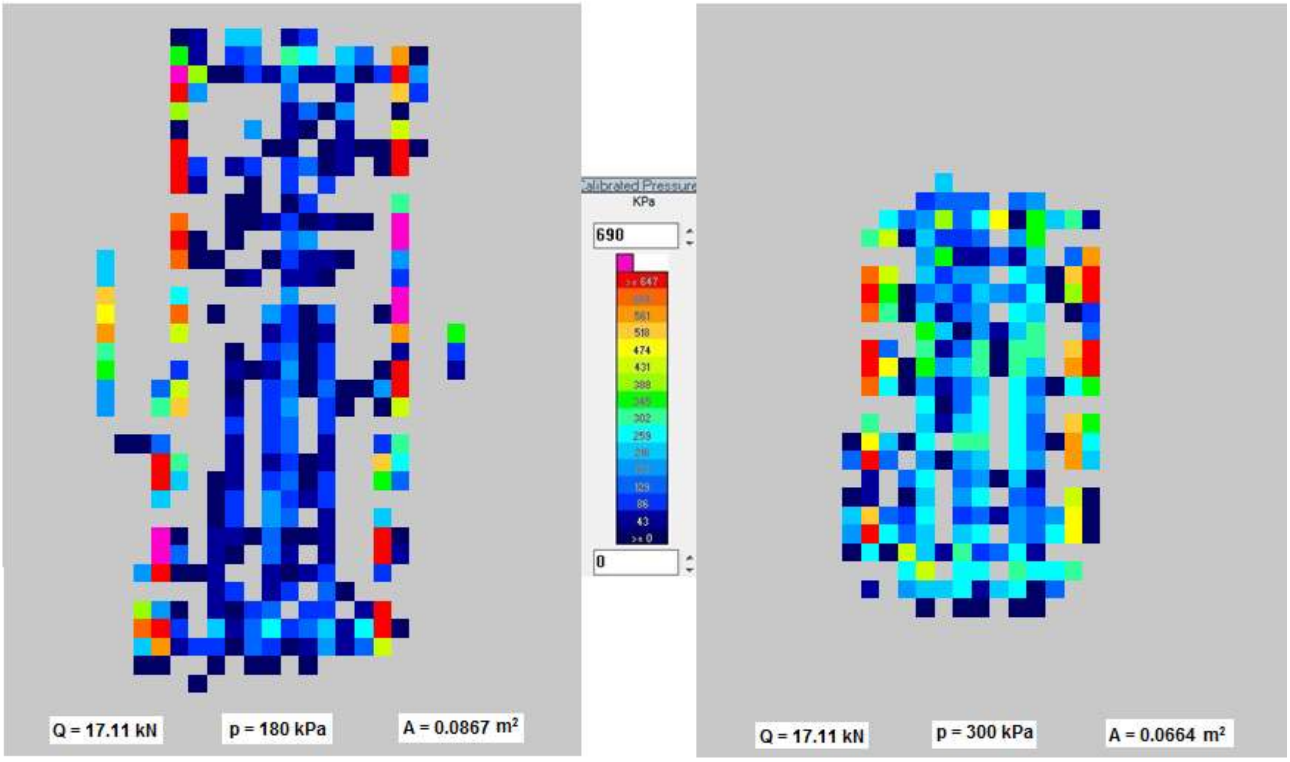

Fig. 9 - Footprint shape at 17.11 kN wheel load for minimum and maximum tire inflation pressure

For the maximum wheel load of 21.18 kN. corresponding to the trailer loaded with four metal plates, at tire inflation pressures varying between 180 and 300 kPa, footprint area varies between 0.0988 and 0.0734 m^2 (Figure 10).

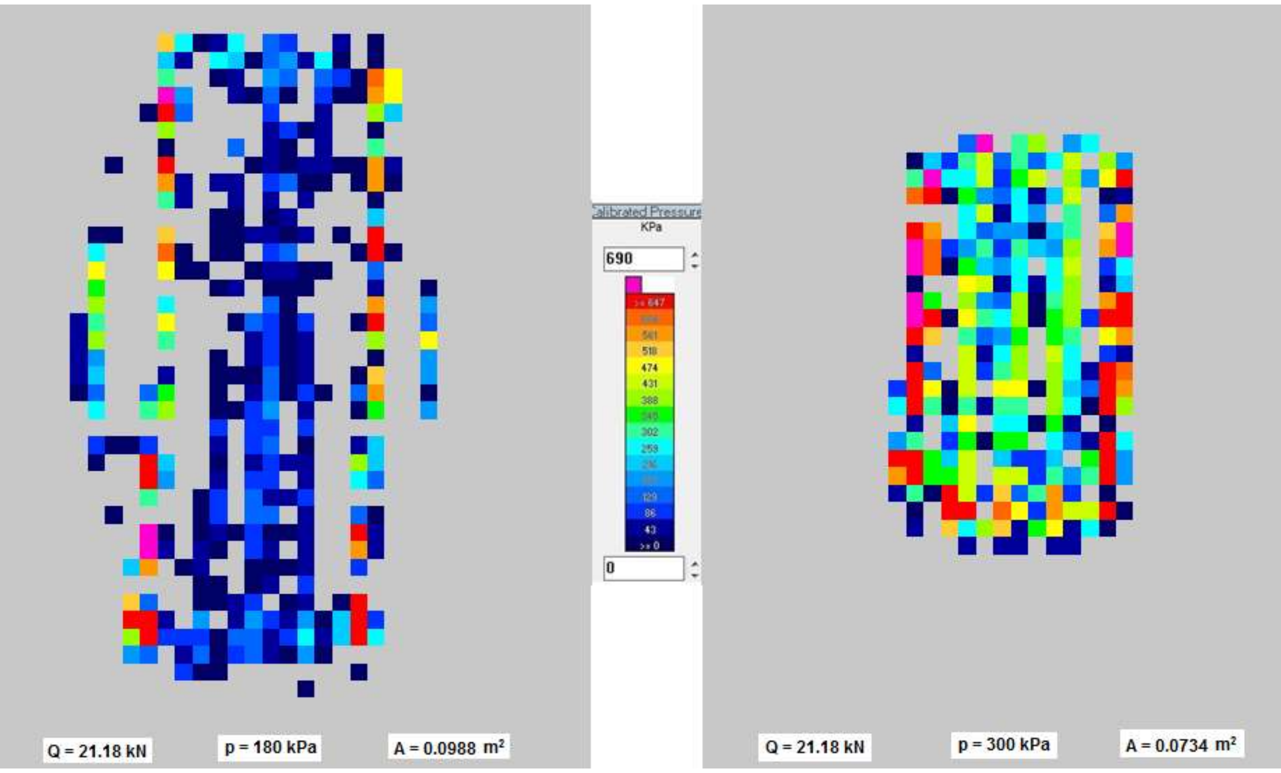

Fig. 9 - Footprint shape at 21.18 kN wheel load for minimum and maximum tire inflation pressure

As it can be seen from Figures 6 – 9, the shape of footprint has changed significantly during the tests. For example, when tire inflation pressure was minimum (180 kPa), at minimum wheel load (4.56 kN) the obtained footprint shape was rather elliptical, while by increasing wheel load to the maximum (21.18 kN) the footprint shape tends to be rectangular with slightly rounded corners. At maximum tire inflation pressure, regardless of wheel load, the shape of the footprint tends to be elliptical. In all analyzed cases, contact pressure increases with increasing tire inflation pressure and also with increasing wheel load.

CONCLUSIONS

Footprint is the interface through which the forces applied by agricultural machinery on the surface of soil are transmitted into soil depth. Wheel load and tire inflation pressure are two important factors that determine through the footprint area, the depth at which the stresses are distributed in the soil, and hence the intensity of artificial compaction. Contact pressure is mainly determined by tire inflation pressure and wheel load, and also by tire dimensions and tire stiffness.

A measure to reduce soil compaction refers to reducing the contact pressure by decreasing the wheel load or by increasing the contact area between the wheel and the soil. To limit compaction, the contact area must be as large as possible, for the contact pressure to be lower and the stresses to propagate as close as possible to soil surface. Using large tire inflation pressures, the contact area is smaller, contact pressure is higher and the soil will be compacted at greater depths, with negative ecological and agronomic consequences.

ACKNOWLEDGEMENT

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THE ROLE OF MATHEMATICAL MODELING IN RESEARCH IN THE FIELD OF BIOACCUMULATION OF HEAVY METALS
/
ROLUL MODELARII MATEMATICE IN CERCETARILE IN DOMENIUL BIOACUMULARII METALELOR GRELE

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***Keywords**: bioaccumulation, heavy metal, mathematical model.*

ABSTRACT
This article presents the role and mathematical modeling importance in research and development of experimental plan. Although the results presented refer only to the field of biology, the presented method is valid for any field of activity. The results refer to research about bioaccumulation of heavy metals in plants. It is exposed how the mathematical modeling of the phenomenon, even under the most elementary form, suggests the basics of the experimental plan. The experiments performing, taking into account the mathematical models suggestions, lead to the correction and the development of mathematical models. These will be able to give new predictions and utilities.

REZUMAT
In acest articol se prezinta rolul si importanta modelarii matematice in elaborarea planului experimental. Desi rationamentele se refera numai la domeniul biologiei. metoda de lucru prezentata este valabila pentru orice domeniu de activitate. Rationamentele se refera la cercetari despre fenomenele de bioacumulare a metalelor grele in plante. Se arata cum modelarea matematica a fenomenului, chiar sub cea mai elementara forma, sugereaza elementele de baza ale planului experimental. Se are in vedere ca realizarea experientelor tinand seama de sugestiile modelelor matematice, vor conduce, dupa prelucrarea rezultatelor la corectarea si dezvoltarea modelelor matematice. Acestea vor putea da noi predictii si utilitati.

INTRODUCTION
According to [3], some of the substances that form the crust of the Earth are elements that cannot be decomposed into simpler substances. Some of these elements are poisonous, even if these are present in a low concentration. These elements are known as heavy metals. Among heavy metals, [3] includes mercury, cadmium, arsenic, chromium, talc and lead.

More generally, according to [5], bioaccumulation is defined as the accumulation of substances (eg pesticides) in organisms of various types. It also states that bioaccumulation occurs in organisms when absorption occurs at a faster rate than elimination of the same substances by catabolism or excretion. According to [1], the longer the half-life of a toxic substance, the greater the risk of chronic poisoning, even if the levels of the toxin are not very high. According to [8], bioaccumulation in fish can be predicted by mathematical models. Expanding the bioaccumulation of heavy metals into other categories of biological material is currently a normal phenomenon. The importance of the consequences of the use of mathematical models in this field will be clear from the results of this article and from the resulting conclusions.

In order to better understand the phenomena related to the propagation of heavy metals in the environment (both in the mineral world and in the world of life),we should know the following definitions:

Accumulation of substances	Process or phenomenon[5] that involves *retaining* or *increasing the concentration*[6] (partial or total) of substances entering an environmental entity through contact with these substances and entities in any possible way.
Bioaccumulation	If the accumulation is in a living (biological) entity of the environment, then it is called bioaccumulation[7].

[5] Substance sequestration results in increased concentration of contaminant in the considered environmental entity (biological or not) at a value higher than normal in the same entity or than the normal environmental concentration.
[6] According to [7].
[7] It is also shown in [2] that the level (intensity or magnitude) of bioaccumulation depends on the absorption rate, the absorption mode and the rate of elimination, as well as on processes of transformation of the substance accumulated through metabolic processes, as well as other factors environment. All these dependencies are essential in shaping the bioaccumulation phenomenon.

Bio concentration	It is a particular case of bioaccumulation, where the substance that is bio accumulated has as its source only water.
Bio magnification	The term refers to the monotonous increase of the concentration of a substance in the biological tissues in a food chain. [9]. [4].

MATERIAL AND METHOD

The mathematical models of heavy metal bioaccumulation are part of the general category of mathematical models describing biology phenomena. These models are included in that branch of biology called biomathematics, [4] which is the branch of biology that deals with the application of mathematical principles in biology and medicine. Biomathematics has multiple applications in the well-known branch of biology: Comparative Genetics, Population Genetics, Neurobiology, Cytology, Pharmacokinetics, Epidemiology, Oncology, or Biomedicine.

Biodynamic bioaccumulation model

This model is presented in [6], being one of the simplest possible and obviously easier to use in the proposed investigations. The author [3] shows that the complexity of the metal accumulation process in plants and animals, as well as the multitude of internal and external factors that influence this process, require the introduction of unifying principles and simplifying hypotheses that allow the solving of mathematical models, using a small number of parameters. Obviously, the introduced simplifications must not remove the model from the real process. The model proposed by [6] is a biodynamic model based on the principle of conserving the mass. Mathematical models of bioaccumulation can be used according to [8], in double sense: a) to provide information on the degree of environmental pollution, if the bio-indicator concentration is known; b) creates the possibility of estimating the concentration at the biotic receptor level when the concentration is known in the external environment.

Several useful properties are retained in the construction of the model, according to [6]:

A. The bioavailability of metals depends on the environment and the chemical composition of the environment;

B. Only certain metal compounds are bioavailable;

C. Animals and plants possess mechanisms to regulate accumulation and elimination of heavy metals in the body;

D. Information about the process of bioaccumulation of a form of metal in a particular pathway cannot be transferred to another form or other path of accumulation;

E. The metals are neither created nor destroyed by the body, they may, only, pass from one form to another;

F. Accumulation capacity varies from organism to body and even for the same specie varies with age, sex, and route of exposure.

Unifying concepts and principles

According to [8], the main ideas of the model are:

I1) the principle of conserving the mass[8];

I2) the existence of multiple accumulation paths;

I3) the existence of an internal disposal mechanism.

The statement on the preservation principle on which the simple model presented in this chapter is based, is the following: **the variation in time of the amount of metal accumulated in the body is equal to the difference between the quantity taken and the amount eliminated**.

The list of the parameters used in the presented model is given in Table 1.

Table 1

List of parameters used in the biodynamic model of the bioaccumulation process

name	notation	Unit
denotes the total of the concentrations in the bio receptor system. c_i is the metal concentration in the bioreactor indexed with *i*	c	(%)
the mass flow entering the bio receptor *i*	F_i	s^{-1} (%/s)
the mass flow coming out of the bio receptor *i*	G_i	s^{-1} (%/s)
time	t	s
the set of parameters on which contaminant absorbs (receipt) depends	u	
the set of parameters on which contaminant loss (the elimination). depends	w	
Equilibrium concentration in the system	c^e	(%)

[8] This principle must be applied with great care. On the one hand we refer to biological entities that are either growing or not, so that can have mass variations, regardless of the process being pursued. On the other hand, depending on the time interval between the measurements, although the amount of contaminant increases in the bioreceptor, due to an appreciable increase in its mass, the concentration may decrease!

The direct absorption rate[9] of the contaminant from the external environment	k_i^u	s^{-1} (%/s)
Concentration of the contaminant in the external environment	c_w	%
Food preference factor	p_i^j	
Efficiency of chemical assimilation	α_i^j	
Diet rate	K_i^j	
Elimination rate	k_i^e	

For a system of interconnected bioreceptors and a single contaminant, the mathematical model of metal accumulation in organisms is given (proposed) by the system of ordinary differential equations:

$$\frac{dc_i}{dt} = \mathfrak{F}_i(c,u) - \mathfrak{G}_i(c,w)),\, i = 1,\ldots,n \tag{1}$$

When the system is in equilibrium, the input flow is equal to the output stream. This hypothesis results in the value of the equilibrium concentration in the bio receptor system:

$$\mathfrak{F}_i(c^e,u) = \mathfrak{G}_i(c^e,w)),\, i = 1,\ldots,n\,. \tag{2}$$

The value of the equilibrium concentration resulting from (2) includes the contribution of the assimilation and elimination mechanisms.

Also, as a principle of model construction, is retained from [6], the hypothesis of hierarchical indexing of bio receptors. By hierarchical indexing, it is understood that if *i*<*j*. then the bio receptor *i* can be the source of feed for the bio receptor *j*. In addition, the following assumptions are made:

Ia) for all *j* and *i*. with $i \le j$. the bio receptor *j* cannot be the source of feed for the bio receptor i;

Ib) mass flow depends linearly on mass concentrations;

Ic) the elimination flux depends only on the internal mass concentration of the bio reactor.

The author [6] asserts that, based on the Ia, Ib and Ic assumptions, F and G flows can be explained as:

$$\mathfrak{F}_i = k_i^u c_w + \sum_{j=1}^{n} p_i^j \alpha_i^j K_i^j c_j,\ \mathfrak{G}_i = k_i^e c_i,\ i = 1,\ldots,n\cdot \tag{3}$$

The food preference matrix satisfies the following properties:

$$p_i^j = 0 \text{ for } j \ge i \tag{4}$$

and if there is j, so $p_i^j \ne 0$, then:

$$\sum_{j=1}^{n} p_i^j = 1\ \cdot \tag{5}$$

For the following statements. we use a partial order relationship on $\mathbb{R}^n$. defined by the formula:

$$x \ge y \text{ if } x_i \ge y_j \quad \forall i = 1,\ldots,n \tag{6}$$

The author [8] lists two important properties of the mathematical model defined by (1) and (3):

• Independent of the initial state of the system, the solution tends asymptotically to the state of equilibrium when time tends to infinite:

$$c(t) \to c^e \text{ for } t \to \infty \tag{7}$$

• The steady state monotically increasing depends on the accumulation rate in the external environment and the concentration of the contaminant in the external environment:

$$c_1^e \ge c_2^e \text{ if } c_{w1} \ge c_{w2} \tag{8}$$

$$c_1^e \ge c_2^e \text{ if } k_1^u \ge k_2^u \tag{9}$$

• The equilibrium point is monotonically decreasing relative to the elimination rate:

$$c_1^e \ge c_2^e \text{ if } k_1^e \le k_2^e\,. \tag{10}$$

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[9] The rate of a chemical, physical or other process, designates what needles in mechanics means the speed of the process. Thus, the direct take-up rate of the contaminant from the external environment is measured in percent per unit of time. Percentage measurements are made in the percentage concentration of the contaminant in the bioreceptor. At the same time, the external environment of the bioreactor loses contaminant, and its elimination rate must be measured in percent of the contaminant lost per unit of time, but referring to the contaminant concentration of this bioreactor external environment. Obviously, for clarity, the transfer rate of the contaminant from the external environment to the bioreactor should be expressed in mass units per unit time and then converted to bioreactor concentrations, respectively, for the outside of the bioreactor.

Using the assumptions (3), which give the forms of input and output flows in the system, the system (1) can be written in compact form:

$$\frac{dc}{dt} = Ac + k^u \tag{11}$$

with the initial conditions:

$$c(0) = c_0 \ . \tag{12}$$

Matrix A is a triangular inferior matrix due to hypothesis Ia. In these conditions, after [8].,the general solution of the equation (11) with the initial conditions (12) is of the form:

$$c(t) = \exp(At)c_0 + \int_0^t \exp(A(t-s))k^u ds \ . \tag{13}$$

RESULTS

A first category of results that will be used in the elaboration of the experimental plan forms the sketch of a set of process parameters. Among these parameters, will be select those who need to be directly or indirectly measured. The list of important parameters of the accumulation process is given in Table 1.

A second category of results consists of exploring various types of environmental phenomena that can cause bioaccumulation or, why not, bio-drain. The author [8] gives the classical solutions for the phenomena of attenuation of a shock initially applied to the model through the initial conditions.

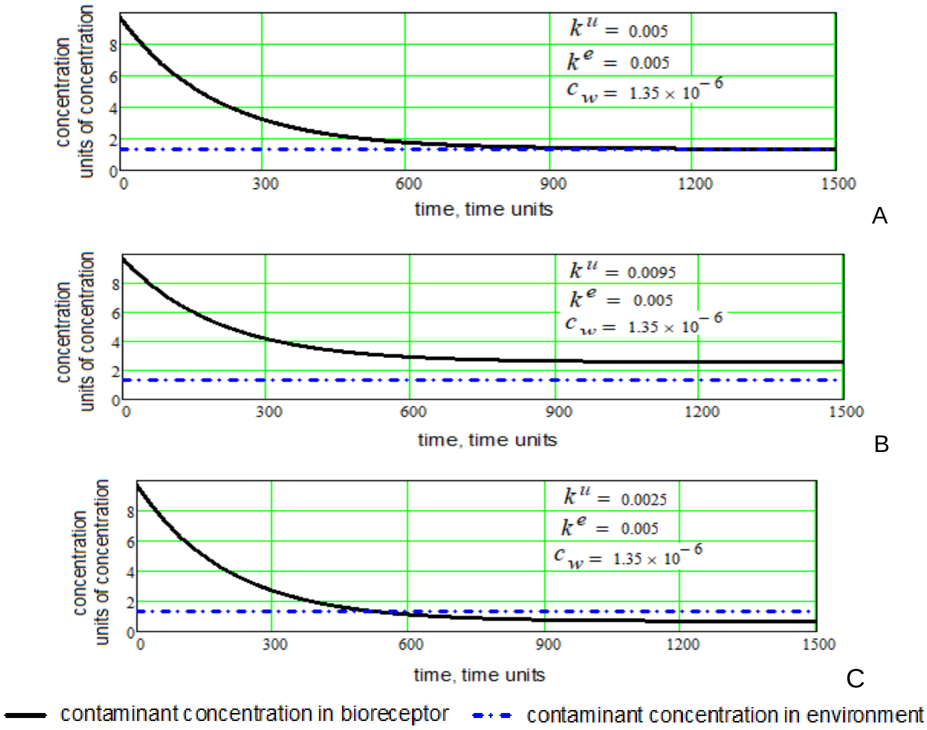


Fig. 1 - Variation of contaminant concentration in the receiver in the case of initial pollution simulated by an initial non-zero value of the concentration in the bio receptor. The initial value of the concentration in the bio receptor was assumed c_0 = 0.00000975 units of concentration, higher than that of the contaminant in the medium

The solution for attenuating an initial shock is a simple analytic solution and can be used to predict the time to return to balance and to predict equilibrium concentrations (in the environment and in the plant). A numerical solution for three different cases of plant structure is given in Figure 1.

The use of numerical solutions opens the perspective of building simulators that can create complex environmental events. They can also simulate bioaccumulation phenomena for plants with a more complex structure. The effect of a contaminant wave on a plant with an initial concentration zero of the contaminant is described for the three plant structure cases in Figure 2.

This second category of results opens multiple perspectives for modelling the bioaccumulation phenomenon and shows clearly the usefulness of the models: first the mitigation prognosis, secondly the values at which the concentration of the contaminant in the plant will stabilize.

Finally, a third result is the bioaccumulation simulator based on this model. This simulator can be developed in different directions by completing with additional relationships, restrictions, or even new parameters.

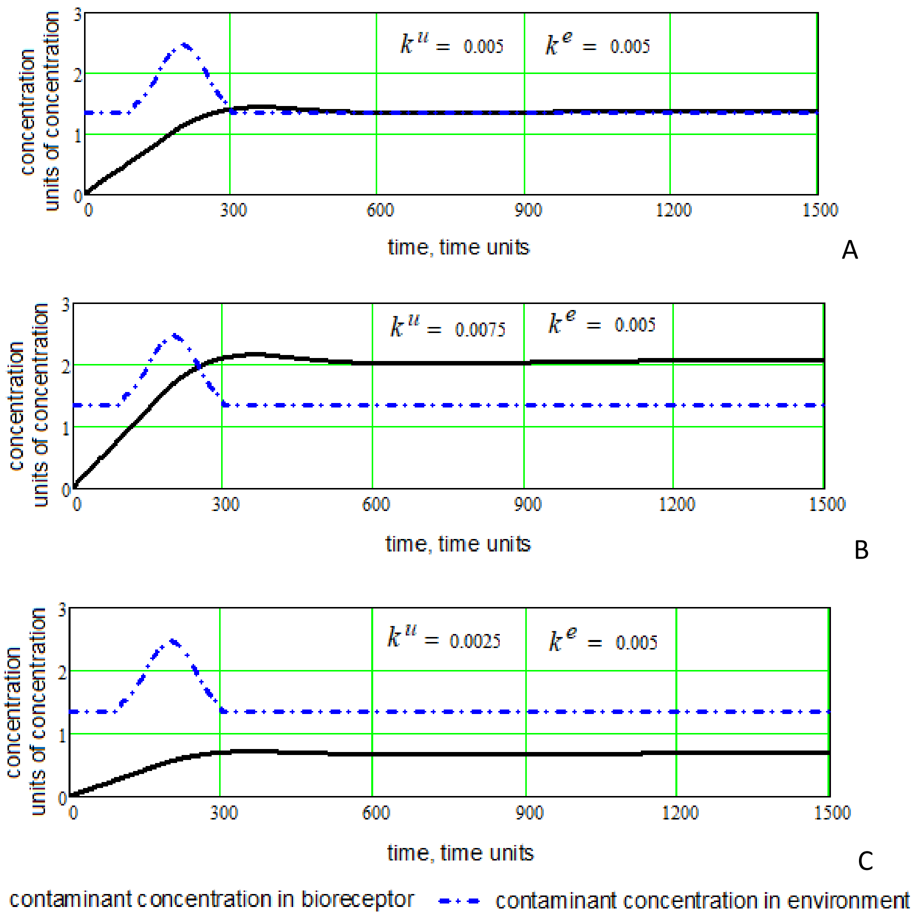
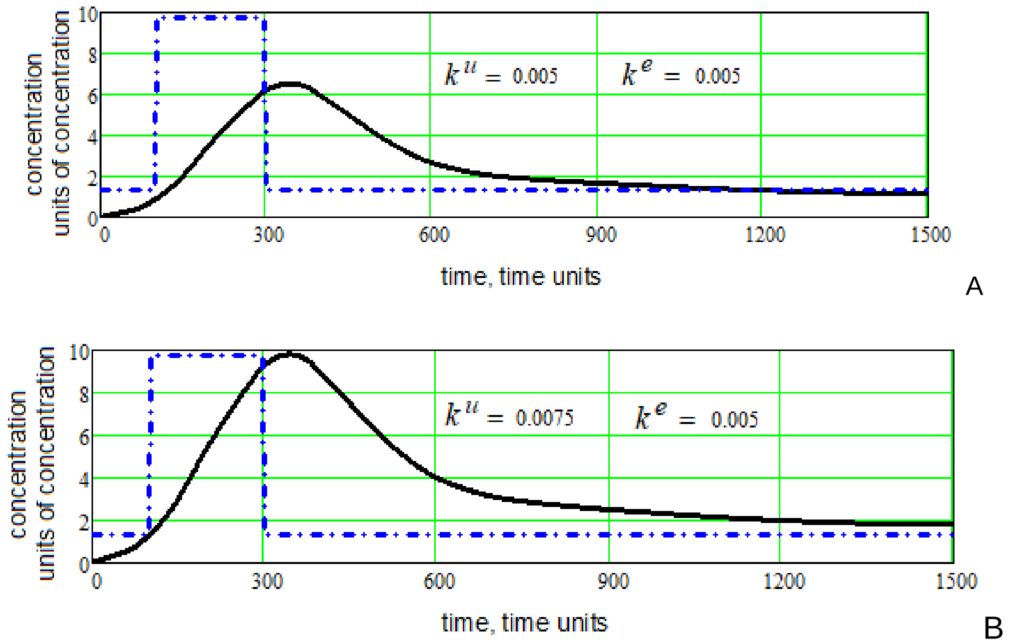


Fig. 2 - Variation of the contaminant concentration in the receiver in the case of environmental pollution with a contaminant stream that alters the concentration of the contaminant environment in a continuous, increasing sense. The baseline concentration in the bio receptor was assumed to be c_0=0.00 units of concentration to observe the description of the impact of the pure contaminant wave.



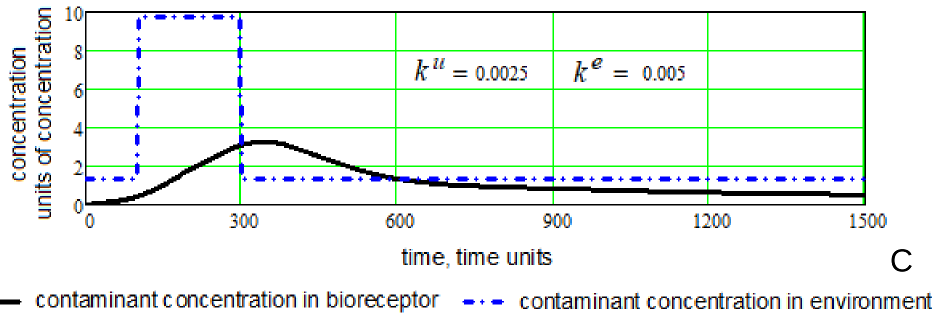


Fig. 3 - Variation of contaminant concentration in the bio receptor in case of environmental pollution with a rectangular wave contaminant that alters the concentration of the environment in the contaminant. The initial value of the concentration in the bio receptor was assumed to be c0=0.00 units of concentration to observe the description of the impact of a pure contaminant.

CONCLUSIONS

The conclusions of this study refer to two problems: the value of the model and its perspectives. Respectively, specifying by the terminology of the mathematical model the parameter list that will be the subject of the experiments.

As for the model, at least intuitively, its behaviour or relatively short duration is in line with reality. The attenuation of environmental pollution phenomena, the prediction of stabilization of high concentrations over time, confirm our general observations and intuition.

From the experimental point of view, the model shows that the concentrations of contaminant in the environment and in the plant at a significant number of moments, as well as the determination of the accumulation and elimination rates, are the most important parameters in performing the experiments and rewriting the models.

A number of development perspectives poses more difficult issues, but they will be explained and modelling will be attempted at the right time.

The model presented is not yet sufficient for an isolation pattern of a plant in a pot, because if the soil is considered the environment then, in the case of a strict initial load, the concentration of the contaminant in the medium should decrease. The model presented cannot simulate satisfactory this phenomenon. Therefore, to solve this problem, it is recommended to use a mathematical model with two biodynamic components.

ACKNOWLEDGEMENT

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ECOLOGICAL IMPLICATIONS OF MECHANICAL EXECUTION OF WORKS IN AGRICULTURE
/
IMPLICATII ECOLOGICE ALE EXECUTARII MECANIZATE A LUCRARILOR IN AGRICULTURA

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Keywords: *pollutant emissions, vibrations, noise, soil pollution, water pollution.*

ABSTRACT
Agriculture mechanization has a positive part, foremost in terms of ecology, because it assures the technical support for applying the sustainable farming systems. At the same time, the agricultural mechanization works are followed by certain negative effects, of different importance. Usually, these effects cannot be avoided, but through a rational exploitation of equipment and judicious choice of technology, they can be maintained at a low level. The paper presents aspects related to pollution of air and immediate environment, soil and water pollution as a result of execution of mechanized works in agriculture, as well as the possibilities of diminishing these polluting effects.

REZUMAT
Mecanizarea agriculturii are un rol pozitiv din punct de vedere ecologic in primul rand prin faptul ca asigura suportul tehnic pentru aplicarea sistemelor de agricultura durabila. In acelasi timp, executarea mecanizata a lucrarilor din agricultura este insotita de unele efecte negative, de amploare diferita. Aceste efecte sunt in principiu inevitabile, dar prin exploatarea rationala a utilajelor si alegerea judicioasa a tehnologiilor, ele pot fi mentinute la un nivel mai scazut. În lucrare sunt prezentate aspecte privind poluarea atmosferei, a mediului apropiat. a solului si a apei ca urmare a executarii mecanizate a lucrarilor din agricultura, precum si posibilitatile de diminuare a efectelor poluante.

INTRODUCTION
Agriculture mechanization enables to perform the production processes. Without mechanization, the agricultural production cannot be achieved. In current state and on long term also, mechanization ensures the appropriate conditions necessary for agricultural systems performing according to sustainable development, the foremost goal in all activity domains.

Mechanization offers technical solutions suitable for sustainable agriculture works, soil and soil water preserving, in order to protect the global atmosphere and immediate environment. Ecologically speaking, agriculture mechanization plays a positive important part.

On the other hand, agriculture mechanization results in negative effects, namely environment pollution, both by the specific of its activity and when combining with other factors related to production.

MATERIAL AND METHOD
In figure 1 are schematically shown the main pollutant effects following the utilization of technical equipment for agriculture mechanization. The importance and severity of pollutant effects are different. Most polluting effects directly ensue by utilization of technical equipment, tractors and agricultural machines necessary to farming mechanization.

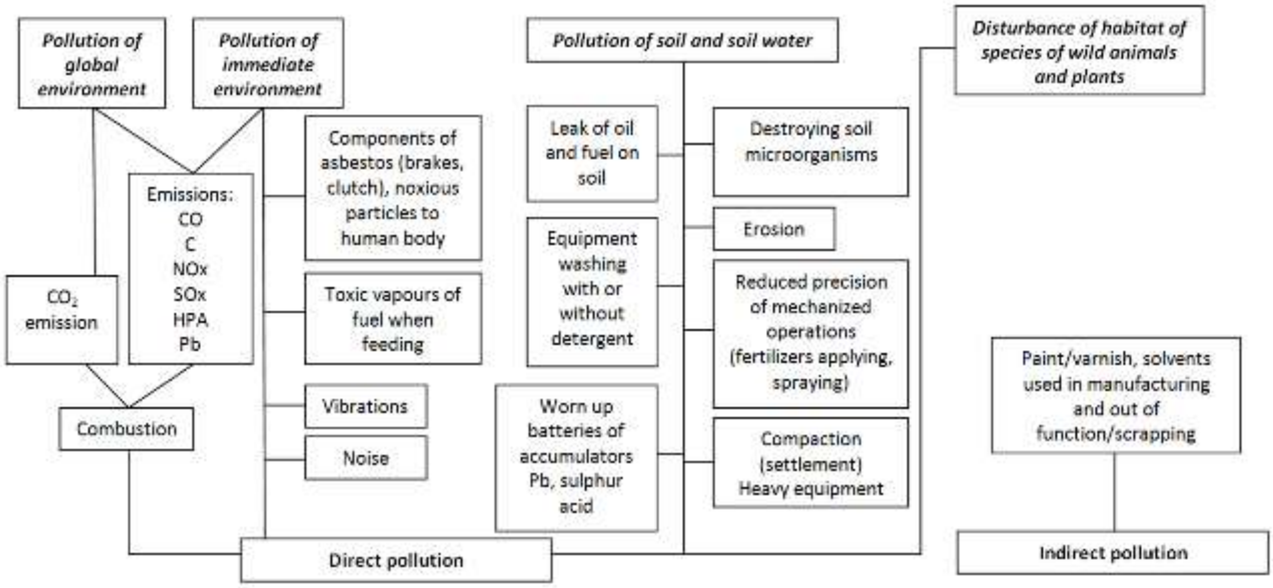

Fig.1 – Main pollutant effects of technical means utilization necessary to agriculture mechanization

RESULTS

Pollution of atmosphere following the fossil fuels combustion

Diesel oil combustion in Diesel engines of tractors and self-propelled machines is accompanied by emission of combustion gases, namely CO_2, C, NOx, SOx, aromatic polycyclic hydrocarbons.

Emission of CO_2 constitutes the most severe polluting factor. Carbon dioxide inevitably results following the combustion and after a certain time, it reaches the atmosphere upper layers and thus, together with other CO_2 quantities coming from other fields activities they worsen the greenhouse effect, that has serious negative consequences on global climate.

It is also well known that the greenhouse effect, as a result of CO_2 accumulation in atmosphere upper layers, has natural causes related to emissions produced by volcanoes, oceans, forests, etc.

Anthropogenic causes of greenhouse effect worsening, namely those related to people activities – industry, transport, agriculture, household consume of fossil source energy – have become worrying in the latest decades.

Any consume of Diesel oil generates a certain quantity of carbon that, once reaching the atmosphere increases the carbon dioxide amount and aggravates the greenhouse effect.

Pollution of environment following the utilization of electric energy coming from thermo electric power stations burning fossil fuels

Proper electric energy consumption does not pollute the environment, because any emissions are not generated. Therefore, electric energy is considered to be very "clean" on the spot. But, if it is considered in a larger sense, its polluting effect is given by the primary source on which the *producing of electric energy* is based.

Any consumption of electric energy coming from thermal stations based on fossil fuels combustion is polluting at planet level.

Pollution of immediate environment following the use of technical means necessary to agriculture mechanization

The term of immediate environment is rather relative. In terms of agricultural tractors and machinery activities, the following effects are taken into consideration:

- Pollutant effects supported by persons that work directly with farming equipment:

- *Noise* produced by engine, tractor, machine; level of noise measured in dB is higher in cabin or area near the noise source. The high noise level may affect the auditory apparatus, but the general health also [2]. [7]. [8];

- *Vibrations* produced by moving parts of agricultural tractors and machinery; vibrations at which the person working with agricultural machine is exposed, that negatively influence the person's well-being, reduce work capacity and affects health [2]. [7]. [8]. Vibrations determined by engine mechanisms, transmission and working equipment operation also generate low frequency vibrations, the so-called jolts provoked by field unevenness encountered by tractor or machine wheels. Exposure to vibrations is more often encountered in agricultural self-propelled tractors and machines cabins. From technical reasons, self-propelled tractors and machines have no suspensions. Therefore, the main part in diminishing the vibrations effects is taken by cabin seat. Human body is particularly sensible to vibrations of relatively reduced frequency, of 4 to 6 Hz. At this frequency, many of vital organs of human body begin to vibrate (Fig. 2).

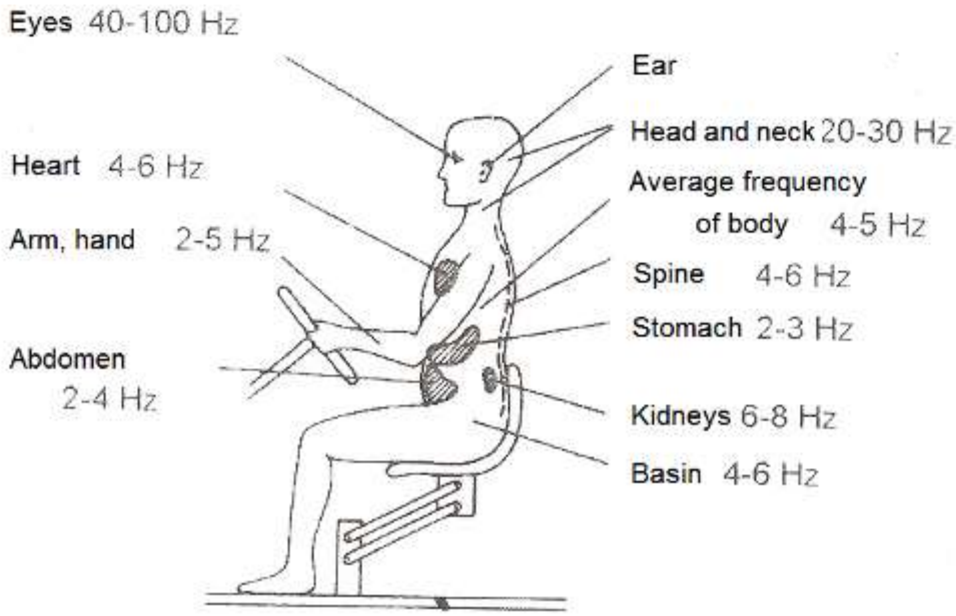

Fig.2 – Frequency of vibrations that affect human health when working in cabin of self-propelled tractor or machine

- *Emissions of gases and powders*; a part of engine combustion gases reaches the area of work of operator, that, inhales them involuntary. Some substances coming from combustion gases, such as carbon, carbon monoxide, aromatic polycyclic hydrocarbons, sulphur dioxides, natrium oxide, lead constituents affect human health [4]. [6].

- Pollution of plants by substances contained in exhaust gases.

Recent researches made in certain countries have found that some toxic substances are taken over by the plants situated on sides of way on which tractors or motorcars are running, this representing a higher or lower risk of pollution.

The inhalation of fuel vapours, generated when feeding, is also noxious for the tractor's operator.

At the same time, the fibrous particles resulted from the wear of friction of asbestos gaskets of brakes and clutches of tractors and harvesting combines, have also a noxious effect.

Pollutant powders, soil particles of plants, particles coming from chemical substances are the result of certain operations in the field such as soil works, applying chemical fertilizers, mechanized harvesting of cereals, but also following stationary works, such as grains cleaning by means of cleaning machines.

Pesticides treatment mechanized applying can be very noxious to humans. In order to reduce their negative effects, not only the machines should be perfected technically speaking, but also special protection measures should be taken for humans, for example, wearing the protection gas mask and special equipment [3]. [5].

At many agricultural equipment with which human beings must work, concomitantly interfere more than one stress: vibrations and noise, physical and psychical stress, inhalation of noxious gases and dust. etc. This is the case of many operations made by tractor and machine in the field or with harvesting combines.

Up-to-date cabins of tractors and harvesters contribute a lot to human well-being, protecting him against these stresses [2]. [6]. [8].

There are also machine aggregates that intensely stress the operator. For example when mowing by means of a motor mower in a slope field, the operator must walk, so his physical effort for handling the machine is rather big and he directly feels the machine's parts vibration and inhales the exhaust gases.

- Pollution of immediate areas

Pollution of areas near the spot where the mechanized operations are performed may disturb rural areas inhabitants, or in case of agricultural tourism, the respective tourists.

Noise, combustion gases, powder can also negatively affect the environment and the operator. Chemical substances spread when applying fertilizers and especially when spraying with pesticides are mainly responsible for the environment pollution but the low quality of mechanized operation increases the risk of pollution in nearer areas. The main cause is given by the reduced precision of dosage and especially low spraying quality, the scattering tendency of drops of solution, that are driven away by the air currents outside the crop field.

- Risk of causing work accidents

When the mechanizing equipment is correctly used, the risk of injuries of operator that commands the agricultural tractor or machine is diminished, but not completely removed. Accidents may result at tractor's overturning, detachment of parts when certain sub-assemblies are suddenly damaged, human body moving parts gripping and others. Thus, the design of machine plays an important role in protection against work accidents.

Pollution of soil and soil water at the utilization of technical means necessary to agriculture mechanization

Soil compaction or immoderate settlement represents one of the most frequent and severe forms of pollution determined by mechanization.

Compaction in surface layers is generally caused by heavy equipment- wheels of heavy tractors and machines and is aggravating by repeated passing. Immoderate compaction negatively changes the soil characteristics and circulation regime of air and water.

Compaction of lower layers appears, for example at recurring ploughing at the same depth.

Pollution of soil and soil water appears because of the reduced precision of mechanized operations performed with chemical substances, for example operations of applying chemical fertilizers and mechanized works of fighting against plant weeds and pests. The main responsible factor of pollution is represented by chemical substances, but great precision mechanizing equipment can maintain the pollutant effects within acceptable limits. On the contrar, reduced precision of machines. especially related to dosage uniformity, drops fineness and uniformity may worsen chemical polluting effects [5]. [6].

Soil erosion has many causes, but in certain conditions mechanization itself can aggravate this by the inappropriate execution of soil works in slope field or by operations that pulverize the soil that afterwards is blown by the wind.

Destruction of microorganisms in soil as a result of mechanical interventions is not so *important,* but is unavoidable.

Soil and soil water pollution determined by leaks of oil and fuel. Lubricants influence health and safety of persons which use them and, at the same time, the environment [1]. It is known that one drop of mineral oil on soil, coming from engine, transmission or hydraulic installation of tractor or agricultural machine is not biodegradable and gradually reaches the groundwater, polluting it. One single drop of mineral oil pollutes one million of water drops, namely: 1 litre of mineral oil pollutes 1,000,000 litres of water.

Oil leaks appear following inappropriate or worn gaskets, but also from hydraulic houses decoupling. The most recent types of tractors are endowed with hydraulic hoses with special construction couplings, enabling to produce a suction when decoupling, avoiding the oil dripping.

Diesel oil leak on soil has similar effects. They may appear when there are inappropriate gaskets or the feeding system fails, but also from different other reasons. Risk of *Diesel oil leak* doesn't appear only in case of unsuitable maintenance of tractor. From two of Romanian types of tractors existing, they are endowed with a system that ensures the air removing from feeding syste, by pumping; therefore, the Diesel oil still contains air bubbles flows and if the tractor is in field, it flows on soil.

*Residual waters coming from washing mechanizing equipment with or without detergents ma*y enter the soil and respectively water from soil. The risk of pollution is rather higher if, by washing, residues of chemical substances are taken over.

Old batteries of accumulators from tractors and harvesting machines with lead plates and electrolyte solution of sulphur acid represent a polluting source when they are recycled without taking the necessary precaution measures.

Disturbance of habitat of species of wild animals and plants

Mechanization works bring discomfort to animals and birds habitat. The negative effects are represented by the noise stress till the destruction by mechanical action of nests or dens, for example during soil works, up to the mortal injury during certain soil works or harvesting works.

Indirect pollution caused by equipment for agriculture mechanization

The indirect pollution is that appeared when manufacturing agricultural tractors and machines, as well as when putting the equipment out of function/scrapping it, through the noxious effect upon the environment caused by paint, varnish, solvents, etc.

Pollution cannot be avoided but its level can be maintained as low as possible if the equipment is rationally exploited and especially, if specific methods of reducing the pollution risk are taken. Reduction of pollution risk by emissions of CO_2 :

- ➢ Diminishing specific consumption of Diesel oil needed by mechanized agricultural operations through:
  - a correct choice of technologies, giving priority to those implying reduced energy consumption, renouncing at works that are not compulsory and do not raise the production;
  - rational use of mechanizing equipment at its normal capacity, avoiding to surpass the appropriate charge;
  - maintainance and correct setting of engines of self-propelled tractors and machines; appropriate adjustment of the injection pump and injectors, utilization of clean air and fuel filters;
- ➢ - total or partial substitution of Diesel oil by biofuel, such as rape oil.
- ➢ - reduce the consumption of gasoline, fluid fuel for heating, natural gases, charcoal in the same way as for Diesel oil [6].

- Reduce pollution of immediate environment:
  Improving the construction of mechanizing equipment aimed at diminishing vibrations, noise and removing the sources of pollution with toxic fuel vapours, combustion gas, including the noxious additives, renouncing at asbestos fibres components for clutches and brakes [6].
- Reduce the pollutant effects on soil and water in soil:
  - ➢ adopting technologies, methods and works causing less soil compaction; avoiding to use heavy agricultural equipment;
  - ➢ increasing the precision of mechanized operations of applying fertilizers, especially chemical fertilizers and pesticides necessary to plants protection. This aims not only at the proper works, but also the afferent ones, especially those related to handling of chemical substances when filling or emptying. etc.;
  - ➢ perfecting the mechanizing technologies and their related equipment for ensuring a mechanization without chemicals and protecting plants by fighting against weeds by mechanical means and biologically remove the pests;
  - ➢ performing mechanized works able to avoid the soil erosion [6];
- Consistently avoiding the pollution by oil and fuel leaks on soil; uncontrolled flow of waste water coming from equipment washing; suitably handling the accumulators batteries;
- Reducing the negative effects of mechanized works that disturb the habitat of wild animals and plants:
  - ➢ Adopting technical measures for diminishing the risk of accidents of wild field animals, especially during the mechanized harvesting of different crops, namely equipping the machine with warning devices that make the animals leave the area where the machine is to work [6].

CONCLUSIONS

Farming mechanization plays a positive part first, in terms of ecology, because it assures the technical support for applying the sustainable farming systems.

At the same time, mechanized execution of farming works is accompanied by certain negative effects of different importance. As a general basis, they cannot be avoided, but through the rational exploitation of equipment and suitable choice of technologies, they may be maintained at a lower level.

The most important pollutant effect is that caused by combustion of Diesel oil and other fossil fuels, process following which the CO_2 quantity in atmosphere increases, thus worsening the greenhouse effect with negative consequences on global climate. This risk is diminished by reducing specific consumption of fuel and replacing fossil fuels with biofuels. Utilization of agricultural tractors and machines determines also the pollution of near environment by noxious emissions, noise, vibrations. The mechanized works may bear the guilt for soil and groundwater pollution by oil and fuel leaks, exaggerated compaction of soil and sometimes, even soil erosion.

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METHODS OF QUALITY IMPROVEMENT IN SERVICE MANAGEMENT
/
METODE DE ÎMBUNATATIRE A CALITATII IN MANAGEMENTUL SERVICIILOR

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Keywords: *quality, management, services, ANOVA, cost allocators.*

ABSTRACT

According to ISO 9001:2015, the improvement of service quality is determined by measurement. Unlike quality building, which refers to the measures adopted to ensure the quality level of services, improvement means increasing their quality level.

As far as services are concerned, their quality assessment is carried out both in the delivery process and after. Customers' satisfaction regarding the purchased service can be determined by comparing the perception of the service received with their expectations.

REZUMAT

Conform standardului ISO 9001:2015, imbunătățirea calității serviciilor se stabilește prin măsurare.Spre deosebire de construirea calității, care se referă la măsurile adoptate pentru asigurarea nivelului calitativ al serviciilor, îmbunătățirea reprezintă creșterea nivelului calitativ al acestora.

În ceea ce privește serviciile, evaluarea calității acestora se realizează atât în procesul de prestare, cât și după. Satisfacția clienților față de serviciul achiziționat poate fi determinată prin compararea percepției serviciului primit de acesta cu așteptările sale.

INTRODUCTION

Service quality is the effect generated by the respective service on the customer, namely the degree of user satisfaction. Differentiating a company by the quality of its services generates an increase in market share over time, and this may be the difference between success or failure of the business.[3]

Maintaining or even improving service quality offers many benefits to a company, such as: reducing marketing costs for customer retention; repeated purchase of the service; increasing the efficiency of the providing system; decreasing the risk level among customers in terms of confidence; increasing the market share.

Service providing companies are employee-oriented, which is an important factor in delivering services. At the same time, firms support the effort of human resources. According to this guideline, the provision of the service is closely related to the competitive strategy of the firm and the entire providing system.[2]

METHODOLOGY

There are several tools, methods and techniques to solve quality issues. Solving service quality issues mainly consists in designing, checking, correcting or adjusting service processes.

The technique known as analysis of variance (ANOVA) uses tests based on a variation ratio to determine whether or not there are significant differences between the means of several data groups, this being achievable if each data group has a normal distribution.

ANOVA method is based on the dispersion analysis, thus, depending on the number of factors studied, so, the experiments can be:

- ✓ *Experiments with a single factor* (simple experiments) – a single factor X varies and it can have values from x_1. x_2. …. x_r;
- ✓ *Experiments with multiple factors* (multiple experiments) – there are several input factors that vary X, Y, Z, ... R (factor interdependence can also be studied in these experiments).

To calculate the value of F, it is useful to apply the following formula and create the table: $F = S_e^2 / S_r^2$, where F-Fisher Test.

Table 1 [*Ionescu S. C.. " Quality Architecture". 2013*]

Fisher test

Variation source	Degrees of freedom	Sum of squares	Distribution	Fisher Test
X Factor	r-1	S_e	s_e^2	$F_{calc}= s_r^2 / s_e^2$
Y Factor	n-r	S_r	s_r^2	
Total	r-1	$S= S_e + S_r$		

The degrees of freedom are calculated taking into account the following criteria:

- ✓ For x there are r columns => r-1 degrees of freedom;
- ✓ For x_1 there are n_1 values => n_1-1 degrees of freedom;
- ✓ For x_2 there are n_2 values => n_2-1 degrees of freedom;
- ✓ In total, there are n_1-1 + n_2-1 + n_3-1 + ... = $\sum n_i + r = n - r$.

Values F_{calc} are compared with F_{tab} (values in the table) for (r-1) and (n-r) degrees of freedom and the probability (1-α)%. According to this comparison, there may be two situations:

1) $F_{calc} < F_{tab}$ => the null hypothesis is accepted and group means are not significantly different, so X does not influence Y;
2) $F_{calc} > F_{tab}$ => the null hypothesis is rejected and the alternative hypothesis is accepted, while group means are significantly different, so X influences Y.[1]

Multifactorial functional analysis differs from the unifactorial one by the fact that it can manipulate several groups of variables simultaneously. Therefore, there may be two types of effects: the main (given by individual factors); Interaction between factors (given by independent factors).

MATERIAL AND METHOD

The management of a service company wants to improve the heating cost allocators installation service in terms of quality. In this respect, the following variables are analyzed: the number of employees, profit, turnover and market share.

In order to carry out the multifactorial functional analysis within this company, we'll use the statistical software "SPSS Statistics 19" (SPSS = Statistical Package for Social Sciences).

The data analyzed are the profit (the dependent variable) and the market share, the employees, the turnover (the independent variables).

Table 2

Dependent and independent data used in the analysis

Den. no.	Profit	Market share	Employees	Turnover
1	2235002.00	10	100	18376000.00
2	3967129.00	15	96	18265000.00
3	3150733.00	20	80	17428000.00
4	2417570.00	25	71	19178000.00
5	2984959.00	30	68	1912000.00

The program used to analyze the dependent data (profit) and the independent data (market share, number of employees, turnover) will provide in the end the correct statistical model. It will try out all possible models in turn, including all the variables from which it will remove one by one those that are not relevant.

Irrelevant variables are those variables that present multicollinearity, meaning they are correlated with other variables in the model.

RESULTS

The first table that SPSS program generates, is a summary of the models the computer has tried. The first model includes all the independent variables and these are removed one by one according to their relevance.

Table 3

Summary of models used in SPSS

Model	Variables entered	Variables removed	Method
1	Turnover, employees, market share	-	Enter
2		Turnover	Backward (criterion: Probability of F-to-remove>=.100)
3		Market share	Backward (criterion: Probability of F-to-remove>=.100)
4		Employees	Backward (criterion: Probability of F-to-remove>=.100)

Below, there is a summary of each model. The R^2 value is important because a higher value indicates the best model. In this case, model 1 has the highest value. $R^2 = 0.817$, which means that there is a strong correlation between the variables analyzed, these being the independent ones (market share, employees, turnover) and the dependent variable (profit).

Table 4

Summary of each model used in SPSS

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square change	F change	df1	df2	Sig. F Change
1	0.904	0.817	0.268	5.85	0.817	1.487	3	1	0.528
2	0.650	0.422	-0.155	7.350	-0.395	2.155	1	1	0.381
3	0.160	0.026	-0.299	7.790	-0.397	1.373	1	2	0.362
4	0.000	0.000	-0.000	6.830	-0.026	0.079	1	3	0.797

- *d f (degrees of fredom)* - degrees of freedom; 0.904[a]
- *Sig* – The probability that the null hypothesis is true, given the F value;
- *F* – F Test.

The next step is to estimate the model using the ANOVA table. This table shows whether the model is relevant, i.e, whether the regression equation parameters differ significantly from 0.

Table 5

ANOVA table for multiple linear regression

Model		Sum of squares	df	Mean Square	F	Sig.
1	Regression	1.528E+12	3	5.09E+11	1.487	0.528
	Residual	3.425E+11	1	3.43E+11		
	Total	1.871E+12	4			
2	Regression	7.901E+11	2	3.98E+11	0.731	0.578
	Residual	1.081E+12	2	5.40E+11		
	Total	1.871E+12	2			
3	Regression	4.79E+10	1	4.79E+10	0.079	0.797

	Model	Sum of squares	df	Mean Square	F	Sig.
	Residual	1.82E+12	3	6.68E+11		
	Total	1.87+12	4			
4	Regression	0.000	0	0.000		
	Residual	1.87E	4	4.68E+11	-	-
	Total	1.87E+12	4			

- *Mean Square* – variation(sum of squares/df)

Table 6

Regression equation coefficients

Model		Unstandardized Coefficients		Stardardized Coefficients	t	Sig.	95,0% Confidence interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-5302100,656	11722679,67		-0,452	0,730	-1,54E+08	1,436E+08
	Piata	351796,98	179238,713	4,067	1,963	0,300	-1925646,799	2629240,76
	Angajati	175614,992	92742,704	3,712	1,894	0,309	-1002792,789	1354022,772
	CA	-0,722	0,492	-0,807	-1,468	0,381	-6,968	5,525
2	(Constant)	-12937258,27	13194806,62		-0,98	0,430	-69709929,01	43835412,47
	Piata	237764,156	202878,019	2,749	1,172	0,362	-635149,506	1110677,818
	Angajati	134133,178	110943,500	2,836	1,209	0,350	-343218,174	611484,529
3	(Constant)	2322593,168	2264618,000		1,026	0,381	-4884432,018	9529618,354
	Angajati	7572,114	26959,356	0,160	0,281	0,797	-78224,589	93368,817
4	(Constant)	2951078,600	305840,261	-	9,649	0,001	2101929,906	3800227,294

In Table 6 are given the coefficients of the regression equation. It is noted that the relevant model is number 3 because it contains only the constant of the profit and the independent variable the market share.

Table 7

Excluded variables table

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
2	CA	-0,807	-1,468	0,381	-0,826	0,606
3	CA	-0,339	-0,440	0,703	-0,297	0,746
	Piata	2,749	1,172	0,362	0,638	0,053
4	CA	-0,334	-0,613	0,583	-0,334	1,000
	Piata	-0,011	-0,020	0,985	-0,011	1,000
	Angajati	0,160	0,281	0,797	0,160	1,000

Table 7 shows the excluded variables; excluding a variable from the regression model means that it is not independent of the others and has a strong correlation.

Table 8

Matrix of correlations between variables in the model

		Market	Employees	Turover
Market	Pearson correlation	1	-0.973	0.576
	Sig. (2-tailed)		0.005	0.31
	N	5	5	5
Employees	Pearson correlation	-0.973	1	-0.504
	Sig. (2-tailed)	0.005		0.387
	N	5	5	5
Turnover	Pearson correlation	0.576		1
	Sig. (2-tailed)	0.31		
	N	5		5

We notice significant correlations between turnover (CA) and employees, if the turnover remains model, the others will be excluded. Based on the results obtained, the following chart was made:

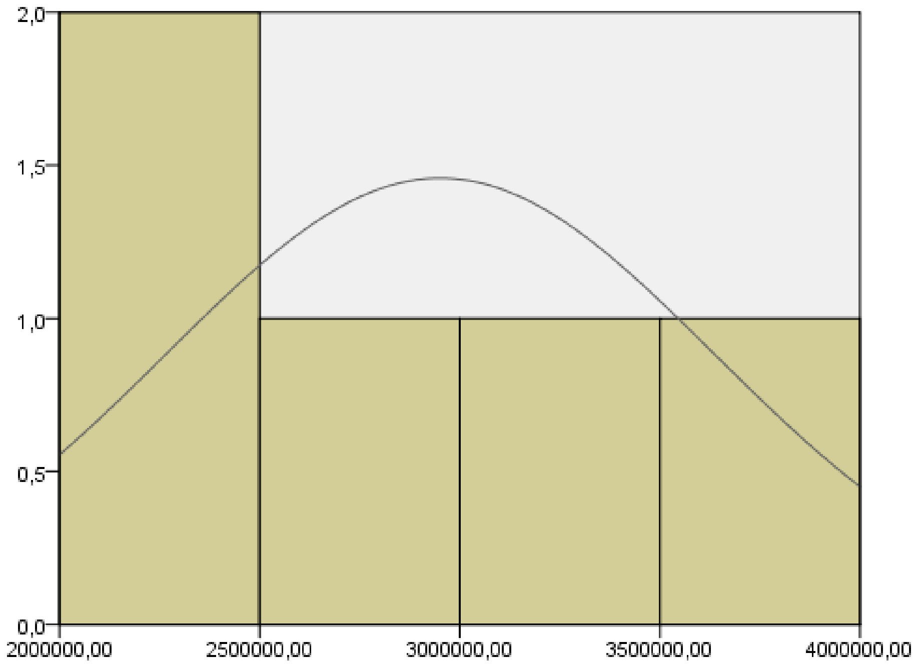

Fig. 1 - Histogram of variables

Therefore, the SPSS program analyzed both independent variables: market share, employees, turnover and the dependent variable: profit, in order to obtain certain statistical results relevant to the economic forecast.

CONCLUSIONS

Applying the ANOVA method, which is a basic tool used to evaluate a regression analysis using the SPSS (Statistical Package for Social Sciences) for the independent variables: market share, number of employees, turnover and dependent: profit, we obtained the Coefficient of correlation R^2 = 0.817, which means that there is a strong correlation between the variables analyzed;

There is a strong correlation between the turnover and the number of employees, the other variables being excluded. This leads to the need for corrective action within the service company.

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AUTONOMOUS DRIP AND SPRINKLER IRRIGATION SYSTEMS INTEGRATED WITH PHOTOVOLTAIC INSTALLATIONS
/
SISTEME DE IRIGARE AUTONOME PRIN PICURARE ȘI MICROASPERSIUNE INTEGRATE CU INSTALAȚII FOTOVOLTAICE

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Keywords: *PV pump system, solar radiation, solar pump, electronic control, sensor, data acquisition.*

ABSTRACT
The autonomous drip and sprinkler irrigation systems integrated with PV, a method of PV pump system calculation for small irrigation and control of agricultural processes, are presented. The solar radiation calculation was performed with PVGIS software. The numerical example contains pump flow rates, pumped water volumes (daily, monthly and for all irrigation period)

REZUMAT
În lucrare sunt prezentate sistemul autonomy de irigare prin picurare și microaspersiune integrat cu instalații fotovoltaice, metoda de calcul a sistemului PV-pompă pentru mica irigare și controlul proceselor agricole. Calculul iradierii solare a fost realizat cu softul PVGIS. Exemplele numerice conțin ratele debitului pompei, volumele pompate de apă (diurn, lunar și pe toată perioada de irigare).

INTRODUCTION
The Strategy for the Development of Agriculture in Republic of Moldova provides for the achievement of the nominated goal and the analysis of the agri-food sector, three priorities and a series of measures [http://gov.md/sites/default/files/document/attachments/government_of_republic_of_moldova_-_action_programme_of_the_government_of_republic_of_moldova_for_2016-2018.pdf].

The first priority provides competitively increasing of the agriculture-food sector from Republic of Moldova, by restructuration and modernization. In the last years, the agriculture is at the low level depending of some factors. Taking this in view as well as taking into account the strategic vision of the sector, it is clear that the Republic of Moldova will increase the competitiveness of agriculture by concentrating on agricultural products with high added value. In this respect, the strategy places a special emphasis on modernizing the sector, improving the level of education and associated systems and facilitating access to input and output markets.

The second priority provides the sustainable management of natural resources. Although, the Republic of Moldova has fertile soils and a favorable climate for agricultural production, it faces the many environmental challenges described above. Therefore, a priority for the Republic of Moldova is adapting to climate change at national level and capacity building. Such an approach should include improving farmers' access to new varieties, technologies and information through farmer training; improving the diffusion of weather forecasts for manufacturers, especially for extreme events; Investigate crop reform options to reduce administrative costs and improve accessibility and encourage private sector involvement in climate change adaptation efforts. Improvement of institutional capacities should focus on the identification of drought-resistant varieties and temperatures, more tolerant animal breeds in the current international market for adoption in the Republic of Moldova, as well as the training of agricultural producers in more efficient use of water using advanced irrigation systems and to make use of new weather forecast information.

According to the long-term meteorological data during the active vegetation period, the average precipitation amounts of 235 mm in the southern region and of 330 mm in the northern region (Gavrilița A.. 2005). Natural moisture is insufficient to obtain expected crops, especially vegetables, even in the years with average climatological characteristics. Often the territories of Moldova, Romania and Ukraine are subject to long-term droughts. Long-term observations indicate that this region is under the influence of a relatively dry 12-year climate cycle and the drought rate is increasing. Figure 1 shows the dynamics of the dry years of the X-XX centuries. The analysis of the drought development data of the 20th century reveals that in the following years the drought will repeat every 2-nd, 3-rd or 4-th year (Gavrilița A.. 2005). At the same time, there is a drastic decrease of the irrigated land, figure 2 *(Andrieş S.. Filipciuc V.. 2014)*. The difficulty of this problem varies from country to country, being more striking in those countries that lack fossil energy sources and sufficient sources of potable water for irrigation. RM is a part of this category of countries, which covers from the import about 86% of the needed energy resources and produces only 18.4 % of the electricity consumption.

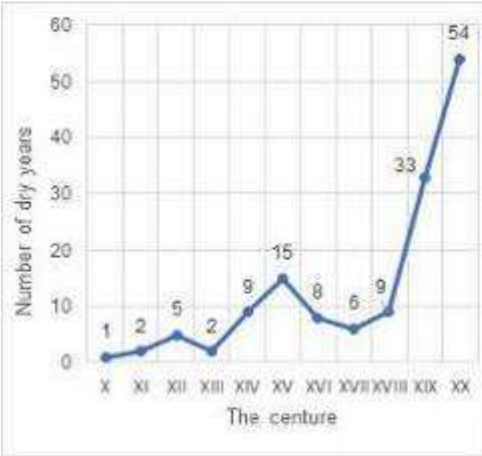


Fig. 1 - Dynamics of the dry years in the X-XX centuries

The main causes of the decrease of irrigated surfaces after 2010 are:

1. Because of privatization, about one million farmers possessing agricultural land with an area not exceeding 2.5 ha have appeared.

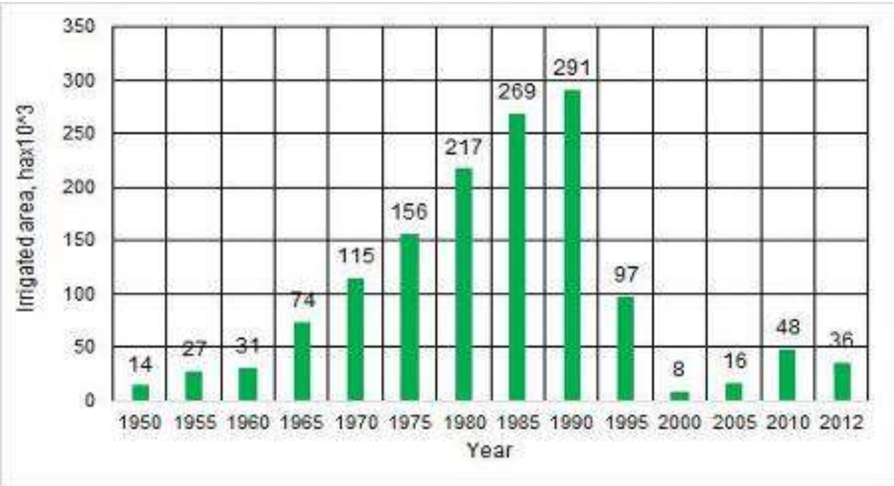


Fig. 2 - Variation of irrigated surfaces during 1950-2012

2. Increasing the cost of electricity tenfold.

Existing systems designed to irrigate large areas and with excessive energy consumption have become uncompetitive.

Therefore, taking into account the provisions of the strategy, the development of automation tools in the agri-food sector is an activity meant to facilitate these provisions. In the following compartments we will present the automation facilities for irrigation installations, performed within the UNDP project "*Autonomous integrated irrigation systems based on wind turbines, small hydro and photovoltaic installations*".

MATERIALS AND METHODS

THE PHOTOVOLTAIC PUMPING

A modern and energy-efficient solution that meets new market conditions is the photovoltaic pumping system, known since 1980s of the last century. In the last five years the cost of solar modules has significantly decreased and photovoltaic irrigation becomes competitive within traditional systems. A growing number of countries launch programs to accelerate the solar technology development (Maican. E. – 2015). For example, Bangladesh has set a target to deploy 50, 000 solar pumps by 2025; India, 100, 000 by 2020; Morocco, 100, 000 by 2022 etc.

Moldova is taking the first steps in this field, only a few experimental photovoltaic pumps having been implemented and there is no program to support this technology. The paper presents a PV pump system sizing method for farmers intending to implement low-power photovoltaic systems for small irrigation. The functional scheme is shown in Figure 2.

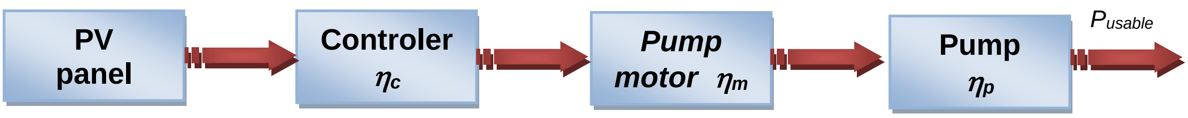


Fig.3 - System functional scheme

Regardless of the irrigated land particularities (land size, type of agricultural crop, irrigation method, etc.). the sizing procedure of the PV pumping system comprises several necessary steps to be taken. These are:

Water Requirement

The first step in designing a solar-powered water pump system is to determine the overall water requirement for the operation. In other words, we need to know the required water volume or irrigation norm, the water volume distribution during irrigation and the daily water requirement etc. These data are available in the literature (Șovăială. Gh., Anghel S., Matache G., Țenu I., Tănăsescu N. – 2015; Duffee J.A., Beckman W.A. – 2013; Gavrilița A. - 2005) or by consulting agricultural specialists.

Determining the solar radiation for your location

Appropriate data should be used to determine the amount of solar radiation available at the site. These data are available in the archive of the State Hydro Meteorological Service (SHMS) or in (Bostan I. et al - 2013). With them, the global solar radiation, G_β in W/m^{2,} on tilted surface or PV pane can be calculated l. The used formula is the following (Duffee J.A., Beckman W.A. - 2013)

$$G_\beta = R_b B + \frac{1}{2}(1 + Cos\beta)D + \frac{1}{2}(1 - Cos\beta)\rho G \cdot \quad (1)$$

where R_β is the ratio of total radiation on the tilted surface at angle β to that on the horizontal surface; B – direct or beam radiation; D - diffuse radiation; G – global radiation on the horizontal surface; ρ – reflectance coefficient. The B. D and G values can be found in (Ed. Gidrometeoizdat, Leningrad - 1990). All data are for an horizontal surface as a possessing result of SHMS measurements for the period of 1954-1980.

In (Ed. Gidrometeoizdat, Leningrad - 1990) are presented numerical values of the ratio R_b for the difference of latitude ϕ and inclination angle β (every 5^0) and the latitude of the place (every 5^0). Based on these data the values of the report R_b for Moldova were interpolated. The territory was divided into three areas - south (latitude 46^0), center - (47^0 latitude) and north - (latitude 48^0). Linear interpolation was used, the difference ϕ - β ranges from 0 to ± 20^0 with a step of 5^0. Numerical data of R_b can be found in (Bostan I.. et. al - 2013).

Using (1) we can calculate the daily global solar radiation. G_β for a different month for each 3 hour: 6^{30},9^{30}, 12^{30}, 15^{30} and 18^{30}. In this case we should use data about B. D and G published in (Ed. Gidrometeoizdat, Leningrad - 1990).

EU countries have developed a free online software for calculation of diurnal and monthly solar radiation. The diurnal radiation is calculated every 15 minutes. For the calculation a new database Climate-SAF PVGIS is used. These data are based on satellite images performed by CM - SAF (Geostationary Meteosat and Polar EUMetSat). The database represents a total of 12 years of data. From the first generation of Meteosat satellites, known as MFG, there are data from 1998 to 2005 and from the second-generation Meteosat satellites. known as MSG, there are data from June 2006 to May 2010. The coverage extends from 0° N (equator) to 58° N and from 15° W to 35° E. These data are more representative of the last climate years and show often higher irradiations than the classic PVGIS data.

Using this software, we calculated the diurnal radiation at Chisinau meteorological station on horizontal surface and we compared them with the ones from the 1954-1980 period. The results are included in Table 1.

Table 1.

Diurnal radiation. kW/m²

Month / hour	April			May			June			July			August			September		
	[7]	PVGIS	Diff.. %	[7]	PV GIS	Diff.. %	[7]	PV GIS	Diff.. %	[7]	PV GIS	Diff. . %	[7]	PVGIS	Diff.. %	[7]	PVGIS	Diff.. %
6^{30}	0.10	0.14	+40	0.19	0.23	+15	0.24	0.26	+8.3	0.21	0.25	+19	0.14	0.19	+36	0.07	0.08	+14
9^{30}	0.44	0.46	+4.5	0.55	0.57	+3.6	0.62	0.59	-4.8	0.60	0.60	+0.0	0.55	0.55	+0.0	0.45	0.41	-8.9
12^{30}	0.53	0.55	+2.8	0.62	0.67	+8	0.72	0.68	-5.5	0.70	0.70	+0.0	0.66	0.66	+0.0	0.55	0.49	-11
15^{30}	0.31	0.37	+19	0.39	0.48	+23	0.46	0.50	+8.7	0.47	0.50	+6.4	0.41	0.45	+9.8	0.29	0.31	+6.9
18^{30}	0.01	0.03	+200	0.05	0.11	+120	0.09	0.14	+55.5	0.09	0.12	+33	0.04	0.06	+50	n/a	n/a	n/a

We note the following:

1. The average error from April to September in the period 9^{30} - 15^{30} does not exceed + 3.0%.

2. Early in the morning (6^{30}) and evening (18^{30}) the errors are high and may exceed 100 %. But this does not affect the calculations because at the respective hours the PV pump does not work.

3. The calculated diurnal radiation values based on the new Climate - SAF PVGIS database are higher compared to those from 1954-1980. In our view, these are the consequences of global climate change.

In the present paper, we used the new Climate - SAF PVGIS database and free online software for calculation of diurnal radiation.

Total dynamic head

The total dynamic head (*H*) for a pump is the sum of the vertical lift, pressure head, and friction loss. The friction losses apply only to the piping and appurtenances between the point of inlet and the point of water distribution in the irrigation pipeline. Therefore, friction losses between the water basin or storage tank and the point of use are independent from the pump and do not need to be accounted for when sizing the pump. So, the *H* is equal

$$H = H_G + H_L + H_P. \quad (2)$$

where H_G – is vertical lift or the geodetic height measured from the water level and the highest point of water lifting; H_L - friction losses; H_P – pressure head or the pressure required for the proper functioning of sprinklers or drippers expressed in m.

Selecting the pump and solar array

Depending on the water source we can select a surface pump or a submersible pump. For PV systems, special pumps, called solar pumps, are also produced. It is characterized by higher efficiency and stable operation under conditions of variation of solar radiation (https://net.grundfos.com). As an example, in fig. 4 are presented the flow characteristics of Lorentz solar surface pump PS1800 CS-F4-4.

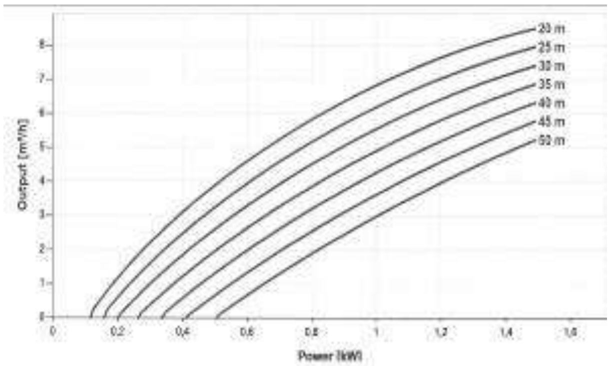


Fig. 4 - Pump characteristics *Q(P.H)*

Depending on the required flow *Q* and *TDH*, we can find the power and then select the PV panel with adequate peak power.

PV panel mounting

As a rule, the PV panel is mounted on special frames and directed to the south. To increase efficiency, we recommend adjusting the inclination angle to the horizon. As the irrigation period in the Republic of Moldova is about 6 months (April - September), it is rational to change this angle once in a month. In the table 2 are included the optimal inclination angle for April – September, valid for the central region (latitude $\phi = 47^0$).

Table 2.

Optimal inclination angle

Month	April	May	June	July	August	Sept.
Angle. grade	33	20	13	17	28	43

If a panel is to be mounted on an existing structure, that structure must first be analyzed to ensure that it has the necessary structural integrity to withstand all local wind, snow and ice conditions.

Daly, monthly and total delivery rates

For this purpose, we calculate daily solar radiation using PVGIS software, the power generated by the PV panel and the effective operating time of the pump per day. From the *Q(P. H)* characteristics the pump flow rate and daily water volume are determined.

RESULTS

The proposed land for irrigation presents a superintensive cherry orchard with a 7-ha area and is located in the west of the Criuleni town (central region), figure 5. The water for irrigation is pumped from a 9000 m^3 basin. The basin is part of a large irrigation system

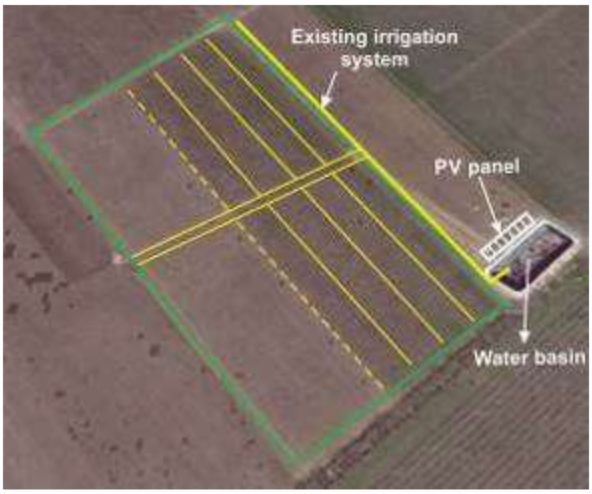


Fig. 5 - The layout of the irrigated land

that uses water from the Dniester River. Thus, the basin is permanently filled. The solar pump drives water from the basin to the existing irrigation system.

The existing irrigation system is equipped with the SUPERNET™ UD Micro Sprinkler, the operating pressure of which must be 1.5-4.0 Bar.

Water Requirement. According to (http://agraris.ro/vegetal/irigarea-plantatiilor-de-mar) the required irrigation water volume for superintensive orchard is about 5000 m^3/ ha. So, for the April - September irrigation period the required water volume is equal to V_R = 5000 ·7 = 35 000 m^3. For pump selection, we calculate the flow by dividing the required water volume to the number of pump operating hours during the irrigation period

$$Q = V_R /(N_D \cdot N_{hd}) = 35\,000/(170 \cdot 8) = 25.7 \text{ m}^3/\text{h}. \qquad (3)$$

where N_D – number of days; N_{hd} - pump operating hours per day

The total dynamic head. H_G = 5 m. H_L = 1.4 m for PVC pipe length-200 m, diameter-100 mm). H_P = 39 m (according to (www.netafim.com Micro sprinklers. Product catalog. – 2014) the sprinkler operating pressure that will not exceed 4 Bar or 39 m of the water column). Thus, H = 45 m.

Pump selection. The most suitable pump for the calculated flow rate Q=26 m^3/h and H= 45 m is the Solar Surface Pump System PS7k2 CS-F20-5 (https://net.grundfos.com), rated flow 27 m^3/h at H = 45 m. The flow characteristics as a function of input power $Q(P. H)$ are shown in fig. 6.

As shown in fig. 6, based on a calculated flow rate of 26 m^3/h (rounded) and a H of 45 m a minimum input of 5.8 kW of peak power is required. With daytime variation of solar radiation, the pump's operating point will slip on the Q $(P. H)$ characteristic.

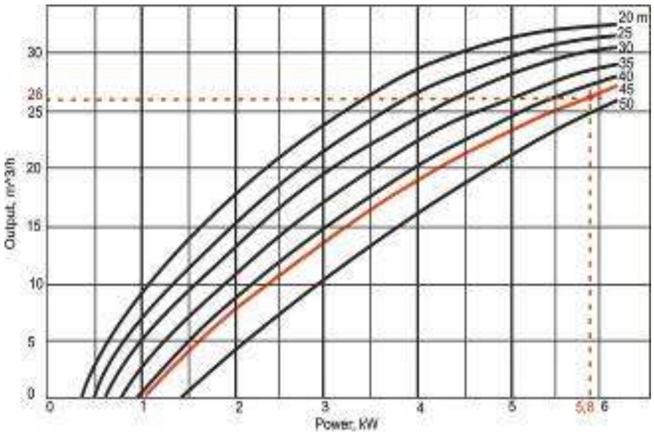


Fig. 6 - The operating point of the pump PS7k2 CS-F20-5

PV panel selection. The PV panel selected for this system must be able to provide the minimum energy requirement to run the pump, in our case about 5.8 kW. However, the panels must have additional capacity to account for any potential reduction in power due to radiation data incertitude,high module temperature, dust, etc. Many PV manufacturers recommend increasing the minimum peak power value by 25 - 30 % to account for these environmental factors. To increase the pump's running diurnal time with a maximum flow, it is rational to increase power by another 50 %. Therefore, the PV panel will be sized to provide a minimum output of 1.8·5.8 = 10.44 kW. We accept 11 kW.

Daly, monthly and total delivery rates. First, we calculate diurnal solar radiation using PVGIS software. Fig. 6 illustrates the June setting: the selected point coordinate Latitude: 47.200768. Longitude: 29.128662, the optimal tilted angle is 13^0, the panel is facing the south – Orientation: 0^0. The results are displayed every 15 minutes. In the same way, we did for all 6 months of the irrigation period. Diurnal radiation over each hour is shown in fig. 7 on the left. With hour solar radiation, the power generated by the PV panel is calculated using formula

$$P_{PV} = (R_{Daily}/1000) \cdot P_p\,. \qquad (4)$$

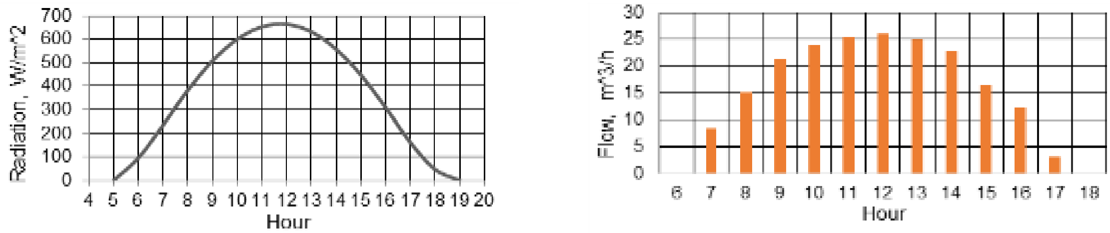
where R_{Daily} **–** average hourly solar radiation as result of PVGIS calculation; P_p – PV panel peak power, 11 kW.

Using the pump characteristic Q $(P.H)$ for H = 45 m (fig. 5. red color) we determine the pump average hourly flow. The calculations are repeated for all pump operating hours. As a result, we get the daily pump flow variation, the daily and monthly volume of pumped water, fig.7 on the right.

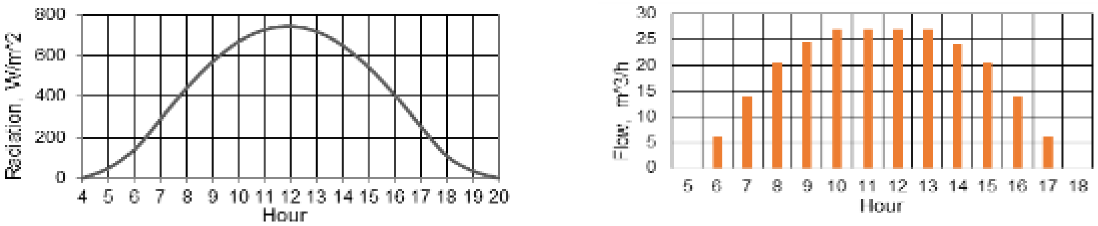
During the irrigation period, the volume of pumped water is equal to the sum of the months volumes from April till September: V_{Total} = 40 300 m^3 and is higher than the required by 15 %. We find a relative constancy of maximum solar radiation on the PV panel and the maximum flow rate of the pump, thus:

1. The maximum solar radiation on the PV panel is equal to 784 W/m^2 and corresponds to July. In April. the maximum radiation is lower by 15.3% and in September - by 21.2%.
2. In May-August over 4 hours a day, the system ensures a maximum flow rate of 27 m^3/h. In April, the maximum flow rate is lower only by 3.7 % and in September - by 4.4 %.

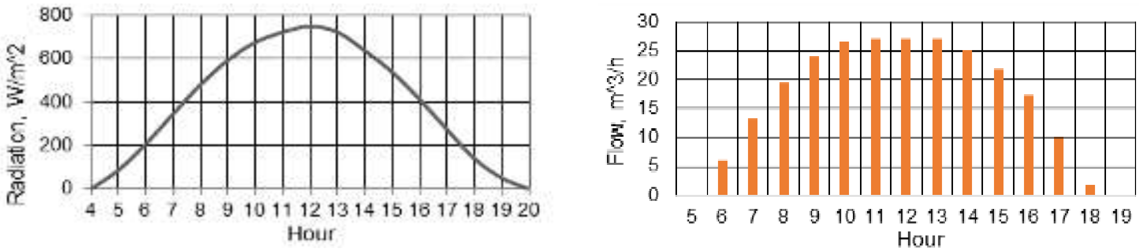
This relative solar radiation and pump flow constancy are due to the selection of a PV panel with higher power and the optimum inclination angle in April – September period.



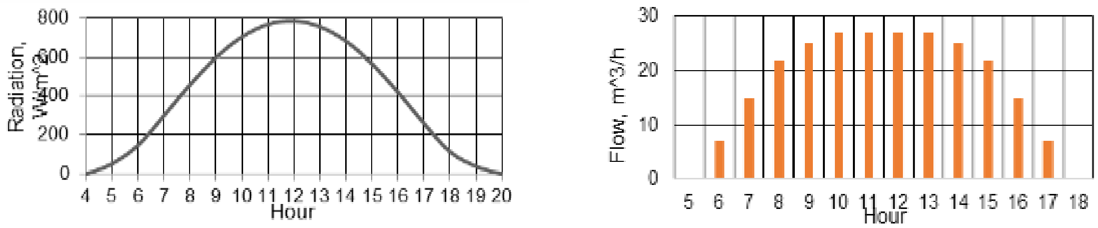
April. V_{IV} = 5268 m^3



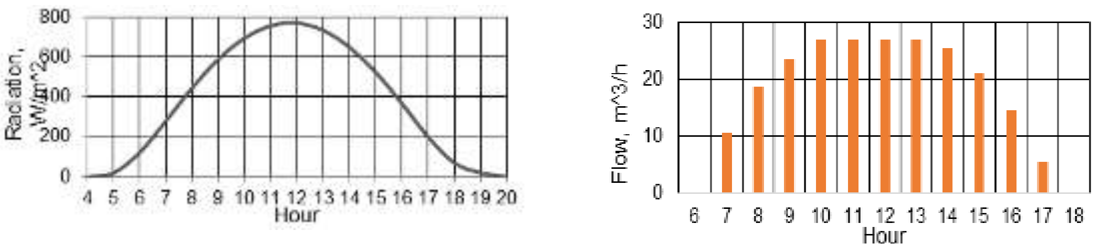
May. V_V = 7378 m^3



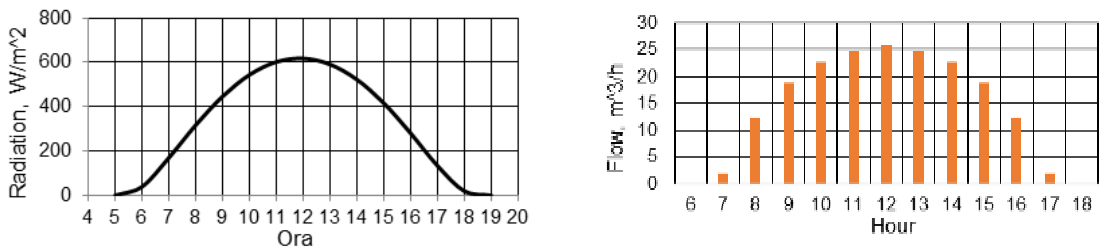
June. V_{VI} = 7377 m^3



July. V_{VI} = 7614 m^3



August. V_{VIII} = 7040 m^3



September. V_{IX} = 5622 m^3

Fig. 7 - Hourly radiation (on left) and pump flow (on right)

THE AUTOMATIZATION, INFORMATIZATION AND MONITORING OF THE PROCESSES FROM AGRICULTURE DOMAIN

At the current stage, although there are very advanced and sophisticated informational technologies and communications, the design of the monitoring and control system is not a trivial problem. The design of the automated control system for monitoring and optimization to ensure the irrigation processes will be carried out taking into account the following factors: acquisition of climatic data from plantations, application of nutrients and pesticides, herbicides, information processing and automatic control of the irrigation system, such as the monitoring of renewable energy sources. On the other hand, the design of the automated system must take into account the location of renewable plants and resources. In other words, the system has to be territorially distributed and it is reasonable to be hierarchized, considering the various issues that need to be solved.

Fig. 10 - Emplacement map of the integrated sensors module and the valve control module for irrigation system on Fortuna Labis (Ungheni) farm

Taking into account the experience of the most advanced companies in this field as well as their own experience, a three- layer hierarchical system has been proposed. The bottom layer is the most sophisticated, inhomogeneous and dependent and specific of agricultural enterprise. At this level are placed the means of acquiring the climatic data on the plantation field, the means of controlling the valves and pumps with remote control, the means of accelerating the fertilization equipment, as well as the means of monitoring and control of the renewable resources.

The second layer of the system has preponderant communication functions with minimal computing capabilities, decision-making, in other words, a kind of gateway between the lower level and the upper level. The mission of this level is to provide communication coverage with all subsystems at the bottom level and to provide communications to the top level server (server).

Finally, the superior layer of the automation, monitoring and control system for irrigation systems is seen as a typical Internet solution, which will store all information on irrigated plantations as well as the state of the equipment and auxiliary subsystems. On the other hand, it must provide authorized access to users of this system. At the third level (server) will be first remote monitoring of several irrigation systems, groups of stations, including homing. If server monitoring and control node is connected to the Internet, then monitoring stations can be done from any point on the earth.

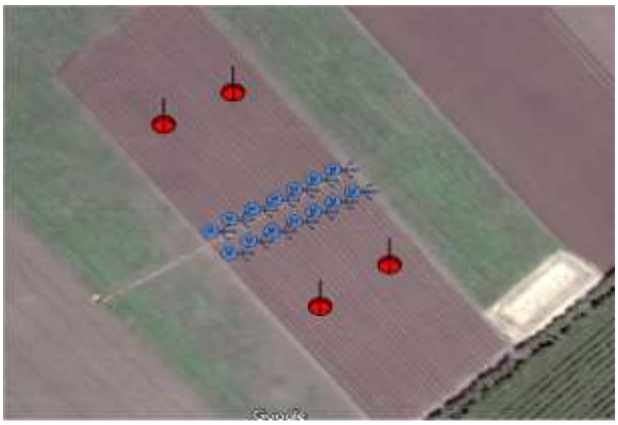


Fig. 9 - Emplacement map of the integrated sensors module and the valve control module for irrigation system on Tri Denal (Criuleni) farm

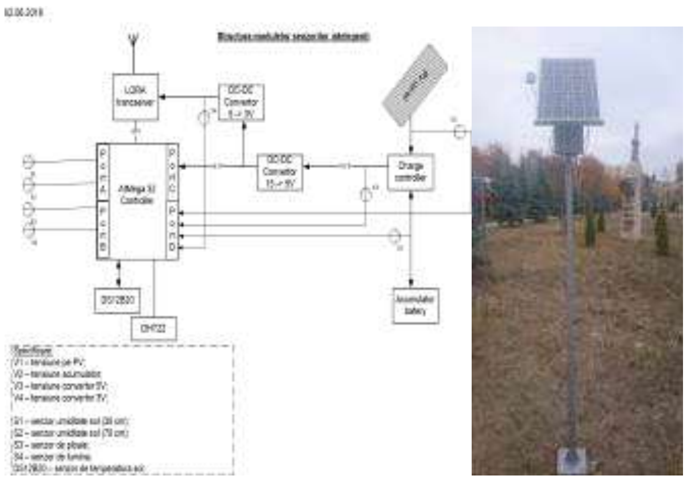


Fig. 8 - Functional schema and real view of integrated sensors module for irrigation system

For any control and monitoring system, including for irrigation installations, data acquisition plays a primary role. For these reasons, it has been decided to build an acquisition subsystem based on an integrated sensor network. It was decided, taking into account the relief and climatic conditions of Rep. Moldova, that the control must be performed by an average performance microcontroller, which will operate autonomously and is monitored and guided by the two most powerful controllers by radio communication at short distances (up to 4-5 km). It was designed and performed the functional schema and real equipment of integrated sensors and valve control modules for irrigation system. The most important sides both of this modules are the autonomous electrical power subsystem with 20W photovoltaic panel and accumulator and remote data acquisition and control by means of radio communication. The integrated sensor includes a set of sensors: air humidity and temperature, soil humidity and temperature at 2 levels; rain sensor, luminosity; photovoltaic panel and accumulator voltage (fig. 8).

As the main goal represents creating architecture of the control unit with the greatest possible reliability (for a duration of 5-7 years of activity) based on small processors, it is necessary to analyze all families of microcontrollers from Atmel, Motorola, Renesas, Texas Instruments to select the proper microcontroller for this task. Making a comparative analysis, we outline that three different solutions are required by several parameters simultaneously such as productivity, memory capacity, energy consumption, cost. accessibility and reliability:

a) uC MSP430F155 part of the MSP430 from Texas Instruments;

b) uC MC68HC912DT128A part of the Motorola HC12 family;

c) uC ATMega part of the Atmel family.

Given the specialization of microcontroller core functions of low layer for controlling data acquisition, control, regulation and distribution of electricity, telemetry control the thermal station control and a microcontroller auxiliary functions of quality analysis of electricity generated, it is necessary to analyze low consumption devices, which typically are designed for wind generators and irrigation systems. For the integrated sensor module, it has been decided to use the uC ATMega controller with performance comparable to other controllers, a very low consumption and a lower price.

Fig. 11 - Real view emplacement of the integrated sensors module and the valve control module for irrigation system

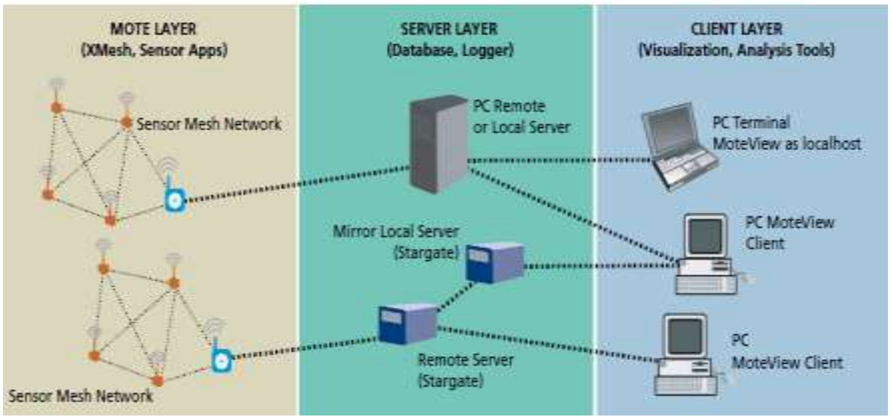


Fig. 12 - The model of interaction between components of the irrigation system through various networks, including the Internet

In the similar mode the valve control module can open/close 2 valve with DC electro-motors and communicate the states of the valves. One important performance is high velocity of data acquisition (all data may be received by 1-2 sec) and the low cost – about 150 dollars per unit.

The territorial location of the integrated sensors and the control modules with the valves is done depending on the specifics of the plantation land and the configuration of the irrigation installations. For this project it was performed the maps of integrated sensors and valve control modules for irrigation system for the concrete destinations: the partner farms Tri Dienal (from Criuleni) and Fortuna Labis (from Ungheni) (fig. 9 and 10) and real view emplacement (fig. 11).

It was decided to use one valve control module and one integrated sensor for 2 parcels (total 6 integrated sensor and 12 valve control modules) on the Fortuna Lapis farm and (total 4 integrated sensor and 14 valve control modules) for the Tri Dienal farm with the goal to minimize the cost of these equipment.

The medium layer of irrigation control system

It is proposed a farm plantation medium layer control module for irrigation system that coordinates all the processes for irrigation installation and for communication with high level (servers). For this case, it is proposed the Rasberry controller with a higher computing performance and low cost. It was developed the software for this controller, which includes more components for the coordinating the communication between low level modules and the servers.

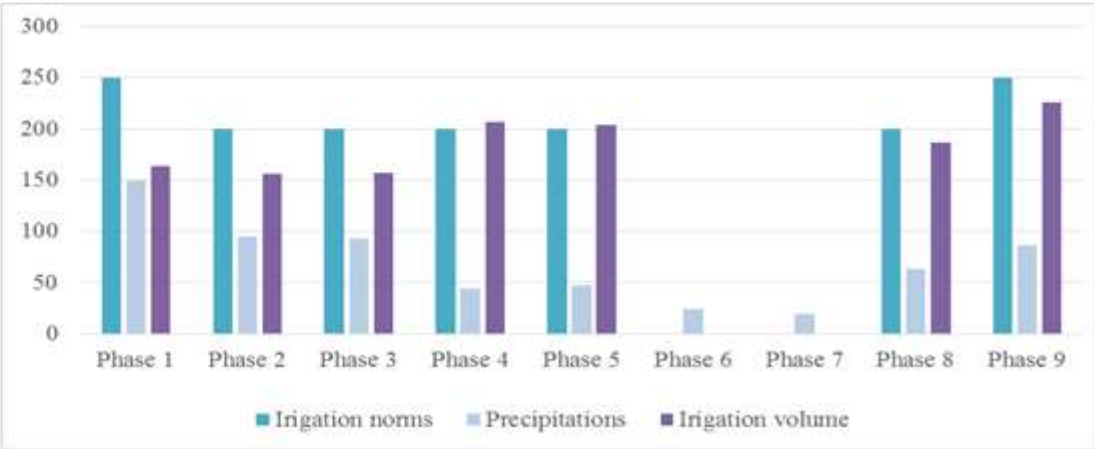


Fig. 13 - Example of report diagram about irrigation norms, precipitations and irrigation volumes for the each phase of plant development

Interaction between the turbine station controllers, integrated sensors and the monitoring system was proposed to be performed according to a model, for example, as shown in fig. 12, which implies the access of the users of the stations practically from an unlimited distance, which is reasonable by the use of communications and computer,. including the Internet.The problem is simplified if the station controller connects to the network through units with a range greater than the previous one, sufficient to intercept the communications network. For such a case, high- speed and medium-to-high-speed radio communications, there is at the moment a whole range of possibilities and means. These means must meet the following requirements for this channel type:

- relatively low emission power, but high sensitivity; the possibility to modify the emission frequencies in a scheduled manner; GSM/GPRS communication modes; possibilities to maintain various communication protocols.

Applying this model, the medium-level controller architecture is proposed, which includes two different communication channels: one for low level interaction in the 435-450 MHz frequency band - the low-band radio amateur band and the second channel based on GSM / GPRS mode for connection to the Internet server. This is a farm plantation control module for irrigation system that coordinates all the processes for irrigation installation and for communication with high level (servers).

Monitoring and reports of the plantations irrigation process

Any system for monitoring various processes, including plantation irrigation, requires totalizing means / tools, reporting on current and cumulative outcomes. Therefore, a series of applications have been developed for the irrigation monitoring system allowing the final user to make the necessary sums and conclusions. We present a series of such reports: the user can visualize the irrigation water consumption on the selected parcel during certain stages of planting development or throughout the season as compared to the irrigation rules and the precipitations (fig. 13), report about portions of irrigation norms, precipitations and irrigation volumes for the some phase of plant development (fig. 13).

CONCLUSIONS

During the irrigation period, the volume of pumped water is equal to the sum of the months volumes from April till September: V_{Total} = 40 300 m^3 and is higher than the required by 15%. We find a relative constancy of maximum solar radiation on the PV panel and the maximum flow rate of the pump, thus:

- The maximum solar radiation on the PV panel is equal to 784 W/m^2 and corresponds to July. In April, the maximum radiation is lower by 15.3% and in September - by 21.2%.
- In May-August over 4 hours a day, the system ensures a maximum flow rate of 27 m^3/h. In April, the maximum flow rate is lower only by 3.7 % and in September - by 4.4 %.

There were developed the hardware of acquisition, processing and communication for the remote control and management of irrigation installation and the realized software of the low and medium layers provided the remote control. The proposed architecture, software structure for the background and public servers can store all the data about irrigation processes.

It have been carried out on the automation of plantation's irrigation process: three irrigation planning and control modalities have been proposed and a software testing has been carried out to ensure the high reliability of the information and command system and efficiency.

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MODERN TECHNOLOGIES AND INSTALLATIONS DESIGNED TO INDUSTRIAL SCALE CULTIVATION OF MICROALGAE FOR OBTAINING ALGAL BIOMASS / *TEHNOLOGII ŞI INSTALAȚII MODERNE PENTRU CULTIVAREA INDUSTRIALĂ A MICROALGELOR PENTRU OBȚINEREA DE BIOMASA ALGALA*

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Keywords: *algae, cultivation technologies, biomass, biofuels.*

ABSTRACT

Nowadays, the biomass produced by the energetic plants is rather criticized, because these plants need large culture surfaces, thus competing with the agricultural land allotted to food production. One of the current trends of scientific biological researches with practical goal is the cultivation of algae designed to obtain the algal biomass as an important raw material used in biotechnologies for production of alternative fuel. This paper presents the most up-to-date technologies and installations for industrial cultivation of microalgae together with INMA researches results materialized in the installation of open culture systems growing, of waterfall type.

REZUMAT

În prezent biomasa produsa din plante energetice este criticată. deoarece aceste plante necesita suprafețe mari pentru cultivare concurând astfel cu suprafețele agricole alocate pentru producția de alimente. Una dintre direcțiile actuale ale cercetărilor științifice de ordin biologic cu caracter practic este cultivarea algelor pentru obținerea biomasei algale, o materie primă importanta utilizată in biotehnologiile de obținere a combustibililor alternativi. In lucrare sunt prezentate tehnologii şi instalații moderne pentru cultivarea industrială a microalgelor şi rezultatele cercetătorilor din INMA concretizate în instalația de cultivare in sistem deschis, tip cascada.

INTRODUCTION

Production of vegetal biomass at large scale means to cultivate numerous species of plants. According to specialty literature (*R. Şumălan. 2011),* biomass is a very important component of carbon cycle and the carbon from atmosphere is turned into biological matter (biomass) by photosynthesis. By vegetal matter combustion, the carbon returns into the atmosphere as carbon dioxide. Biomass is biodegradable and renewable. Production of biomass is continuously extending due to increased interest in alternative energy sources.

Biomass is a renewable energy that supplies biofuels, generally of solid type and liquid biofuels. (*I.R. Pecingina. 2011*). Biofuels are fuels produced by bio-renewable sources coming from nature that, after their combustion in the engine produce less noxious emissions to the environment.

According to European and national laws and literature *(Carăuş I. 2007; I.R. Pecingina. 2011; M. Pavnutescu. 2011*) on improving environment quality, the general goal is to limit the quantity of fuel related to harvests and orient towards the biofuel coming from non-food sources, such as *waste and algae.*

The higher price of oil, as well as, the growing food crisis have led to an increased interest in algae culture, from which result vegetal oil, biodiesel, bioethanol, biobutanol and other fuels. This new energy source has many advantages among which the fact that it does not harm the environment, when storing it randomly and it does not affect fresh water stock, being biodegradable.

According to quantitative criterion, algal biomass represents about 20% out of world aquaculture production (*S. Dobrojan and. so. on., 2016*). The advantages and very good results obtained by applying at different fields algal biomass make imperative the necessity of growing algae.

Recently, large quantities of red, brown and green and blue-green algae are being cultivated. Algae make efficiently use of solar energy conserving it in biomass. (*Marchin T.. s.a.. 2015*).

More recently, algae industrial growing increased in the whole world as a source of renewable fuels. According to estimates, from the 50,000 of microalgae species cultivated, about 10 are being grown at industrial scale in order to obtain some products such as: Spirulina, Crypthecodinium cohnii, Chlorella, Dunaliella salina, Ulkenia sp, Haematococcus pluvialis, Schizochytrium, Aphanizomenon flos-aquae, Euglena and Odontella aurita.

Among the 10 species industrially cultivated, the species Chlorella, Spirulina and Cryptecodinium have the biggest contribution, as it results from the studies of specialists in domain. (*S. Dobrojan s.a.. 2016; Egardt J. Lie O. 2013*).

A strategic trend that is more and more spread lately is based on obtaining biodiesel and biogas from algal biomass.

MATERIAL AND METHOD

Large-scale cultivation of algae is achieved by means of various installations in terms of size, design and shape. There were designed very simple installations consisting of channels of small depth made in the soil, lined with polyethylene foil, but also special installations of big size were built, these ones comprising concreted circular or other shape basins endowed with systems of agitation of algal suspension, aerating systems, harvesting systems and even devices of adjusting the growing parameters (including automated systems).

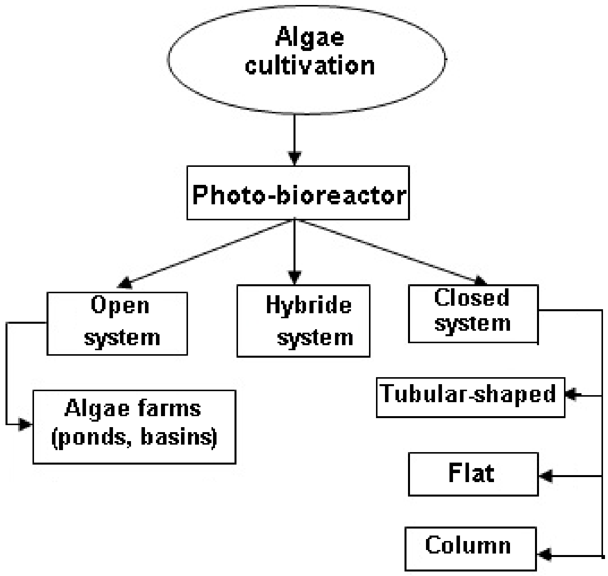


Fig. 1. – Schematic representation of algae growing systems

Industrial-scale cultivation of microalgae is being achieved by differents systems, as they are shown in the scheme from fig.1.

- Open algaculture systems are recommended for areas of warm climate.

From practical reasons, algae should be grown in special farms and they should not be harvested in their natural environment, namely in the sea. Taking into account that the open systems might be contaminated by bacteria, biomass is mainly designed to obtain biofuel.

A large capacity farm endowed with circular basins, built in Taiwan is shown in fig.2.

Its basins have approx. 45 meters diameter and the algal slurry depth is about 50cm; the algal culture is agitated by means of a mobile radial arm that also injects pressure air into the algae growth medium, where carbon dioxide of 20% was added for *Chlorella* and 10% for *Spirulina* culture.

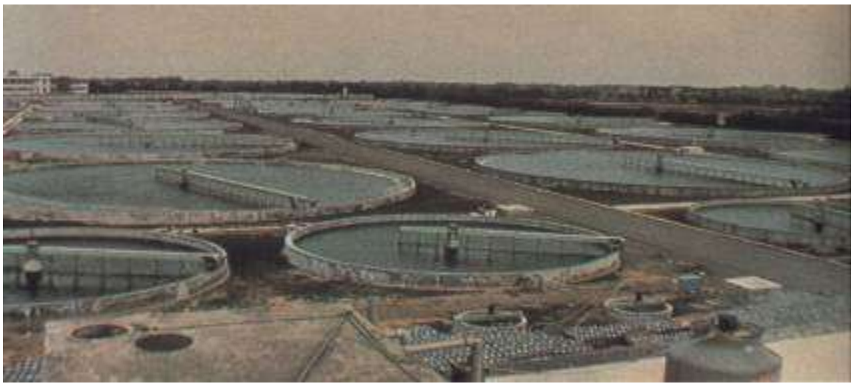


Fig. 2 – Industrial-scale installation for growing microalgae (from Hills, 1981)

- Closed systems of industrial scale algae culture consist of closed bioreactors placed vertically or horizontally, the algaculture being grown in recipients as sacks, bags, tubes, columns, flat constructions, etc.

Algae growth in closed cells (bags) and columns, fig.3 was developed as an alternative method of producing algae more rapidly and more efficiently than in the open systems.

Fig. 3 – Algae cultivation in plastic bags (

Within the system of algae culture on vertical, the algae are laid in transparent plastic bags, this way being exposed to sun rays on both sides. The bags with algae are hung from the ceiling and the roof protects them against the rain. Due to sunlight exposure algae productivity increases, as well as extracted oil yield. At the same time, algae contamination must be avoided. .

Another type of bioreactor is the tubular reactor, built of transparent pipes placed in parallel. In fig. 4 is presented a vertical tubular bioreactor *(M. Farieda. s.a.. 2017.)***)**

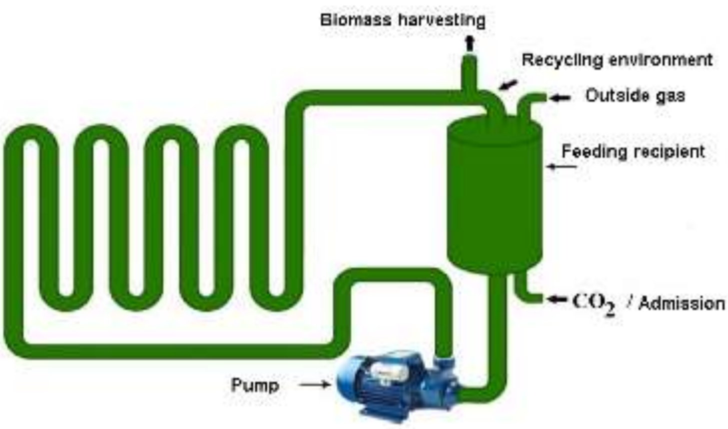
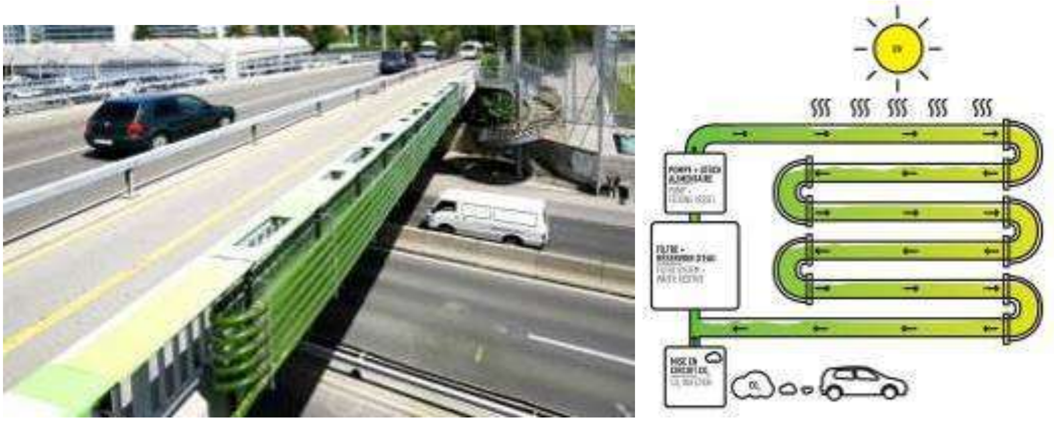


Fig.4 - Tubular photobioreactor with vertical tubes

The French-Dutch Company *Cloud Collective* (*Beverley Mitchell, 2014*) has transformed one strip of a Swiss highway in Geneva into an urban algae culture farm using the algal bioreactor with transparent pipes. (fig.5 a).

The installation was designed and manufactured in order to demonstrate that any urban scenery can be used as support for producing biomass. (fig.5b). The algae liquid slurry circulates through the transparent pipes feeding with carbon dioxide coming from emissions generated by motorcars passing on the highway.

The process results in biomass-green fuel and environment air filtration using a simple method.



a) b)

Fig.5 – Biomass production through a system of transparent pipes mounted on a viaduct

a) *Highway overpass in Geneva*

b) *Production of algae biomass in transparent tubing reactors installed in urban areas*

Another type of photobioreactor is the flat panel bioreactor as in fig.6 (M. Farieda s.a.. 2017. A.C. Apel s.a .2017) The method consists in passing a thin algae layer on a transparent panel made of glass, plexiglass or polycarbonate. A special attention was given to flat photobioreactors due to big ratio between surface-volume and high density of cells.

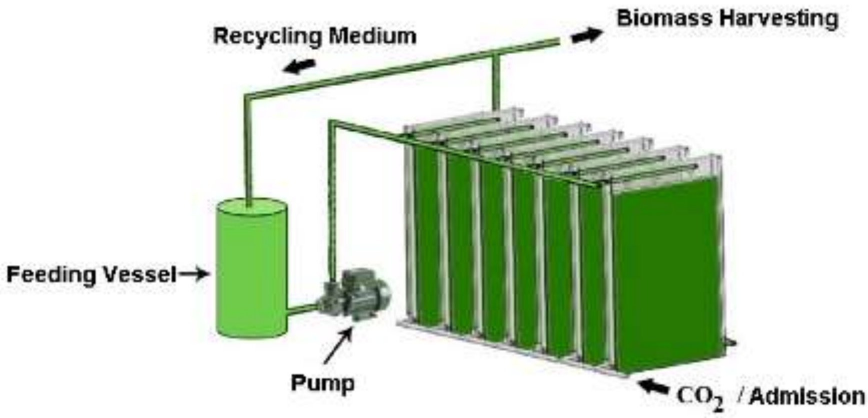


Fig.6 – Photobioreactor with flat vertical panels

Flat panels have generally the advantage of being able to be placed vertically or inclined towards sunlight, for a better illumination.

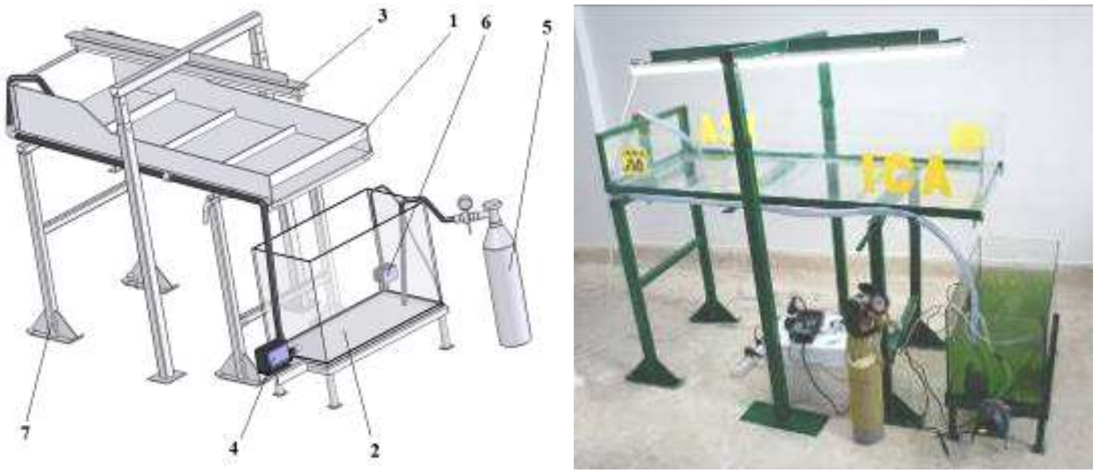
As a general rule, the algaculture installations of any type comprise: photobioreactors, energy sources, feeding systems, stirring systems, illuminating systems, harvesting systems, automating and control systems of working process.

RESULTS

In order to study an innovative technology for obtaining algal biomass in laboratory conditions, a functional model of installation for growing algae in open system of waterfall type, has been performed within INMA Bucharest.

Installation is made of one or several flat open reactors working in waterfall system, one collecting compartment, illuminating system, stirring system, algae recirculation system, as it is presented in fig.7.

In this type of reactor, the transparent panels made of glass, plexiglass or polycarbonate enable the sun direct radiation, light dissipation of heat, easy cleaning and maintenance. Algae culture is recirculated and slips on transparent panels in a thin layer of 3…35 mm.



Appliance diagram Functional model ICA

Fig.7 - Installation for open system growth of algae of waterfall type - ICA:
1. flat reactor; 2. collector; 3. illuminating system; 4. recirculation system;
5. CO_2 feeding and Ph control system; 6 agitators.

Algae growing technology includes a series of processes, methods and techniques that must be respected and applied for obtaining algal biomass:

- Ensuring the nutritive environment;
- Algae inoculation is accomplished by special methods varying according to culture growing characteristics, level of adaptation to concrete cultivation conditions;
- Ensuring the conditions of cultivation-temperature, illumination, stirring;
- Biomass obtaining.

The researches on algaculture in the installation of waterfall type are being in course of developing.

Microalgae cultivated in this installation is Chlorella. This microalgae is rich in proteins and essential fatty acids, minerals, vitamins, fibres. Chlorella is the richest source of chlorophyll known up to present, but it is cultivated also as a rich source of ribonucleic (RNA) and deoxyribonucleic acid (DRA).

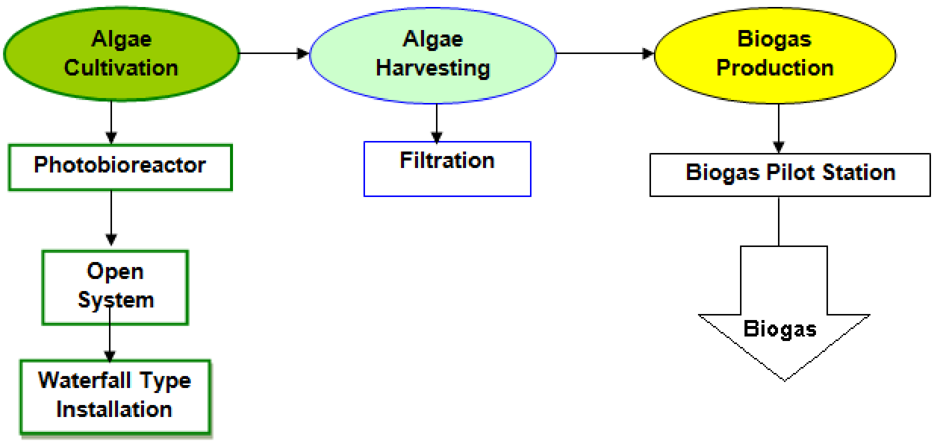


Fig. 8 - Diagram-technology for obtaining biogas from algal biomass:

Chlorella needs a specific medium of growing. namely a high purity and quality of water at which adds a great variety of natural minerals.

Culture of algae studied will grow in BBM (Bold Basal Medium) medium.

The innovative technology designed to obtain advanced biofuel from algae. proposed by INMA. fig.8 consists in the following special technical equipment:

- Open growing system of algae using the waterfall type installation whose size is in accordance with the capacity of production desired.

- Algae harvesting-by filtration and centrifugal force.

- Obtaining biogas with pilot station by advanced dry and humid methanogenesis MGA endowed by INMA.

CONCLUSIONS

- In order to improve the environment quality one of the possible sources is to use the alternative energy.
-Unlike other alternative sources of energy, algae present a series of important advantages; they grow rapidly, do not compete with food sources for agricultural fields and do not need fresh water to develop.
- Microscopic algae could represent the newest and most viable and profitable generation of biofuels, outrunning the traditional fuels, natural oils and wood.
- Microalgae are microscopic aquatic organisms that feed by photosynthesis.
- In order to cultivate algae at industrial scale for obtaining biomass, three systems are viable: open, closed and hybrid systems, characterized by specific technologies and installations.
-Installation for algae growing in open system, of waterfall type can be appropriately sized according to production expected and is designed both to grow algae at lab-scale and industrial scale.
- Installation proposed is mainly made of one or several flat open reactors on which the algae culture slips in a thin layer, enabling the direct sunlight, light dissipation of heat, easy cleaning and maintenance. The advantage of system above is that to reach a high biomass density and a big productivity due to big ratio between surface and volume.
- Biomass will be capitalized through the pilot station for biogas production endowed by INMA.

ACKNOWLEDGEMENT

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INVESTIGATIONS REGARDING DEGRADATION BY HYDRATION-DRYING OF SOME BIOCOMPOSITES REINFORCED WITH NATURAL FIBER
/
INVESTIGATII PRIVIND DEGRADAREA PRIN HIDRATARE-USCARE A UNOR BIOCOMPOZITE ARMATE CU FIBRE NATURALE

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Keywords: *composite, thermoplastic starch, Miscanthus fibers, degradation.*

ABSTRACT
Biocomposite materials with improved properties can be obtained by reinforcing a biodegradable matrix with natural fibers. In order to obtain the biodegradable matrix a viable solution are thermoplastic starch based polymers. A method to avoid the inconveniences of using thermoplastic starch (poor mechanical properties and low resistance to moisture) can also be the reinforcement with natural fibers. The composite material studied was obtained by the reactive extrusion of various mixtures of starch, glycerol, poly (butylene adipate-co-terephthalate) (PBAT) and Miscanthus fibers as reinforcing material. This paper presents the results of water uptake and FT-IR spectroscopy investigations for 4 samples of composite material with thermoplastic starch matrix and reinforced with Miscanthus fibers in different concentrations (up to 20%).

REZUMAT
Materiale compozite ecologice cu proprietati imbunatatite pot fi obtinute prin armarea unei matrici biodegradabile cu fibre naturale. Pentru obtinerea matricei biodegradabile o solutie viabila este reprezentata de polimerii pe baza de amidon termoplastic. O metodă pentru a evita inconvenientele utilizării amidonului termoplastic (proprietăți mecanice slabe și rezistență scăzută la umiditate) poate fi si armarea cu fibre naturale. Materialul compozit studiat a fost obtinut prin extrudarea reactiva a diferite amestecuri de amidon. glicerol. poly(butylene adipate-co-terephthalate) (PBAT) si fibre de Miscanthus ca si material de ranforsare. Aceasta lucrare prezinta rezultatele absorbtiei de apa si investigatiilor spectroscopiei FT-IR pentru 4 probe de material compozit cu matricea de amidon termoplastic ranforsat cu fibre de Miscanthus in diferite concentratii (pana la 20%).

INTRODUCTION
Extending the use of composite materials in almost all areas of activity is influenced by a multitude of factors such as the need for materials with less weight but with certain mechanical properties, environmental and health concerns, the need to reduce energy consumption, sustainable achievement. etc. [5]

The use of renewable materials both as reinforcement elements and as matrix for composite materials contributes to the mitigation of some environmental pollution problems due to synthetic composite materials. Degradable composite materials are composite materials made of a polymer matrix derived from renewable sources (polysaccharides, vegetable oils) or from fossil sources (synthetic polymers such as polyethylene, polypropylene, polyesters, etc.) with natural fiber reinforcement or by-products from agriculture. One of the most used and studied bio-composite materials is one that uses starch as a matrix [2.6]. To improve the properties of starch based materials biobased polyesters or synthetic biodegradable polyesters such as poly (butylene adipate-co-terephthalate) (PBAT) [7] can be added.

The use of natural fibers (flax, yute, hemp, Miscanthus) to reinforce the biodegradable matrix ensures improved properties of the composite, good mechanical properties, low weight and certain environmental benefits.[1.3.4].

Generally, the manufacturing technologies of degradable composite materials involve machines and processes for obtaining the matrix, preparing the reinforcement components, impregnating or treating the fibers, cutting the fibers, making the reinforcement (different shapes: network, fabric, braid, etc.) injection molding, compression and extrusion, compression-molding, or other processes.

MATERIAL AND METHOD

The samples in this study were prepared by reactive extrusion with a laboratory twin-screw extruder with co-rotating intermeshing, self-wiping screws ZK 25. Collin. (Germany). The raw materials used were: native corn starch obtained from SC ROQUETTE SA Calafat, Romania, having water content of 12.01 %, a density of 0.561 g/cm^3 and an amylose content of 21%. glycerol purchased from SC Nordic Invest SRL Cluj-Napoca with a concentration of 99.5% and a density of 1.262 g/cm^3. Poly(butylene adipate-co-terephthalate) (PBAT) purchased from BASF Company - product code is Ecoflex F Blend C1200 with mass density of 1.25-1.27 g/cm^3, melting point 110-120 ^{o}C and melt flow 2.7 - 4.9 g/10 min. and Miscanthus fibers obtained from Arge Miscanthus Romania.

Table 1 shows the ratio of the components used in the formula for the composite material reinforced with fibers.

Table 1

The components ratio in the composite formula

Composite sample	Starch (%Starch+PBAT+ Glyc)	PBAT (%Starch+PBAT+ Glyc)	Glycerol (%Starch+PBAT+ Glyc)	Miscanthus fibers (%Starch+PBAT+ Glyc))
P0	64	13	23	0
P5	64	13	23	5
P10	64	13	23	10
P20	64	13	23	20

The samples were cut into rectangular pieces (fig.1) and was added distilled water. For each sample we measure the water uptake using a Partner WLC 0.6/B1 analytical balance with a precision of 0.1 g after the excess water was removed by placing the sample on absorbant paper for 1 minute. The modification induced by hydratio/drying processes could have effects on the vibration of the molecular bonds. FT-IR measurements can reveal this kind of modifications. To study degradation due to hydration-drying processes, the samples were hydrate by submerging them in distilled water for 48 hours (fig.2), after which they were dried for 6 days at 25°C. The FT-IR absorption spectra were recorded with JASCO FTIR 4100 spectrometer in spectral range 400 - 4000 cm^{-1}. resolution 4 and accumulation 100.

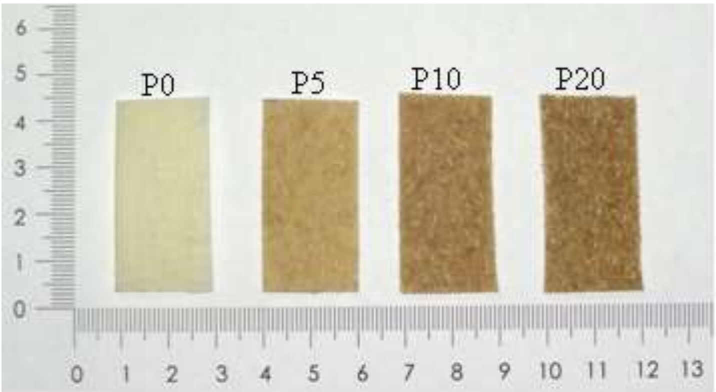


Fig.1 – Composite material samples with different fibers content

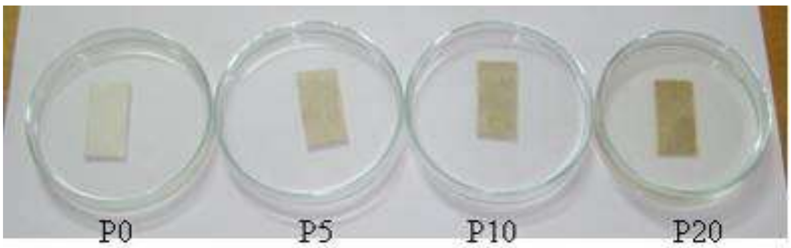


Fig.2 –Samples after 48 h of submerging in distillate water

RESULTS

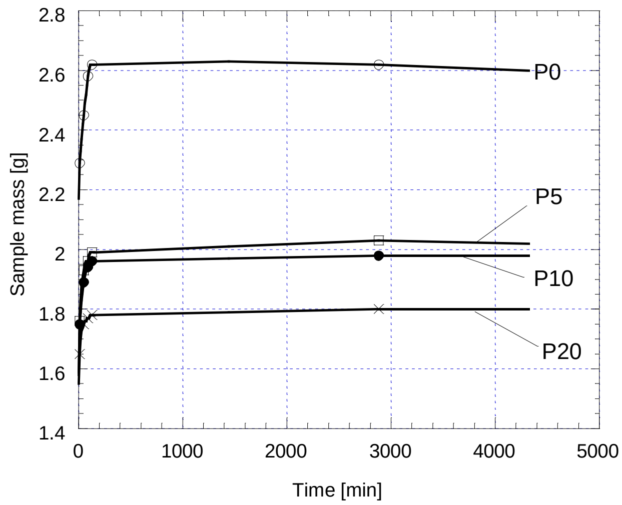
Table 2 presents the samples mass with uptake water absorbed after 24/48/72 h of hydration by four composite materials samples with different formula presented in Table 1. The sample P0 which has the formula with no fibers (0%) reached the maximum water uptake with higher velocity (in 24 h) and that started to degrade. The sample P5 which has the formula with lower fibers content (5%) absorbed the highest amount of water (~28% of sample mass) in 48 h and than started to degrade. The lowest quantity of water (~16% of sample mass) was absorbed by the sample P20 (with 20% Miscanthus fiber) in 48 h.

Table 2

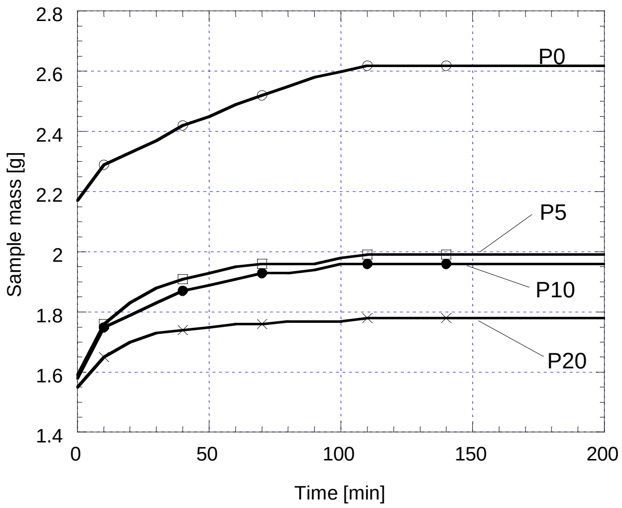
The sample mass after hydration and water uptake

Sample	P0	P5	P10	P20
Dry sample [g]	2.17	1.59	1.58	1.55
Distilled water [g]	20	20	20	20
Sample after 24 h	2.63	2.01	1.97	1.79
Sample after 48 h	2.62	2.03	1.98	1.80
Sample after 72 h	2.60	2.02	1.98	1.80
Water uptake [g]	0.46	0.44	0.40	0.25

As can be seen from fig. 3. B, all samples regardless of the fiber content absorb most of the water in the first 3 hours, but the samples reinforced with Miscanthus fibers absorbed the highest amount of water slower than the sample with no fibers (P0).



a)



b)

Fig.3 –Sample mass with water uptake after 72 h- a; detailed view for the first 3 hours – b

Also the sample with higher fiber content absorbed the lowest amount of water. The samples reinforced with different ratio of fibers keep their integrity for 72 h but the sample P0 (no fibers reinforcement) start to degrade after 24 h (fig.3.a) Also the sample with higher fiber content absorbed the lowest amount of water. The samples reinforced with different ratio of fibers keep their integrity for 72 h but the sample P0 (no fibers reinforcement) started to degrade after 24 h (fig.3.a)

In order to study the samples by FTIR spectroscopy we recorded and compared the IR spectra of samples P0-P20 before and after hydration-drying. Due to the observation regarding water uptake, we analyzed the spectra of samples P0 (no fiber content). P5 (5% fibers absorbed the highest amount o water) and P20 (20% fibers absorbed the lowest amount o water).

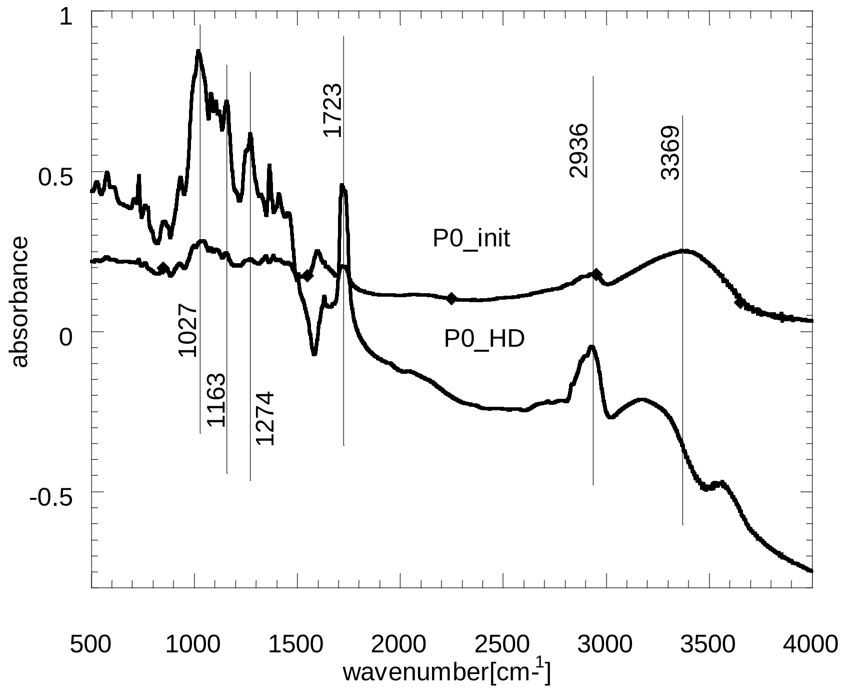


Fig.4 – FT-IR spectra of P0 sample: initial state-P0_init and after hydration-drying

CONCLUSIONS

Biocomposite materials with improved properties can be obtained by reinforcing a biodegradable matrix with natural fibers.

Samples were prepared by reactive extrusion with a laboratory twin-screw extruder.

Raw materials used are: native corn starch, glycerol, PBAT and Miscanthus fibers.

All the samples regardless of the fiber content absorb most of the water in the first 3 hours.

Miscanthus fiber content decrease the speed of water uptake

The sample with higher fiber content absorbed the lowest amount of water.

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RESEARCH ON THE IMPLEMENTATION OF FEM ANALYSIS USE, TO INCREASE THE TESTING EFFICIENCY OF RESISTANCE STRUCTURE OF AGRICULTURAL TRACTORS CABINS
/
CERCETĂRI PRIVIND IMPLEMENTAREA UTILIZĂRII ANALIZEI CU ELEMENTE FINITE PENTRU CREȘTEREA EFICIENȚEI TESTĂRII STRUCTURILOR DE REZISTENȚÂ ALE CABINELOR TRACTOARELOR AGRICOLE

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Keywords: *Roll-Over Protective Structure, Testing, Finite Element Method, Cabin, Tractor.*

ABSTRACT

Most cabin testing procedures are destructive and if the resistance structure is inadequate it would require redesigning and retesting of the cabin in order to reach its validation. This entails high costs, so there has been a need for a virtual testing phase using the Finite Element Method to be introduced in the validation cycle of a resistance structure. In the validation procedure presented in this paper, the phase of virtual analysis using the Finite Element Method is of particular importance for reducing the costs and time required to validate the resistance structure for an agricultural tractor.

REZUMAT

Procedurile pentru testarea cabinelor sunt în mare parte distructive. iar dacă structura de rezistență este necorespunzătoare este necesară reproiectarea și retestarea cabinei pentru a ajunge la validarea acesteia. Aceasta presupune costuri ridicate, astfel că a apărut necesitatea ca în ciclul de validare a unei structuri de rezistență pentru cabină să se introducă și o etapă de testare virtuală folosind metoda elementelor finite. În procedura de validare prezentată în această lucrare, etapa de analiză virtuală utilizând metoda elementelor finite are o importanță deosebită pentru reducerea costurilor și a timpului necesar pentru validarea structurii de rezistență pentru un tractor agricol.

INTRODUCTION

Tractor characteristics, working conditions and ground are factors that influence the risk of tractors rolling. Thus, in the design and development of tractors it is of great importance to protect the operator from potential injuries or even death due to a roll-over. The development of standards has been bound to tractor evolution. Worldwide were set standards to address the safety of operators and the tractors need to comply with them (*Shende et.al.. 2016*).

Requirements of design and testing of ROPS have been studied by many research institutes and universities in the field of agricultural engineering. This was achieved by research, testing and examination of tractor roll-over accidents. Under relatively controlled conditions were recreated and tested tractor roll-overs, aiming to study the loadings applied to the ROPS and the subsequent behavior of the tested structures (*OECD Tractor Codes Brochure*).

Over time, national standards for ROPS testing were harmonized to create those existing today, allowing OECD to be at the forefront of ROPS test standards development. Originally, the tests for validation of ROPS performance were using a sequential combination of „Dynamic" swinging (pendulum-type) mass impacts from the rear side and likely the front of structure. These were accomplished by applying gradually crushing loads to the upper „roof" of the ROPS. The OECD Code 3 illustrates this type of testing procedure. first introduced in 1966 (*OECD Tractor Codes Brochure*).

ROPS tests seek to ensure that the ROPS will safely absorb some minimum level of strain energy under loading, without the risk of structure failing or deflecting into the safety „clearance" zone, which is most likely to be occupied by the operator. The level of test loading is linked directly to the mass of test tractor, given that in a rollover, the forces and impact energy applied to the ROPS increase with the weight of the vehicle (*OECD Tractor Codes Brochure*).

Researches conducted in various countries served as basis to develop a testing procedure that replaced the swinging pendulum mass with a series of slowly-applied loadings. The direction and sequence of loading and the vertically applied crushing loads were retained. The loading sequence for OECD Code 4 is illustrated in Figure 1. The levels of loading / strain energy which the ROPS must withstand, are directly related to the weight of the test vehicle (*OECD Tractor Codes Brochure*).

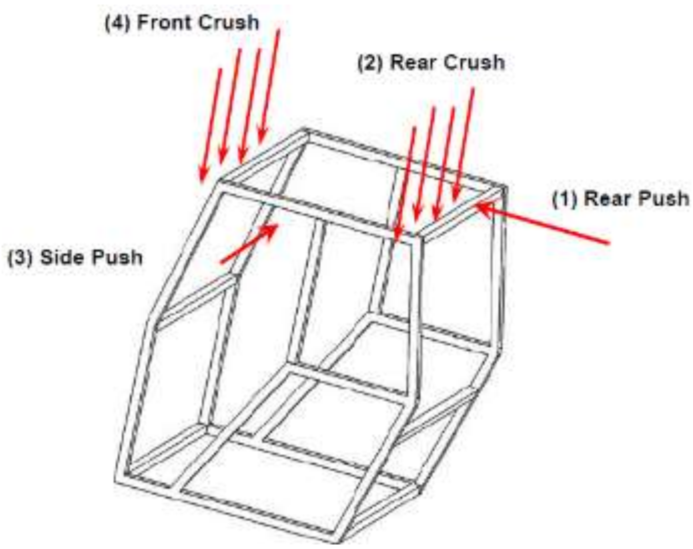


Fig. 1 - Typical OECD Code 4 'Static' ROPS test loading sequence (*OECD Tractor Codes Brochure*)

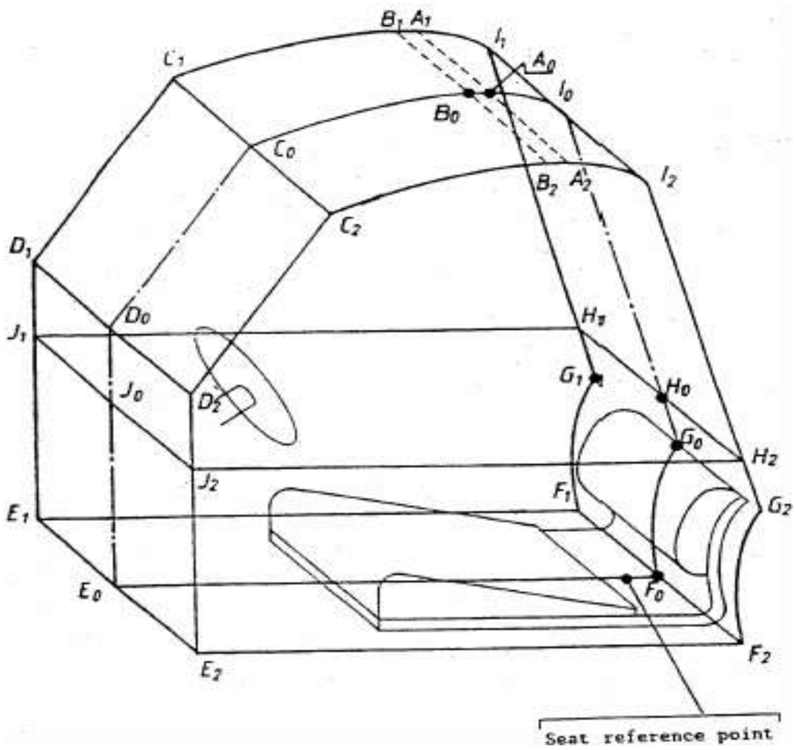


Fig. 2 - Clearance zone of the driver

Directive 2003/37/EEC shows that tractors weighing over 800 kg can be homologated using the OECD standard code for the official testing of protective structures on agricultural and forestry tractors (static test), also known as Code 4. It was designed a ROPS connective to the rear axle of different tractors and a computer program to calculate the design of ROPS.

While loading, there cannot be any interference of any parts into the driver's clearance zone (Fig. 2). or the area occupied by the driver during the rollover, while he stays on the seat and holds onto the steering wheel (*Mangado et.al.. 2017*).

MATERIAL AND METHOD

ROPS Test Codes were released in the 1980's and they have not changed significantly ever since. The family of OECD ROPS Codes has increased and includes test procedures for Narrow-Track tractors (wheeled tractors for vineyard and orchard) (Codes 6 and 7), plus Crawler tractors (track lying) (Code 8) and Telehandlers (self-propelled variable reach all-terrain forklift trucks for agriculture) (Code 9). Less dynamic ROPS tests are performed today, most of them by „static"-type procedures in which Code 4 is frequently used. Unlike other OECD Test Codes, the ROPS test is linked to the tested structure, which could be adapted to a range of various types of tractors. Structures are subjected to tests with loadings to fit the heaviest model in the vehicle range, in the safe knowledge that the requirements of the lighter models will be complied. The results of OECD ROPS tests are not public, but are kept confidential to the vehicle / ROPS manufacturer and the testing station which performed the test. Test report is subsequently checked by the OECD Coordinating (Quality Control) Centre and, if appropriate, an OECD Approval Number is issued for the ROPS to prove that it has met the test requirements (*OECD Tractor Codes Brochure*).

Figure 3 illustrates the complex diagram for determining the continuous roll-over behavior in case of tractor overturning laterally with a front mounted ROPS (*OECD Standard code 6*) where: Version B1 refers to the Point of impact of ROPS behind longitudinally unstable equilibrium point; Version B2 refers to the Point of impact of ROPS near longitudinally unstable equilibrium point; Version B3 refers to the Point of impact of ROPS in front of longitudinally unstable equilibrium point.

Not only the slope of the ground causes the loss of stability resulting in a rollover. More than half of lateral rollovers are caused by tractors slipping into channels or crashing against obstacles (*Chisholm, 1972*). Aiming to limit the risk of an overturn different active devices (mobile ballasts and inclinometers) have been tested experimentally (*Fabri and Ward, 2002*; *Mangado et.al., 2017*). Actually, computer simulation modeling is widely used (*OECD Tractor Codes Brochure*).

Impact tests are designed to represent the most frequent type of road crash, resulting in major or fatal injury. Computing the impact forces during various collisions is made by the following principle: "the change in the kinetic energy of an object is equal to the net work done on the object". This is referred to as the Work-Energy principle, an useful tool in solving mechanics problems. It is determinable from energy conservation and application of equations for work and energy, so it depends on conservation laws. In straight-line collision, the performed net work is equal to the mean force of impact times the distance travelled during the impact (*Singh S.A.. 2013*).

The load sequence is formed of a combination of loads, with the application based on an energy target and crushing tests with a vertical application based on a force target. Code 4 requires to apply one longitudinal load, asymmetrical to the longitudinal axis of the ROPS, two crushing tests (one on the front and one on the rear of the ROPS) and one lateral load applied at a position defined with respect to the seat index point (SIP) (*Molari et. al., 2014*). The ISO standard establishes a lateral load in a position defined with respect to the deflection-limiting volume (DLV), one crushing test applied in the middle of the structure and one longitudinal load.

In comparison to other standards, Code 4 allows a wide lateral clearance zone that includes the deflection-limiting volume of the ISO standard and extends to the front of the steering wheel to create a large volume around the driver. As for the frontal view, the ISO standard is more conservative at the shoulder point. The magnitudes of longitudinal and lateral loads stated by the two standards are different. Code 4 establishes a defined energy to be absorbed by the ROPS and the ISO 3471 standard establishes the energy and force for the lateral load and a force for the longitudinal load (*Molari et. al.. 2014*).

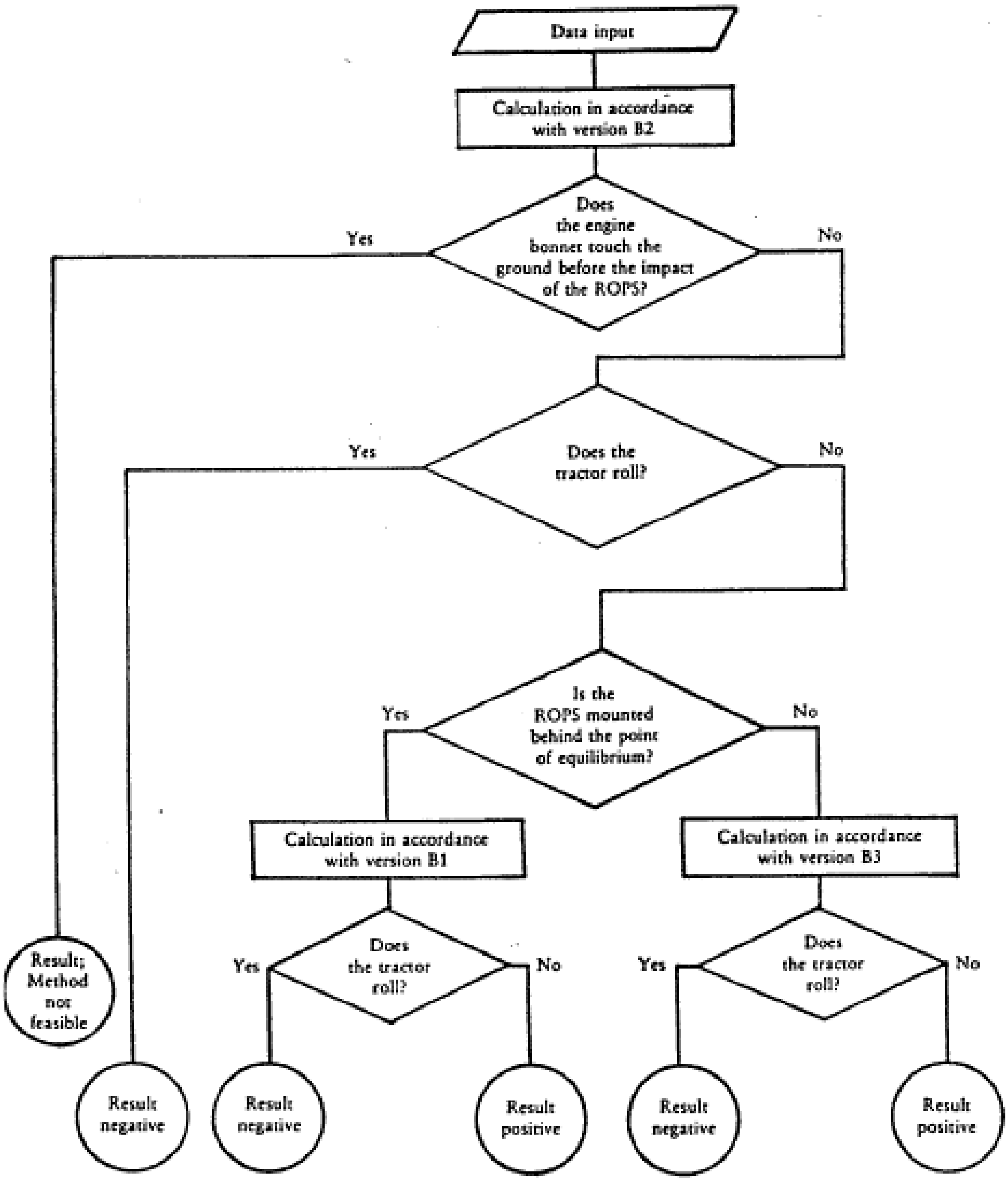


Fig. 3 - Flow diagram to determine the continuous roll-over behavior of a laterally overturning tractor with front mounted roll-over protective structure (ROPS) (*OECD Standard code 6*)

The classical method of testing-homologation is made according to the diagram in Fig. 4 and the flow diagram proposed for the testing-homologation using the analysis by the finite element method of the cabin resistance structure (Fig. 5). The analysis will show the limits imposed by model size and the geometry will be notably simplified, so this research should highlight the issues, limits and constraints in the procedure proposed by the standards. It could represent a general guideline for future enhancements of design and it could be useful in estimating the limits of products being put into service in the future.

The rear part and one lateral of the tractor's structure were pushed by hydraulic cylinders. The longitudinal loading was stopped when the energy absorbed by the protective structure was equal to or higher than the required energy input established by Code 4.

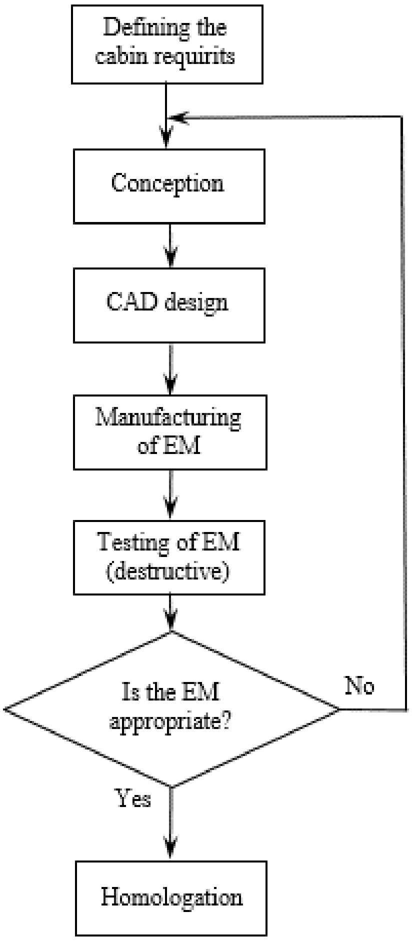


Fig. 4 - Flow diagram for the classical method of testing-homologation

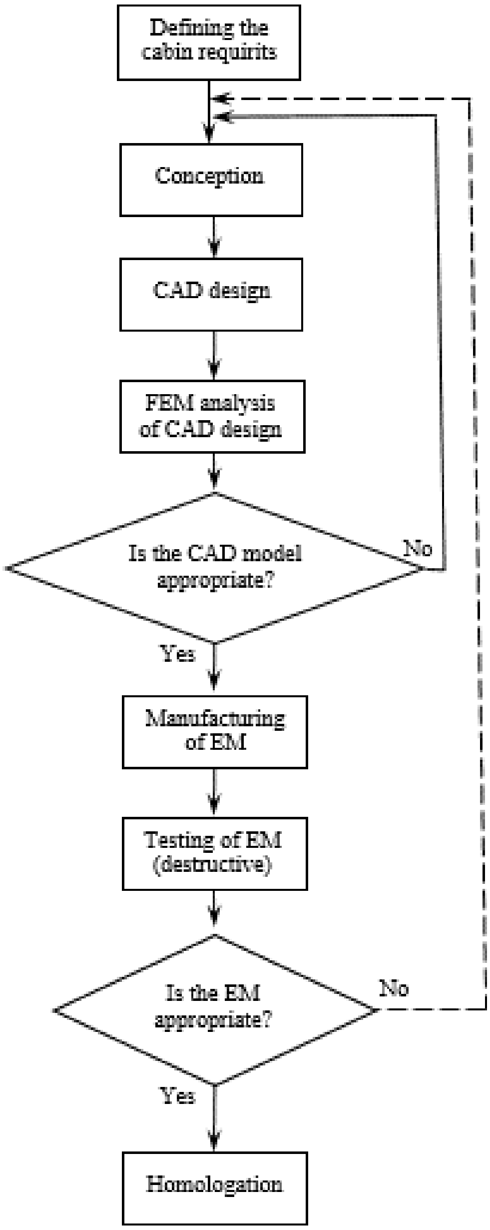
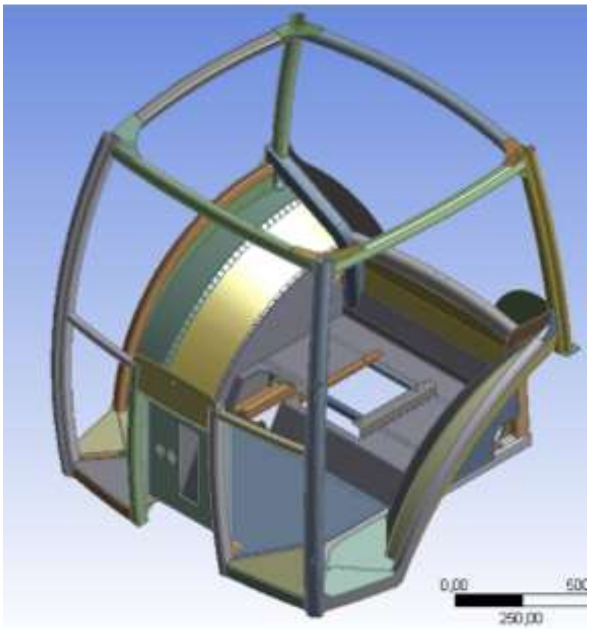
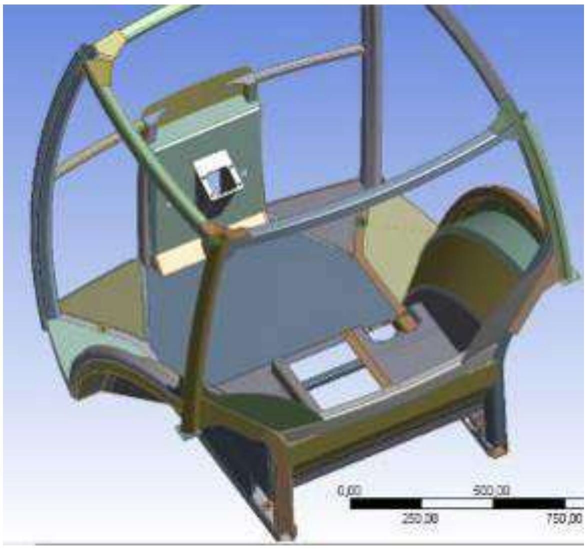


Fig. 5 - Flow diagram proposed for the testing-homologation by FEM

The ROPS are accepted if they comply to a series of conditions during and after testing: no part will enter the clearance zone or crash the seat during the tests, respectively the clearance zone (as defined and located by Code 4) is not outside the protection of ROPS. Any part touching flat ground when the tractor rolls over toward the direction from which the test load is applied, will be considered “outside the protection of the structure”. To assess it, width settings of tires and tracks should be the smallest standard fitting specified by the manufacturer. In addition, at the point where the required energy absorption is found in the horizontal loading tests, the force must be higher than $0.8 \cdot F_{max}$. which is the maximum resistance measured during the test.

The structure of resistance of the analyzed tractor cabin is shown in Figure 6. It is achieved in the INVENTOR program and then converted and imported for Finite Element Analysis in ANSYS. Figure 7 shows the meshed model with finite elements containing 859.902 nodes.





a) *b)*

Fig. 6 – Structure of resistance of the tractor cabin

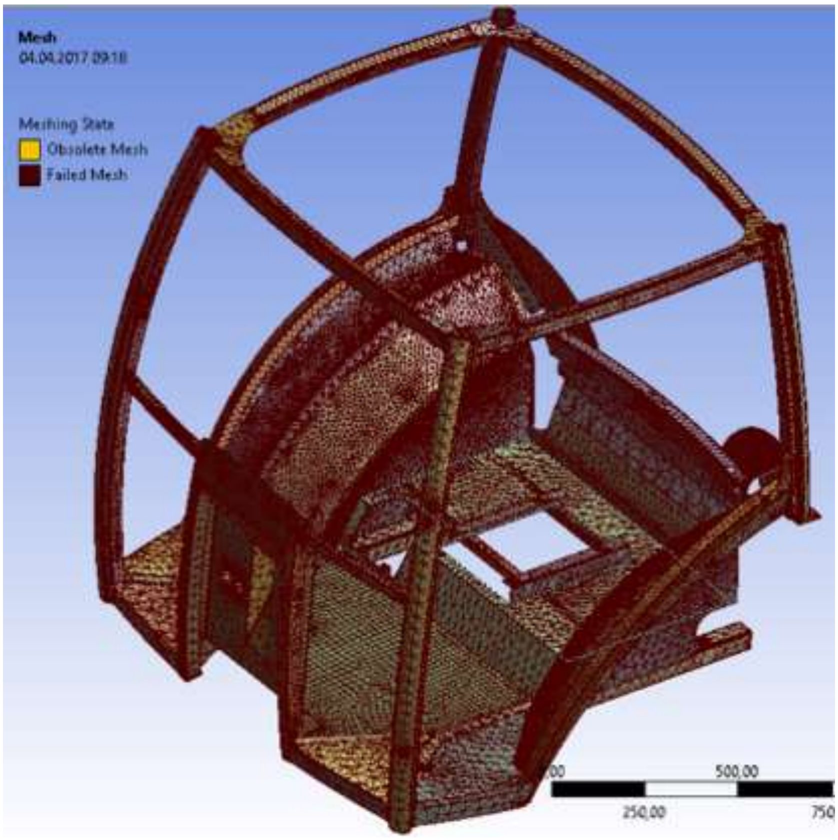


Fig. 7 – Meshed model of the structure of resistance of the tractor cabin

RESULTS

The partial result of the simulation of behavior for the resistance structure of the cabin in the case of applying horizontal force from the rear to the front part is presented in Figure 8. It can be observed that the dynamic simulation stopped after 0.22 mm displacement. Figure 9 shows a detail of strain distribution.

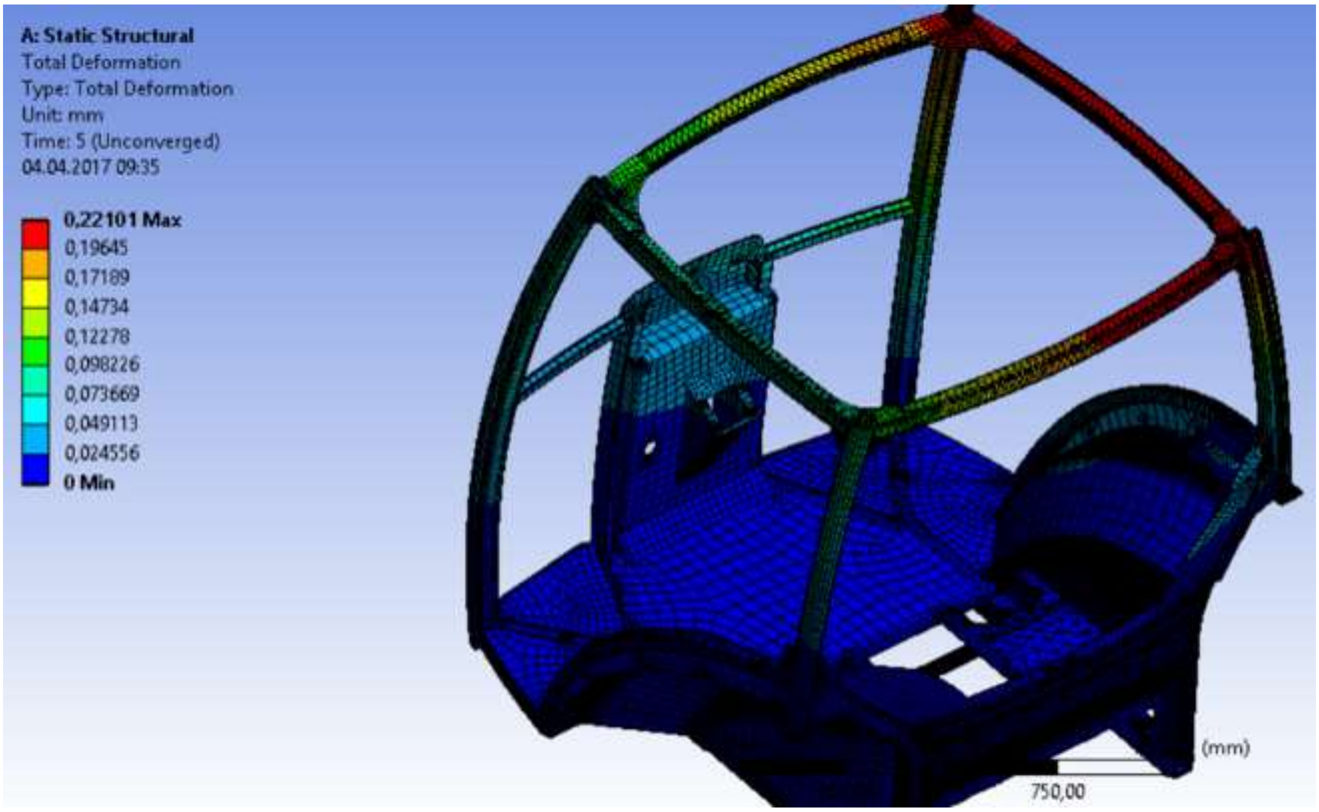


Fig. 8 – Distribution of strains in the resistance structure of tractor cabin

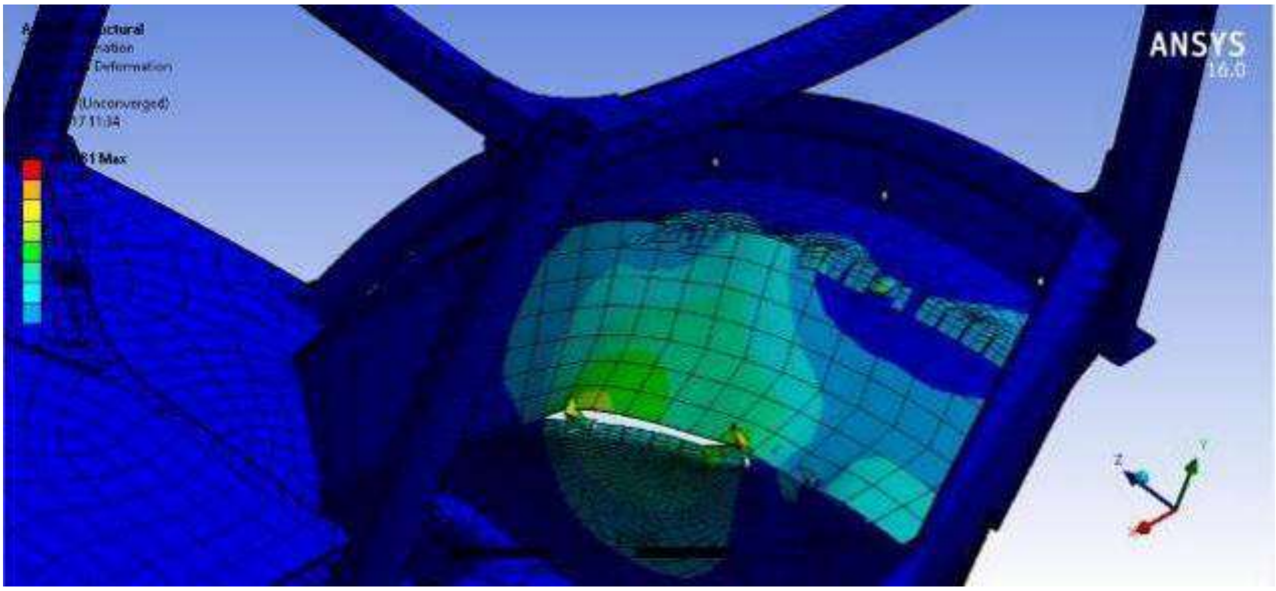


Fig. 9 – Detail in the distribution of strains in the resistance structure of tractor cabin

CONCLUSIONS

- Comparing Figures 4 and 5 it can be observed that, although more complex, the diagram in Figure 5 allows the remarkable decrease in homologation costs of the resistance structure for the cabin of agricultural tractors.
- Effective testing of the experimental model is carried out only after establishing that the CAM model is appropriate, following the FEM analysis.
- The full time required for homologation decreases.
- The accuracy of the test results increases when using the diagram in Figure 5.
- It can be noticed that the front structure that serves for the mounting of the dashboard and the steering wheel has a role in taking up the stresses (Fig. 8).

ACKNOWLEDGEMENT

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RESEARCH ON THE OPTIMAL DESIGN OF THE RETRACTABLE FINGER FROM A COMBINE HARVESTER'S AUGER
/
CERCETĂRI PRIVIND PROIECTAREA OPTIMALĂ A UNUI DEGET ESCAMOTABIL AL TRANSPORTORULUI ELCOIDAL DE LA COMBINA DE RECOLTAT CEREALE

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***Keywords**: finite element method, polymer,. Optimization, CAD.*

ABSTRACT
The article presents a procedure for the design and dimensional optimization using finite elements analysis of a polymeric retractable finger and a comparison with a metallic one. The retractable fingers are parts of the auger from the combine harvester's header. The design and simulation of the mechanism were achieved in SolidWorks. The loads resulted during the simulation were used to perform stress analysis and to optimize the retractable finger's dimensions.

REZUMAT
Lucrarea prezintă o procedură de proiectare și optimizare folosind metoda elementelor finite a unui deget escamotabil polimeric și o comparație cu unul metalic. Degetele escamotabile sunt părți componente ale transportorului elicoidal de la hederul combinelor de recoltat cereale. Modelarea și simularea mecanismului au fost realizate în SolidWorks. Sarcinile rezultate în urma simulării au fost utilizate pentru a realiza analiza structurală și pentru a optimiza dimensiunile degetului escamotabil.

INTRODUCTION
Nowadays, combine harvesters are equipped with massive headers capable of harvesting large amounts of vegetable material. A very important component of the header is the retractable finger auger. For a better flow, manufacturers use large diameter augers with fingers displayed on the full length of the auger.

One of the main factors machine-building industry permanently focuses on is the reduction of the total cost of the manufactured component. Usually, another important objective is the mass reduction of the entire product. Both of the above mentioned demands can be greatly influenced from the materials selection stage. Frequently, metallic parts are replaced with plastic ones when possible. [1]

Obviously, the final machine component must meet the functional requirements without diminishing its safety. [1]

From this point of view, strength, rigidity, relative reliability and durability are traditional key factors. Another emergent requirement that most of the plastics also met is recyclability, which indirectly ads its contribution to further costs reduction. [1]

Computer-aided design (CAD) is the use of computer systems (or workstations) to aid in the creation. Modification, analysis or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation and to create a database for manufacturing. [2]

FEA as applied in engineering is a computational tool for performing engineering analysis. It includes the use of mesh generation techniques for dividing a complex problem into small elements, as well as the use of software program coded with FEM algorithm. [3]

MATERIAL AND METHOD
CAD software SolidWorks was used for designing the retractable finger auger. The auger was created using a set of simple commands, such as Extruded Boss/Base or Shell but also using "Helix" and "Curve Pattern". Each part was modeled independently, then they were assembled using Solidworks Assemblies.

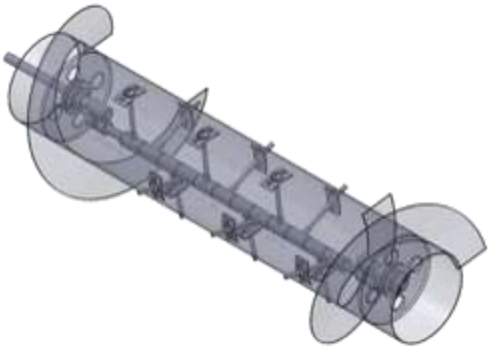

Fig. 1 - Retractable finger auger

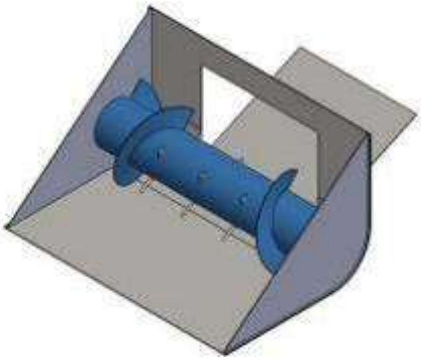

Fig. 2 - Assembly

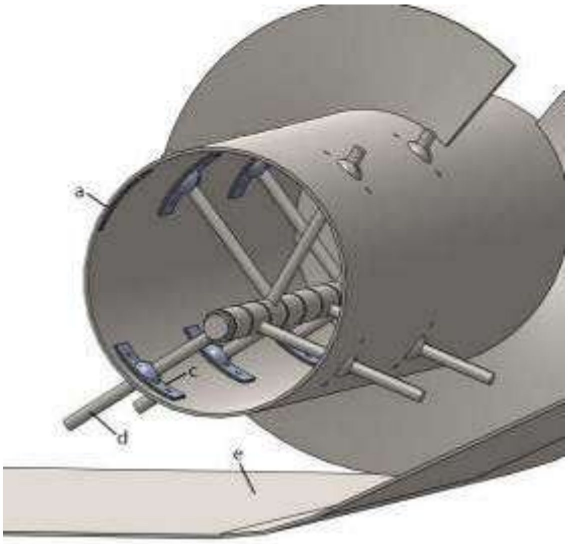

Fig. 3 - The simplified model of the mechanism

One of the parameters that must be calculated before the motion simulation, is the vegetal mass rate undertaken by one finger. The maximum mass rate that can be processed by the entire equipment is 7 kg/s. As the transporter has 12 retractable fingers, it is calculated that each finger must ensure a mass rate of maximum 0. 58 kg/s. The mass md of vegetal material pushed by one finger in the course of one rotation is:

$$m_d = \frac{60 * Q_{tr}}{n} = \frac{60 * 0.58}{180} = 0.193\, kg/rot$$

where *n* is the transporter's rotational speed (rpm).

A cuboid (fig.4.) was added to the mechanism from figure 3. It was placed on the platform and symbolizes the mass of vegetal material pushed by one finger in the course of one rotation.

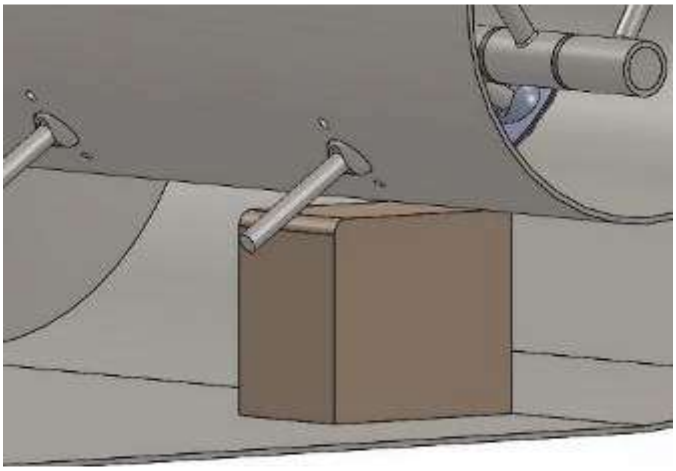

Fig. 4 – Cuboid placed on the platform

Table 1

The properties attached to the cuboid [1]

Mass (kg)	0.193
Density (kg/m^3)	100
Coefficient of friction with steel plate (for 17% plants humidity)	0.56 (static); 0.39 (dynamic)
Coefficient of elasticity k: (N/cm)	1.5
Damping factor c: (Ns / cm)	2

Values of friction. damping and elasticity coefficients are the upper limits of their intervals. in order to simulate the most difficult running conditions.

The 3D model was meshed with high quality parabolic tetrahedral elements. with nodes both at corners and at the middle of each edge.

A revolution of 180 rpm was specified for the cylindrical case. The simulation lasted for 0.1 s. The program computed the kinematic and dynamic parameters of the mechanism.

Fig. 5 - Meshed model

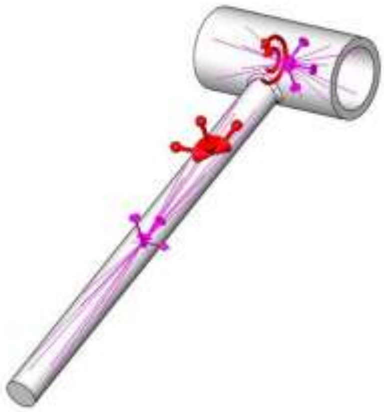

Fig. 6 - Distribution of the static and dynamic loads on the retractable finger

SolidWorks Simulation was used to calculate the retractable finger's behavior under the action of previously computed reaction forces and moments.

For the analysis, the part was assigned with the properties of a carbon steel, then with the properties of a polymeric material, Polyetheretherketon (PEEK).

Table 2

The properties of the carbon steel

Properties	Units	Values
Density	kg/m3	7800
Tensile strength	MPa	220.59
Modulus of elasticity	MPa	210000

Table 3

The properties of PEEK

Properties	Units	Values
Physical		
Density	g/cm3	1.32
Water Absorption (24 hrs)	%	0.5
Mechanical		
Tensile Strength (yield)	MPa	96
Tensile Modulus	GPa	3.6
Ultimate Elongation	%	50
Flexural Strength	MPa	191
Flexural Modulus	GPa	3.654
Compressive Strength	MPa	118
Ultimate Shear Strength	MPa	52.4
Izod Impact Strength (1/8" thick specimen)	J/cm	0.8
Rockwell Hardness		M99
Coefficient of friction (0.5 m/s. 70 kg load)	it	0.18
Thermal		
Maximum CST	°C	250
Melting Point	°C	334
Processing temperature	°C	193-221
Thermal Expansion Coefficient	mm/mm	0.08-0.12

RESULTS

Stress distribution computed during the structural analysis of the metallic finger is presented in figure 7. The maximum Von Mises stress (71.4 MPa) is much lower than the tensile strength at yield of the used steel.

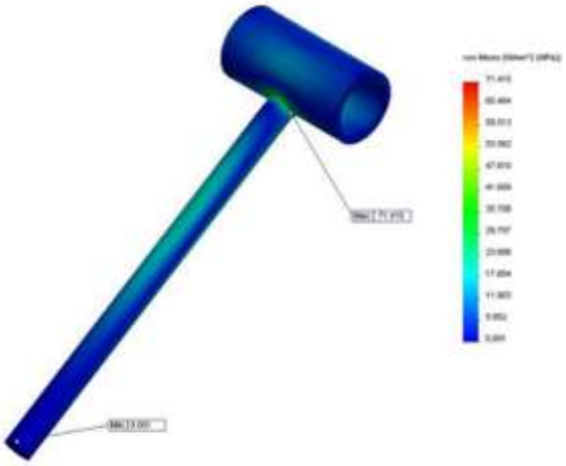

Fig. 7 - Distribution of the von Mises stresses on the metallic finger

Stress and displacement distribution computed during the structural analysis of the polymeric finger are presented in figure 8. The maximum Von Mises stress (32.5 MPa) is much lower than the tensile strength at yield of the used polymer.

The maximum displacement appears on the finger's tip, with a value of 2.1 mm.

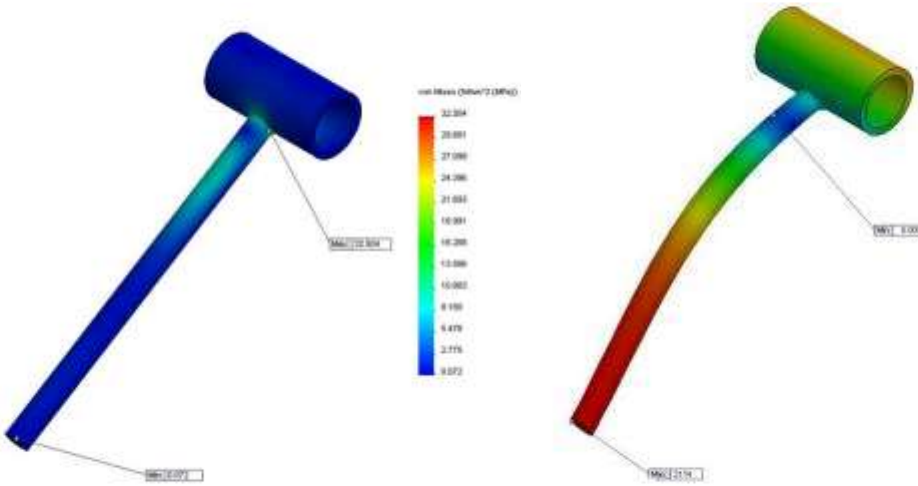

Fig. 8 - Distribution of the von Mises stresses and displacements on the polymeric finger

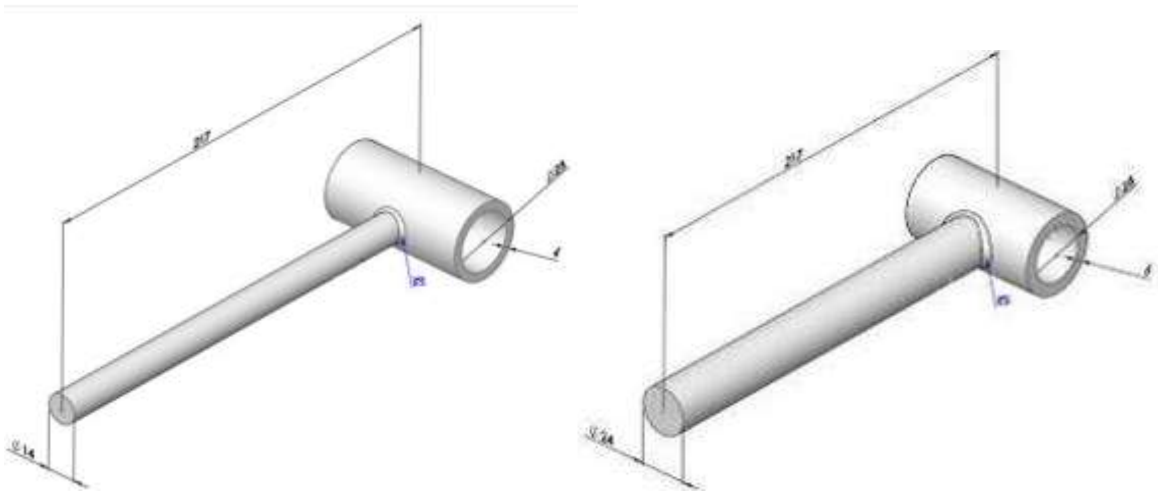

Fig. 9 - Dimensions of the non-optimized retractable finger, respectively the optimized finger

After the analysis the optimization procedure was defined. The procedure had to configure a finger with minimum mass, so that the maximum displacement should not exceed 1.5 mm by more than 5%. Table 7.4 presents the dimensions that can be modified (fig.9), as well as their upper and lower limits.

Table 4

Values ranges of the variable dimension

Dimension	Initial value	Lower bound	Upper bound	Tolerance
Finger diameter (mm)	14	14	26	1 %
Fillet radius (mm)	2	2	6	1 %
Hub thickness (mm)	4	3	7	1 %

Table 5

Dimensions calculated after the optimization procedure

Dimension	Initial value	Final value	Difference	
			absolute	relative (%)
Finger diameter (mm)	14	24	10	71
Fillet radius (mm)	2	3	1	50
Hub thickness (mm)	4	6	2	50

Table 6

Mass characteristics of the optimized part

	Metallic finger	Initial polymeric finger	Optimized polymeric finger
Mass (g)	467.38	78.16	177.86

CONCLUSIONS

From this study it results that CAD software can be successfully used to perform analysis on the distribution of stresses and deformations in moving parts of agricultural machinery in order to optimize their construction.

By replacing metallic parts with polymeric ones, it can lead to reduction of the equipment mass together with higher durability and corrosion resistance.

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CONSIDERATIONS REGARDING VERTICAL DRYERS FOR CEREAL AND TECHNICAL PLANT SEEDS
/
CONSIDERATII PRIVIND USCATOARELE VERTICALE DE SEMINTE DE CEREALE SI PLANTE TEHNICE

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Keywords: *Drying, seeds, vertical dryers.*

ABSTRACT

Drying seeds is done to avoid degradation due to high moisture they have to harvest and to be kept for a longer time. It is necessary that the drying operation to be carefully planned and managed to ensure the optimum drying temperature. This temperature depends on the subsequent destination of the dry product, so that the seeds intended for sowing be not affected as germination capacity.

This paper presents a synthesis on the drying process of cereal seeds and technical plants using vertical dryers. This is a prerequisite for deepening the study of this type of machines, both constructively and in terms of the characteristic working process, in order to optimize the parameters.

REZUMAT

Uscarea semintelor se realizeaza pentru a se evita degradarea acestora datorita umiditatii ridicate pe care o au la recoltare si pentru a putea fi pastrate un timp mai indelungat. Este necesar ca operatia de uscare sa fie planificata si gestionata cu grija pentru a asigura temperatura de uscare optima. Aceasta temperatura depinde de destinatia ulterioara a produsului uscat, astfel incat semintelor. care sunt destinate pentru semanat, sa nu le fie afectata capacitatea de germinatie.

În aceasta lucrare se prezinta o sinteza referitoare la procesul de uscare a semintelor de cereale si plante tehnice utilizând uscătoare verticale. Aceasta reprezinta o premisa pentru aprofundarea studierii acestui tip de utilaje, atat din punct de vedere constructiv. cat si al procesului de lucru characteristic, in vederea optimizarii parametrilor.

INTRODUCTION

Harvested crop products are used in important sectors of the economy. Thus, healthy grain seeds are used for sowing and for human or animal consumption. Agricultural products account over 90% of the raw material used in the food industry, where they are processed by various processes (*Casandroiu. 1993*).

Until their use for the population consumption, industrial processing or commercialisation, it is necessary to ensure preserving and storage for a long time and without loss.

In this regard, we are talking about subjecting agricultural products to a primary processing process, aiming to bring the product into a state characterized by a certain purity, humidity, temperature, etc.. in order to avoid its deterioration and to preserve its nutritional qualities.

The primary processing of the various seeds is carried out in specialized units equipped with technological lines in which the processes are mechanized and automated. Here, besides the operations in which the physical condition of seeds such as aeration, drying or cooling, is changed, other types of seed methods such as sorting, filtering, sedimentation, etc.. are also intended to degrade.

In the primary processing, the seeds mass pre-cleaning and cleaning obtained from the combine harvest, the impurities contained (vegetal, mineral and / or weed seeds) are essential. These operations are necessary to meet the requirements of national and / or European standards according to their destination (sowing, consumption, industrial processing, storage. etc.) (*Casandroiu, 1993; Voronov et al., 1955*).

Due to the fact that at harvest the agricultural products have higher moisture content than that required for a long life, it is necessary to dry them. This is one of the oldest conservation methods, where,due to a heat and mass transfer phenomenon, the water migrates from the interior of the product to the surface of the product, from which it evaporates (*Mohammed et al. 2010*).

Pre-storage drying for further processing substantially reduces the risk of mass-storage disturbances of the stored product and also allows for better storage management. The delay in performing this operation or incomplete implementation generate significant qualitative and quantitative losses (Gummert et al. 2004). It is recommended to dry seeds to the moisture limit that can guarantee good conservation. Thus, besides a high germination power and cessation of the seed degradation process, it is ensured by microorganisms and insects that act strongly when the humidity is high. Also, drying is required to ensure the moisture appropriate to the mechanical conditioning operation for sowing, because seeds with high moisture content can be easily damaged. (*Olaniyan and Alabi, 2014*).

The drying operation can be performed either naturally or artificially.

Natural drying can be accomplished by: solarisation (direct exposure to sunlight during the summer period and rigidity of the seed lot to increase the evaporation area); active aeration (air is introduced under pressure into the mass of stored products); handling with ventilation facilities (used for silos that are equipped with many dehumidifiers); passing batches of products through "cold" drying installations - without fuel consumption (through the column), using dry and warm air instead of the drying agent.

The sun-drying method is limited only to hot sun geographies and the dry atmosphere with strong winds, which do not characterize all the regions producing cereals (*Andritsos et al. 2003*). Also, in a solar dryer, cereal grains are often not protected from weathering (rain, storm, wind, dust) and insect pests. rodents etc., which can seriously affect their quality becoming even inedible.

Artificial drying of cereal grains is a widespread operation, being the safest way to dehydrate them, because with it greatly reduces losses and the quality of the resulting product is significantly improved compared to solar drying (*Balbine et al.. 2015*).

This process also has important drawbacks because it is highly energy-intensive and may favour an increased degree of damage to the grain by cracking or breakage, due to the large internal stresses induced during its deployment. In order to eliminate these inconveniences, it is necessary to progressively dry the seeds by means of complex plants in which the thermal regime is automatically controlled depending on the nature, the seed moisture and the parameters of the drying agent.

Vertical and horizontal dryers with continuous or discontinuous operation based on convective dehydration are used to dry seed crops.

Consistent with the current context regarding the reduction of energy consumption and environmental protection, this paper presents a synthesis of the technology of dehydration of cereal seeds and technical plants made in vertical dryers.

MATERIAL AND METHOD

The operating principle of tower dryers is generally based on heat recovery, especially that resulting from cooling the seeds. Thus, this paper presents some of the most efficient vertical dryers used worldwide.

The GSI Group produces three types of continuous flow tower dryers (Figure 1). The supply of each type of dryer is carried out through the upper part, the product reaching the reception room designed to reduce the impact of the fall on the berries and to ensure their uniform distribution.

After they pass through the reception room, the cereals reach the heating hopper between the two cylindrical walls, concentrically arranged. The high capacity of the hopper is an advantage as drying the product is slow, at low temperature.

In the middle of the heating section is the inverter system which moves the warm beans located near the inner wall of the hopper instead of the wet grains adjacent to the outside wall, thus ensuring uniform drying irrespective of the distance between the grain column and the wall from the heating chamber.

After leaving the heating zone, the cereals reach the bottom of the dryer, where they are cooled by the atmospheric air forced by the fans through the walls of the hopper. The same airflow is then reused to dry the grain in the hopper, being already heated by the heat absorbed from the cereals in the cooling zone. For this reason, the amount of fuel used by the burner is reduced to further heat it.

Depending on the size of the dryer, one to four fans are placed in line. They are mounted in the interior, designed to operate at low speed. Thus, noise and energy consumption are low. Fan motors also have a long life.

The dryer uses a computerized Vision control system.

In order to be in line with the European standards on processed grain quality, GSI's dryer burners work with natural gas or liquefied gas. In this way, the cereals are heated directly resulting in a high-quality product.

The dryer is equipped with walkways, ladders and protective grids made of high-strength materials, so that all dryer areas can easily be accessed for inspection, cleaning and maintenance.

Fig.1 – Flow diagram of the GSI tower dryers [8]
1 – feeding area; 2 – reception room; 3 – cereal level monitoring device; 4 bunker for heating; 5 – air flow that crosses the grain column; 6 – grain inverters; 7 – stainless steel panels; 8 – separator funnel; 9 –cooling zone; 10 – download area; 11 – Vision system; 12 – humidity control sensor.

The SG Feerum Dryer (Figure 2) is an equipment designed and manufactured in Poland by Feerum S.A., which allows the work in drying mode from feed to seed grain as well as fine-grained oilseeds. Feerum dryers are designed to maintain a stable strong work throughout the drying period. Their capacity is from 19 to 30 tons. As fuel sources for dryer can be used natural gas, liquid gas or diesel fuel.

The SG Feerum dryer is equipped with: centrifugal fans with dust collector; capacity to dry, which increases the capacity of the dryer by 25%; service platform for the air fans; the heat source as an integral part of the main air channel dryers; adjustment of air feed capacity can be changed depending on the grain type; device for real time control over grain moisture throughout the drying and cooling processes; real time air temperature monitoring and touch screen with PLC for full process control in local languages.

The Portuguese company Entriger made the Agi-Entriger Dryer (fig. 3) to achieve the grain drying, which works continuously or intermittently.

In this system, the drying takes place by contacting the beans with the hot air during the passage through the drying tower located in the centre of the dryer and containing the cereals. Hot air is released in at least four points in each of the overlapping pipes. Perforated pipe columns thus allow, in addition to heat exchange with higher yield, better circulation and air contact with grains, which results in an effective level of moisture loss of the product and guarantees better quality of the product.

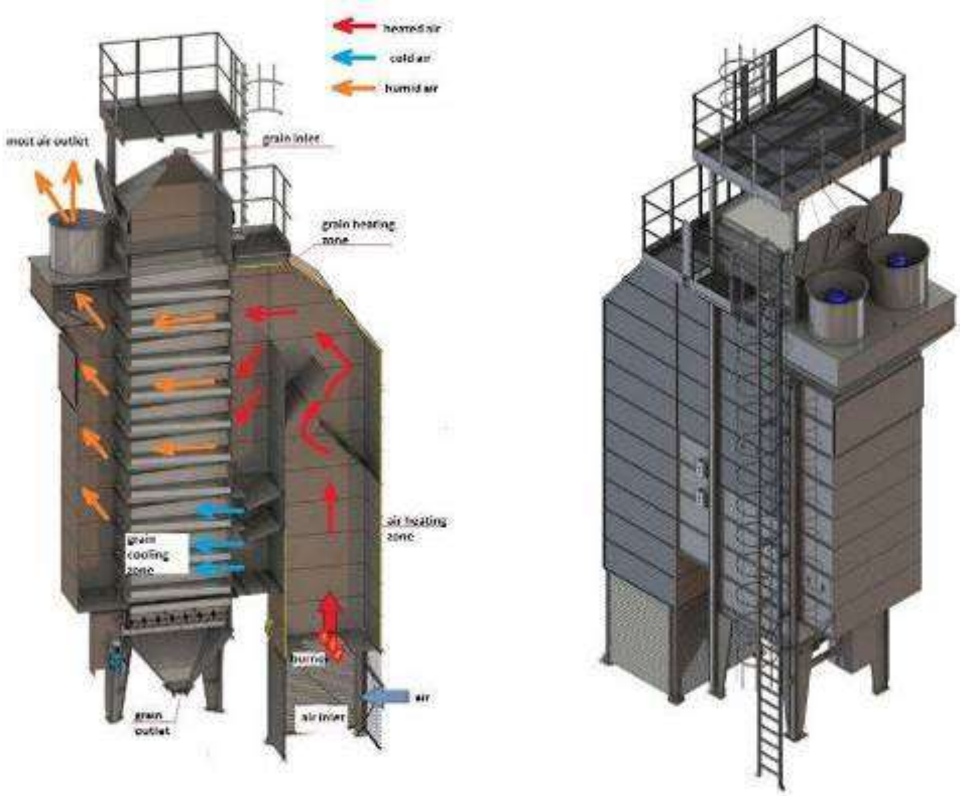


Fig.2 – Flow diagram of SG Feerum Dryer [9]

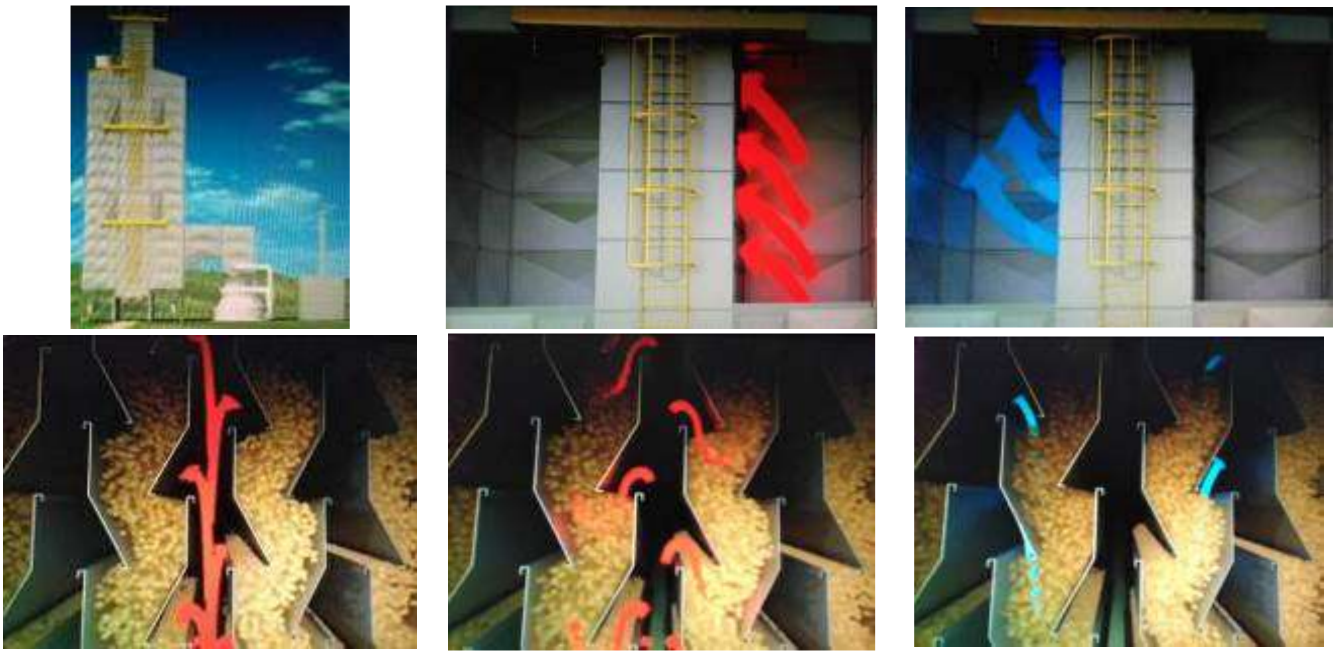


Fig. 3 – Flow diagram of Agi-Entriger Dryer [10.11]

Italian company "Macmar" manufactured three models of tower dryers. In FIG. 4 is shown the Tower Dryer of the RG series. The drying process is divided into 4 stages corresponding to a single operating configuration of the machine: loading, drying, cooling and discharge.

The products enter still wet and after going through the machine from the top to the bottom, they are dried and cooled. The recovered heat from the grain during the cooling phase significantly reduces fuel consumption. The cereals are subjected to a progressive decrease of the temperature, so that the grain does not receive any damage by sudden temperature changes, thus arriving in the discharge zone perfectly cleaned and cooled at room temperature. After this process the dried product it can be stored without any problem and in absolute safety.

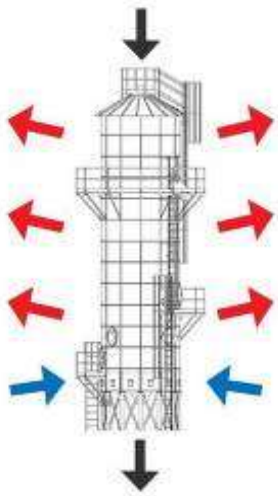


Fig. 4 –RG Drying tower [12]

The Eco Master dryer (fig.5) made by the Cimbria group in Austria is used for drying cereals and other granular products. It has a modular design that increases the size of the unit, if the drying requirements increase later.

The dryer is designed for industrial use and the drying and cooling sections are therefore built in 2 mm galvanized plates with inclined and conical air ducts to ensure high durability and homogeneous air and grain distribution - a pre-requisite for maintaining product quality without undesirable energy loss.

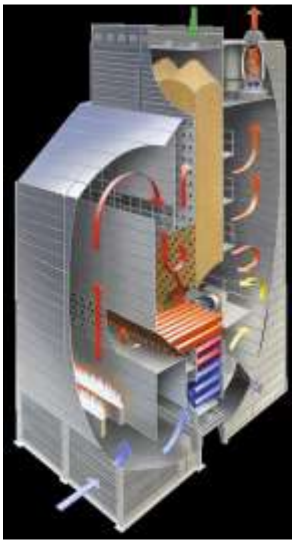


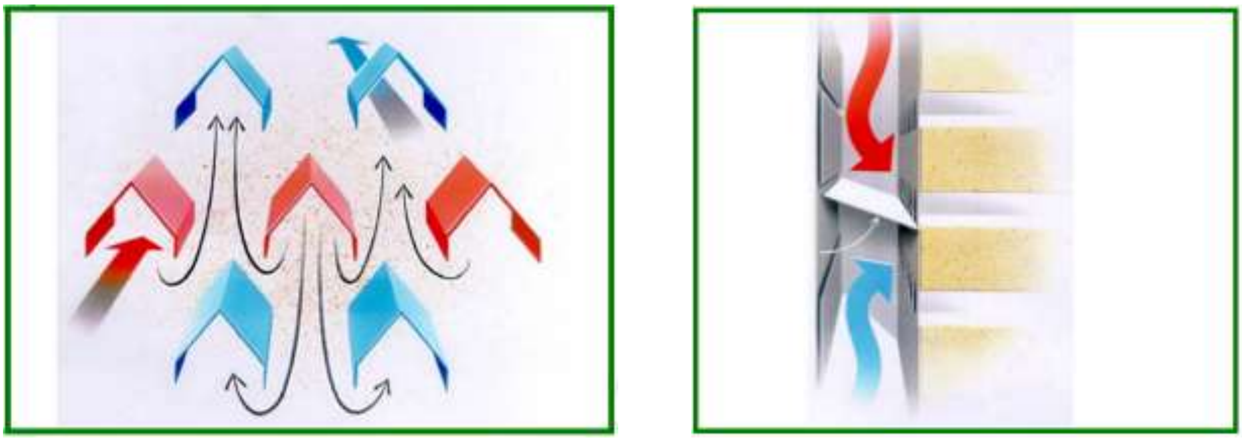
Fig. 5 – The Eco Master Dryer [13]

Cimbria drying sections (fig. 6. a) are build from triangular air ducts mounted between two walls. The ducts are alternately tapered against both walls and open in the tail end. The alternate ducts are respectively connected to the hot air and the exhaust chamber, through which the air is distributed in the drying column. In addition the ducts are displaced in relation to each other. Thus, each hot air duct is surrounded by 4 exhaust ducts and reverses with the exhaust ducts. The cereal moves slowly down between the hot air and exhaust ducts and is ventilated from different directions.

The mutual stream between the cereal and the air ensures that the product is exposed to a changing airflow. This alternating exposure to hot- and cold air ensures a gentle treatment and a homogenous drying of the grain and the speed of the cereal flow through the column is controlled by the discharge.

The Cimbria drying column is suitable for both drying and cooling purposes (fig. 6. b). The Cimbria dryer enables a varying cooling zone that makes it possible to configure the dryer to the exact drying and working conditions at all times. This zone is regulated with a shutter placed in the bottom part of the hot air duct.

By using air and energy in the best way possible, the costs are reduced and the capacity is optimized.



a. b.

Fig. 6 – Principle sketch from Eco Master Dryer [13]
a. Air Streams; b. Cooling Shutter

The Dry line (Figure 7) manufactured by the Swiss group Buhler operates in continuous flow and is used in reception, storage and manufacturing facilities.

The ambient air is sucked in by the main fan and heated by a hot air generator. Heat can be produced from conventional sources (oil, gas) as well as from alternative energy sources (biomass). The positioning of the main fan on the suction side produces negative pressure inside the dryer and transports the air from the hot air generator through the drying column and the downstream de-dusting before it is discharged through the rain flap. After hot air drying in the upper section of the drying column, the product is cooled in the lower section of the column. To increase the energy efficiency of the system, the hot air and cooling air heated by the cooled product is reused, adding to the hot air given by the generator to ensure high durability and homogeneous air and grain distribution - and pre-requisite for maintaining product quality without undesirable energy loss.

Fig. 7 – The Eco Dry Dryer [14]

The drying column of this dryer line, Eco Dry has a special and patented feature, namely conical piping arranged diagonally. The pipes are V-shaped and open at the bottom. The air comes from the heat source by opening the pipes (red) to the product and escaping through the exhaust ducts (blue). Thus, the product is heated and releases moisture into the warm air, which absorbs and cools through evaporation.

The conical shape of the pipes allows for more capacity columns and a uniform air distribution in the dryer and also prevents unintentional product discharge through the channels.

The diagonal layout of the pipes makes the product alternate from hot to cold, which leads to increased energy efficiency and reduced thermal stress on the product by almost 50%. Separation of the product flow ensures easy handling of the product, the drying process being extremely mild. This dryer can be combined with an Eco Cool dry cooler, contributing to a significant reduction in operating costs.

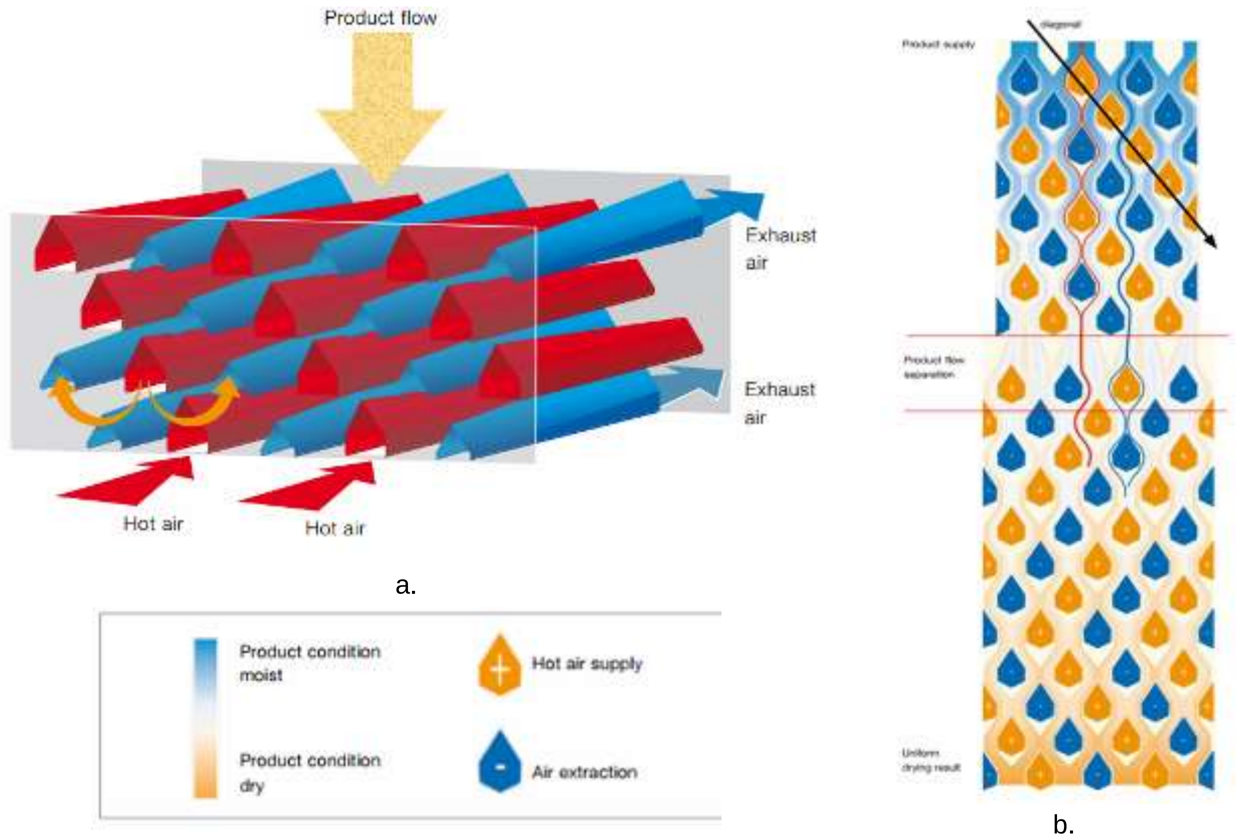


Fig. 8 – Scheme of drying column of Eco Dry dryers [14]
a. airflow through conical pipes; b. Layout of pipelines

RESULTS

Technical and functional characteristics of dryer's type manufactured of Feerum are the only ones presented below in table 1, because producing / manufacturing companies give little technical details about their equipments.

Table 1

Technical and functional characteristics of SG and DG Feerum Dryers [9]

Type/Continuous operation SG Dryers	**Unit**	**Model**			
		SG 6	**SG 10**	**SG 12**	**SG 16**
Filling volume – grain	t	13	19	21.8	29.5
Drying sections	pc.	0-6	7/8	9/10	12/13
Cooling sections	pc.	6-0	3/2	3/2	4/3
Heat power	kW	500	1100/1200	1400/1500	1750/1920
Dryer airflow	m³/h	27000	4400	53000	71000
Installed max. electrical power - fans	kW	13.8	~22.0	~26.6	~40.5
Installed max. electrical power – cycle-ventilators	kW	-	-	-	-
Device height	m	8.8	11.25	12.5	15.64
No. of buffer sections	pc.	2	2	2	3
Buffer volume	t	4.3	4.4	4.4	6.3
Grain column volume	t	8.7	14.5	17.4	23.2
LPG gas consumption	l/t/%	2.25	2.22	2.22	2.22
Natural gas consumption	m³/t/%	~1.9	~1.9	~1.9	~1.9
Oil consumption	l/t/%	1.5-2.0	1.5-2.0	1.5-2.0	1.5-2.0
Corn – efficiency for drying from 30% to 14.5% grain humidity					
Ambient air temperature	°C	5	5	5	5
Drying air temperature	°C	80-110-130	100-130	100-130	100-130
Relative humidity of outside air	%	85	85	85	85
Efficiency for moist grain	t/h	2.17	3.3	5.6	7
Efficiency for moist grain	t/day	52	80	135	168
Rape – efficiency for drying from 14% to 7% grain humidity					
Ambient air temperature	°C	15	15	15	15

Drying air temperature	°C	90	90	90	90
Relative humidity of outside air	%	65	65	65	65
Efficiency for moist grain	t/h	3.25	4.3	7.3	9.1
Efficiency for moist grain	t/day	78	104	175.5	218.4
Wheat – efficiency for drying from 18% to 14% grain humidity					
Ambient air temperature	°C	15	15	15	15
Drying air temperature	°C	100	100	100	100
Relative humidity of outside air	%	65	65	65	65
Efficiency for moist grain	t/h	4.3	10	16.8	21
Efficiency for moist grain	t/day	104	240	405	504

CONCLUSIONS

In the vertical drying columns, the seeds move from top to bottom through the space between the walls, drying more intensely at the top of the dryer compared to the bottom. Although a significant amount of energy is being recovered, consumption remains high because dryers have high capacities.

It is still necessary to optimize the performance of these systems in order to obtain dried seeds of superior quality with unimpaired germination capacity to reduce the energy consumption for the drying process, to reduce the drying time, to reduce the construction costs of a dryer, to reduce the length of the drying column or the size of the dryer, so that the process is carried out as evenly as possible.

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ASPECTS REGARDING THE ASEPTIC PACKAGING OF FOOD PRODUCTS
/
ASPECTE PRIVIND AMBALAREA ASEPTICĂ A PRODUSELOR ALIMENTARE

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Keywords: *food products, aseptic packaging, sterilization.*

ABSTRACT

Aseptic packaging of food products is necessary to prolong their validity and to preserve their original qualities, but also for obtaining higher quality products. Aseptization must be done both for the product to be packaged and for packaging, but also for the enclosure where packaging takes place (the packing machine). There are many ways to sterilize package, but the sterilization procedure usually begins with the packaging material which must be maintained under sterile conditions until the package is made, but also during filling and closing. For the product to be packaged, the most used sterilization methods are thermal treatments, while for packing machines both thermal treatments are used (with steam and hot air) but also combined treatments (thermal and chemical). For packaging material, the most commonly used sterilization procedure is spraying with hydrogen peroxide or peracetic acid solution.

REZUMAT

Ambalarea aseptică a produselor alimentare este necesară pentru prelungirea valabilității acestora și pentru păstrarea calităților lor inițiale, dar și pentru obținerea unor produse de calitate superioară. Aseptizarea trebuie realizată atât pentru produsul de ambalat, cât și pentru ambalaj. dar și pentru incinta în care are loc ambalarea (mașina de ambalat). Există numeroase metode de sterilizare a ambalajelor, dar procedura de sterilizare începe, de regulă, cu materialul de ambalaj care trebuie menținut în condiții sterile până la confecționarea ambalajului, dar și în timpul umplerii și închiderii acestuia. Pentru produsul de ambalat. cele mai utilizate metode de sterilizare sunt tratamentele termice, în timp ce pentru mașinile de ambalat se utilizează atât tratamentele termice (cu abur și a aer fierbinte) dar și tratamente combinate (termice și chimice). Pentru materialul de ambalaj, procedura cel mai des utilizată de sterilizare este stropirea cu apă oxigenată sau cu soluție de acid peracetic.

INTRODUCTION

Aseptic packaging is defined as the filling of a sterile food product intended for marketing in sterile containers, under sterile conditions and closing the containers so that reinfection is prevented (hermetic closure). It is obtained, therefore, high quality products with a high shelf life.

Aseptic packaging involves both sterilization of the product and of the materials and package used. Sterilization of products for aseptic packaging is carried out, in general, by HTST or UHT procedures which allow both the destruction of microorganisms and the inactivation of enzymes *(Turtoi M., 2003; Ramos et al. 2015; Tran et al. 2008; Nema and Ludwig, 2010))*.

Aseptic term implies absence or removal of any unwanted micro-organism from the package, product or other characteristic areas, while the term hermetic is used to indicate mechanical properties corresponding to the exclusion of penetration phenomenon of microorganisms into a package, but also of water vapor or gas in / out of the packaging.

Aseptic packaging is used for many reasons:
- the use of unsuitable packages for sterilization in the package;
- thermal treatments used allow achieving of a high temperature for a relatively short time, thus increasing the efficiency of treatment in comparison to lower temperature but long-term treatments;
- prolonging the shelf life of food products stored at normal temperatures.

At aseptic packaging, the product is transported to the packaging machine in a closed system, presterilized and then aseptically dosed in packages that is formed inside the machine. Filling takes place in the aseptic area of the machine, packages sterilization being performed with sterile air under pressure. The aseptic area of the machine in which is realized the filling is small with few moving elements. This is a very important factor which contributes to the integrity of the entire system. The packages are closed under the liquid level, filling is thus complete and, in this way, the content is completely protected against oxidation and at the same time the package is used with maximum efficiency. For products that require agitation, filling may be incomplete.

MATERIAL AND METHOD

Aseptic packaging principles

The food products are altered depending on the speed at which the micro-organisms multiply. Multiplication of micro-organisms occurs rapidly in a warm environment and slows at low temperatures. It results that, when the food product is frozen, micro-organisms cannot multiply at all, being completely destroyed when a very high temperature is applied (*Okawara. 2008*; *Office of Compliance, 2004*).

By controlling and destroying micro-organisms, the food products are kept longer.

Sterilization methods used in aseptic processing of food are HTST (high temperature - short time) or UHT (ultra-high temperature).

The HTST process is defined as being sterilization by heating the product at an elevated temperature between a few seconds and a few minutes depending on the temperature value.

The UHT process is a thermal sterilization treatment in continuous flow to a temperature that may vary between 130-150°C with a maintenance time of 2-8 seconds. The maximum temperature is used for products with low viscosity, (for example milk) and the minimum value is used for products with high viscosity. Thermal treatment must reach 135°C for a period of one or more seconds (*Ramos et al. 2015; Tran et al. 2008)*.

Milk products and fruit juices must be packaged under aseptic conditions to preserve the microbiological qualities conferred by the thermal treatment applied.

When sterilizing food products through processes HTST or UHT problems with inadequate enzyme inactivation may occur. This is specific especially to vegetal enzymes (ex. peroxidases), namely proteases and bacterial lipases.

It is noteworthy that, bacterial enzymes have a much higher resistance to temperature as compared to spores of *Bacillus stearothermophilu,* which are reference spores in thermal treatment.

Aseptic packaging is used for food products such as:

- whole milk / partially skimmed / dietetic milk pasteurized or sterilized (UHT);
- milk based drinks (milk with flavours, milk with cocoa, milk with chocolate);
- milk enriched with vitamin and mineral salts for children, athletes and future mothers;
- consumer cream, sweet or fermented;
- acid dairy products, such as yoghurt, beaten milk, etc.;
- natural mineral water with flavours or purified water;
- specific beverages for athletes;
- simple or mixed fruit juices;
- beverages based on fruit juice;
- alcoholic beverages;
- cold tea;
- coffee and coffee based drinks with added milk;
- soups, flavoured sauces;
- vegetable oil and oil based products (creams, mayonnaise, liquid margarine, dessert sauces).

Tetra Pack aseptic packaging consists of successive cardboard layers, aluminium foil and polyethylene. This combination provides safety and convenience in the use of the product. Each type of packaging material has its specific function in protecting the food. Combination of cardboard, polyethylene and aluminium foil varies according to the product to be packaged; in all cases, however, the only material that comes in direct contact with the food is polyethylene for food use.

Thus, for a product packaged in Tetra Brik Aseptic, there is the following combination of materials:

- 75% paper from renewable sources that gives firm packages and stability;
- 25% polyethylene to prevent reinfection of the product with micro-organisms, which confers resistance to the aggression of external factors;

– 5% aluminium, which is a barrier to air and light, helping to preserve the taste and nutritional qualities of the food product.

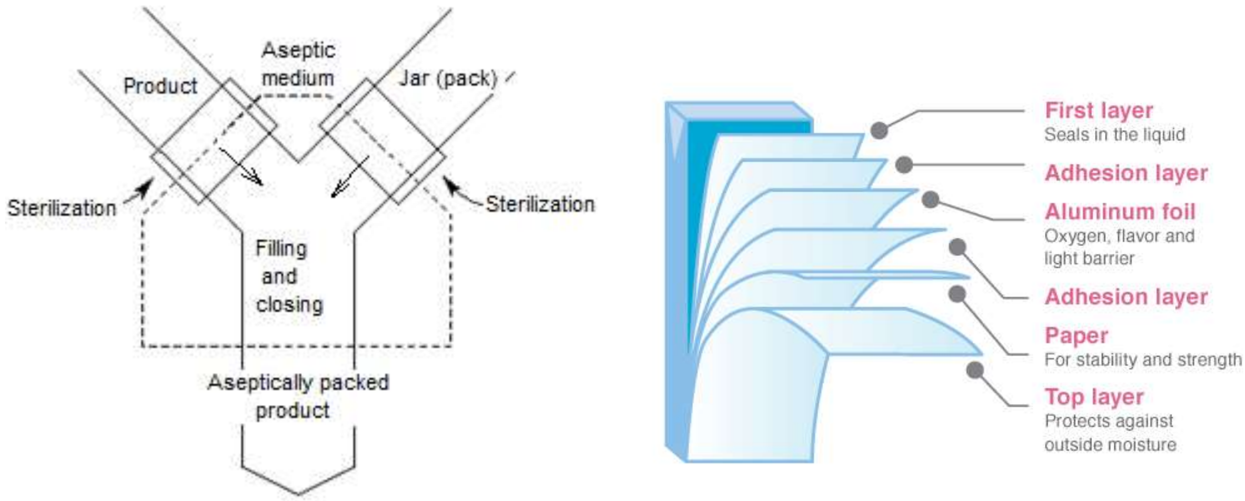

Fig.1 – Principle of aseptic packaging (a) *(Turtoi. 2003)* **and complex material for aseptic packaging (b)**

Aseptic packages have different shapes and are accessible to any type of consumer. It is necessary, However, that everything is sterile in the manufacturing process, food products, packaging material, equipment and environment in which packaging is carried out.

Aseptic packaging is UHT sterilized before heat-treated food product is introduced, resulting in a food with a life span of over 3 months.

As a method of sterilization, the passage of the packaging material can be used through a hydrogen peroxide bath, in concentration of 30%, heated to 70°C for 5-6 seconds. Hydrogen peroxide is then removed from the packaging by pressing rollers or hot air.

The environment in which foods are thermally processed and sealed must be, also, lacking bacteria, which means that packaging machines must be sterile as before and after the packaging process is completed.

RESULTS

Sterilization of the surface of packaging material in contact with food products

For the sterilization of packaging material used in aseptic packaging three methods can be used, singular or in combination: thermal treatment, chemical treatment and irradiation.

A. Sterilization of the surface of the packaging by thermal treatments

a. *Sterilization with saturated steam*

The safest thermal agent for sterilization is saturated steam. When using it, the following problems may occur:

– an enclosure is required in which the packaging must be kept under pressure in order to reach sufficiently high temperatures at which sterilization can take place in a few seconds;
– avoid the penetration of fake air into the sterilization space as far as possible otherwise it can influence heat transfer from the steam to the surface of the packaging;
– steam condensation may remain on the surface of the packaging by diluting the food product.

b. *Steam sterilization with superheated steam*

Overheated steam can be used for sterilization of aluminium metal cans and tin plate.

It has the advantage that it can be used for sterilization of packaging, as well as packaging materials under normal pressure conditions, reaching temperatures of 220-225°C. for 35–45 s depending on the material from which they are made.

c. *Hot air sterilization*

As with overheated steam, hot air sterilization has the advantage that the necessary temperatures can be obtained at atmospheric pressure. This simplifies the problems of mechanical design of the sterilization system. This process is used for the sterilization of complex aseptic cartons made from cardboard /

aluminium foil / plastic material. At the surface of the material, the temperature 145°C can be reached for 180 s. under the conditions in which the hot air used for sterilization has a temperature of 315 ° C. Even if the working temperature is high, hot air treatment can only be used for packaging where acidic food is packaged.

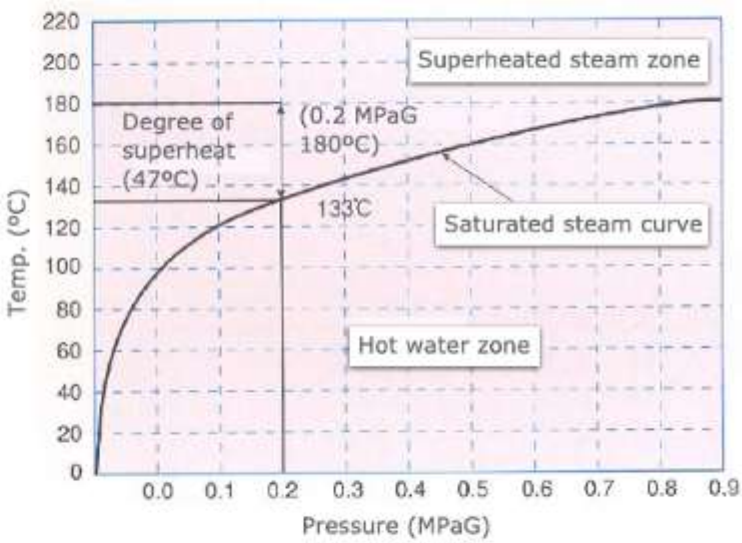

Fig.2 – State Diagram of Water (Pressure - Temperature) *(Okawara. 2008)*

d. *Sterilization with hot air and steam*

It is a combined process that is used to sterilize packages from stable materials to lower temperatures (about 160°C),, such as the sterilization of the inner surfaces of glasses and caps made from polypropylene, in which case the hot air blows inside the glasses through a nozzle that evenly heats both the bottom and the walls of the glass (*Akers. 2010*).

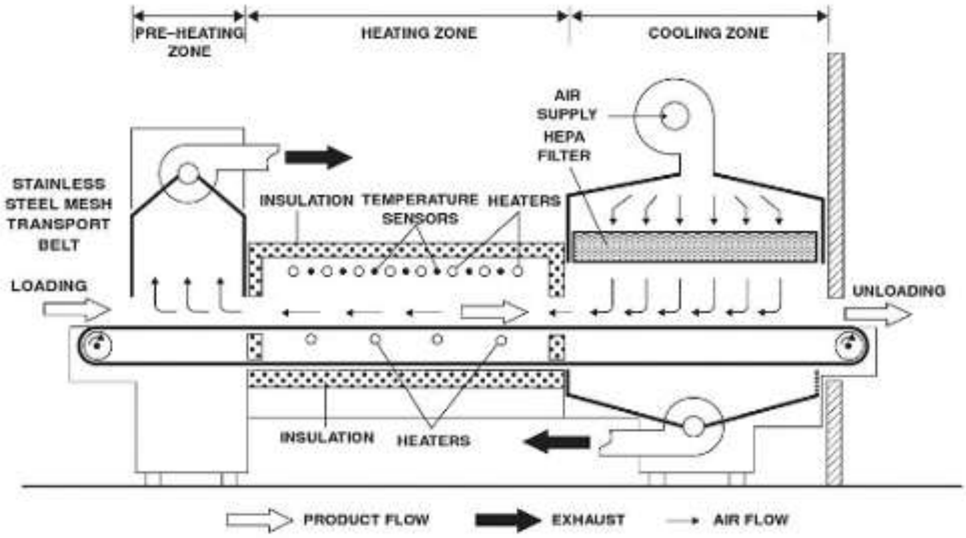

Fig.3 – Dry heat sterilization / depyrogenation tunnel. Schematic *(Akers. 2010)*

e. *Sterilization by extrusion in the manufacture of packaging*

In the process of extruding preforms for obtaining plastic containers (polyethylene, polyethylene terephthalate, polypropylene etc.) can be reached temperatures of 180-230°C, which are kept for up to 3 minutes so that the packaging is sterilized. Variations in retention time of the granules inside the extruder and uneven temperature distribution cannot guarantee, however, the sterility of all the particles.

For this reason no reduction in microbial spores greater than 3-4 D can be achieved and the packaging thus obtained can only be used for acidic food products with a pH below 4.5. If after the extrusion a sterilization with hydrogen peroxide is made of the packages, they can also be used for products with a pH> 4.5.

B. Sterilization of the packaging surface through chemical treatments

a. *Sterilization with hydrogen peroxide*

Hydrogen peroxide (H_2O_2) is used for a long time in treating the surface of the packaging to destroy the micro-organisms in combination with the effect of heat, because at the ambient temperature neither the concentrated solutions have a fatal effect. For the short-term destruction of the most resistant spores on the packaging material, the minimum temperature must be at least 80 ° C. and the concentration is at least 30%. There is also the danger that hydrogen peroxide used to sterilize packaging and packaging material will reach the food.

The packaging material is sterilized, mostly, by immersion in hydrogen peroxide with concentration 30-33% or by spraying on the surface of the packaging, followed by hot air drying in both cases.

To reduce the amount of oxygenated water used and increase the efficiency of treatment, we can use a series of combinations of heat and / or radiant or irradiated energy. Thus, for lethal effects of 3-5 D. the hydrogen peroxide concentration drops below 5%. for which the possibility of hydrogen peroxide in the packaged product decreases.

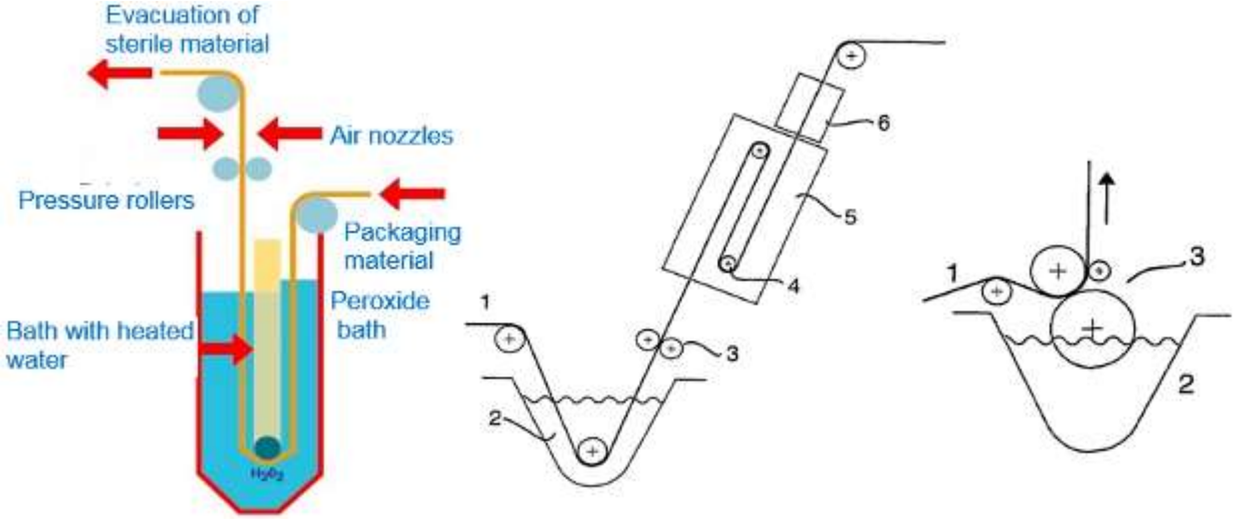

Fig.4 – Sterilization of the packaging material by immersion (chemical treatments)

b. *Sterilization with peracetic acid*

Peracetic acid has increased destructive efficiency in combination with hydrogen peroxide, even at 20°C. a 1% solution removing over 100 species of resistant spores in just 5 minutes. The duration of sterilization is reduced, in this case about 5 times, and the maximum working temperature is 40°C.

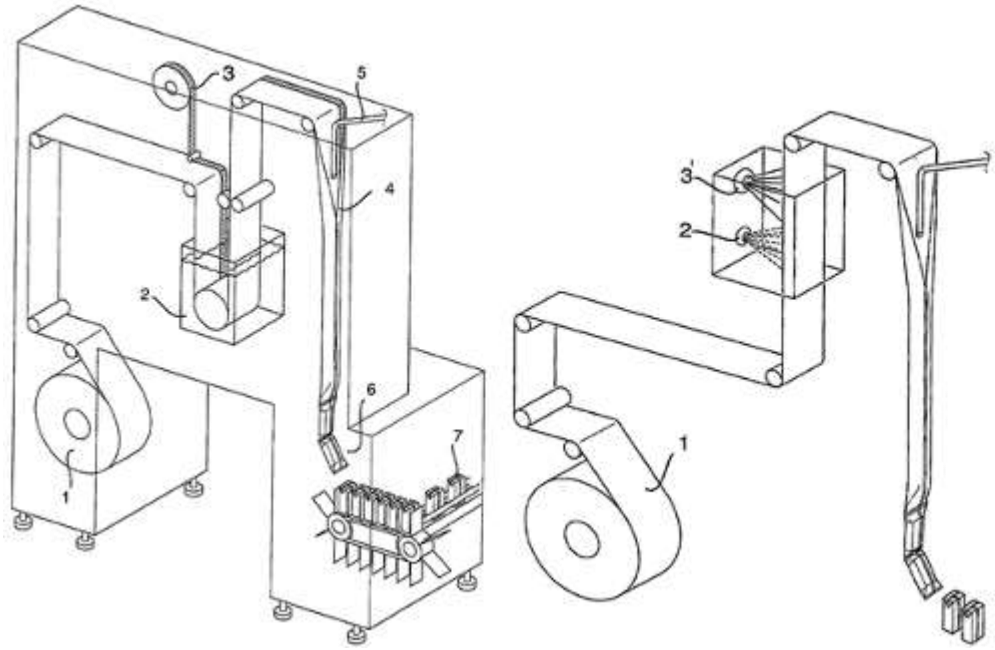

Fig.5 – Chemical treatments applied to packaging materials for forming, filling and closing

1 – roll with packaging material; 2 – immersion area in sterilizing solution; 3 – packaging accessory; 4 – packaging formation; 5 – filling the packaging; 6 – packaged product; 7 – full packaging disposal; 2' – splash area; 3' – hot air drying area

C. Sterilization of the packaging surface by irradiation

Surface of packaging or packaging materials used in aseptic packaging can be sterilized by irradiation with ultraviolet radiation, infrared, ionizing or pulsed light (*Bhavya and Umesh-Hebbar. 2017; Falguera et al. 2011; Reineke et al. 2015; Tanino et al. 2007*).

a. Irradiation with ultraviolet radiation

Ultraviolet radiation with a wavelength of 200-280 nm has the effect of destroying microorganisms, the optimal value being 253.7 nm. To inactivate microorganisms, the energy density of the radiation treatment must be at least 400 J/cm^2 *(Falguera et al. 2011)*.

The conditions for good efficacy of sterilization of ultraviolet radiation surfaces are:

- the irradiated materials to be smooth, UV-resistant and non-adhering dust to avoid the shading effect of surfaces;
- the irradiation intensity should be uniform and suitable for sterilization of the entire package, even if it has a complex form.

The method is used, in general, commercially available in combination with hydrogen peroxide.

b. Irradiation with infrared radiation

Infrared Radiation (IR) is converted into heat by contact with an absorbent surface resulting in an increase of surface temperature. Like UV irradiation, irradiation with IR is used only for smooth and regular surfaces. IR is used to treat the interior of the aluminium caps on which a plastic lacquer was deposited. Due to the possibility of soaking the lake, maximum temperature should be less than 140°C.

c. Irradiation with ionizing radiation

Radiation techniques using gamma radiation of Co60 or Cs139 are used to sterilize the inside of the packaging, usually made of materials that do not withstand sterilization temperatures or cannot be sterilized efficiently by other means, due to the shape they have, such as laminated plastic bags used in bag-in-box aseptic packaging.

They irradiate with at least doses of 25 kGy (2.5 Mrad), which are sufficient to ensure sterility. The bags are enclosed in microorganism impermeable boxes before irradiation. A dose of 20 kGy ensures the sterilization of a 9 mm polyethylene strap infected with approximately 105 spores *Bacillus stearothemophilus*.

d. Treatment with light pulses

Light pulses (PL) are obtained from the "flash" lamp and their effect is sufficient to destroy the microorganisms on the surface of a package. Light pulses have a duration of 10-1–10-6 s. a spectrum of wavelengths of 170–2600 nm, providing an energy density of 0.01–50 J/cm^2. When sterilizing packaging material, the pulse lamp is inserted into the tube that is formed in packs of complex materials type pillow pack to a packaging machine in the formation - filling - closing system *(Bhavya and Umesh-Hebbar. 2017*).

Food sterilization

Sterilization is the process by which all living microorganisms are removed or destroyed on the surface of the packaging and inside the food. The sensitivity of micro-organisms must be taken into account in the choice of sterilization methods used in relation with the action of external environmental factors and the physical and chemical qualities of the product subjected to sterilization.

Sterilization is intended to destroy all microorganisms present in the food, both vegetative forms, as well as those sporulated. When sterilizing, some of the microbial and toxins are also destroyed, likewise, some of the enzymes are inactivated (tissues and microbes) (*Barbosa-Canovas and Juliano. 2008*).

In order to be commercially stable the food, it should be heated for a certain time at a pre-determined temperature, depending on the nature of the food (*Cumings. 2004*).

Liquid products less acidic, like milk, are more likely to develop microorganisms and bacteria than strong acid products (for example, fruit juices).

UHT thermal treatment (Ultra High Temperature) or Ultra Pasteurization takes place before packaging, with optimized heat exchangers (*Ramos et al. 2015; Tran et al. 2008)*

Through this controlled process which allows the action of heat for a very short period of time (between 2 and 4 seconds) – followed by an equally rapid cooling, minimal nutritional losses are minimized.

A combined application of electric pulse treatment (PEF) with heat treatment can lead to an accelerated inactivation of endospore in comparison to a pure thermal inactivation in an identical temperature field. This treatment could be used as an alternative treatment technique at ultra-high temperatures of liquid foods with a high pH value, such as milk, vegetable juices or soups (*Reineke et al. 2015)*. The PEF treatment parameters applied resulted in energy inputs of 60.92-257.14 kJ kg^{-1} and thermal loads of 94.61-136.25 °C.

Also, food products (in general, vegetables and fruits) can be sterilized with ionizing radiation. Still, conservation with ionizing radiation destroys vitamins, minerals and lack the food from taste and smell. The method has the benefit that the food remain "fresh" for a long time. This treatment involves exposing the food to a stream of ionizing rays that can be generated by a radioactive source. Foods can be irradiated with gamma or with X ray. Radiation-beam technology uses radioactive substances. ^{60}Co or ^{137}Cs. Here, the processors should however have a great responsibility, because doctors draw attention to the danger of these treatments (*Bogdan et al. 2011*).

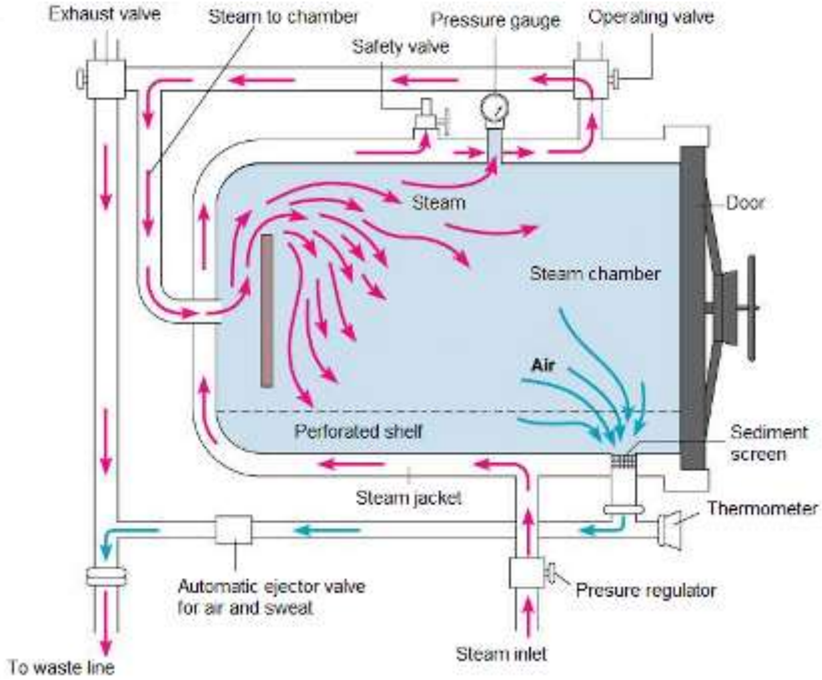

Fig.7 – The principle of sterilizing autoclaves of preserved foods *(Cumings. 2004)*

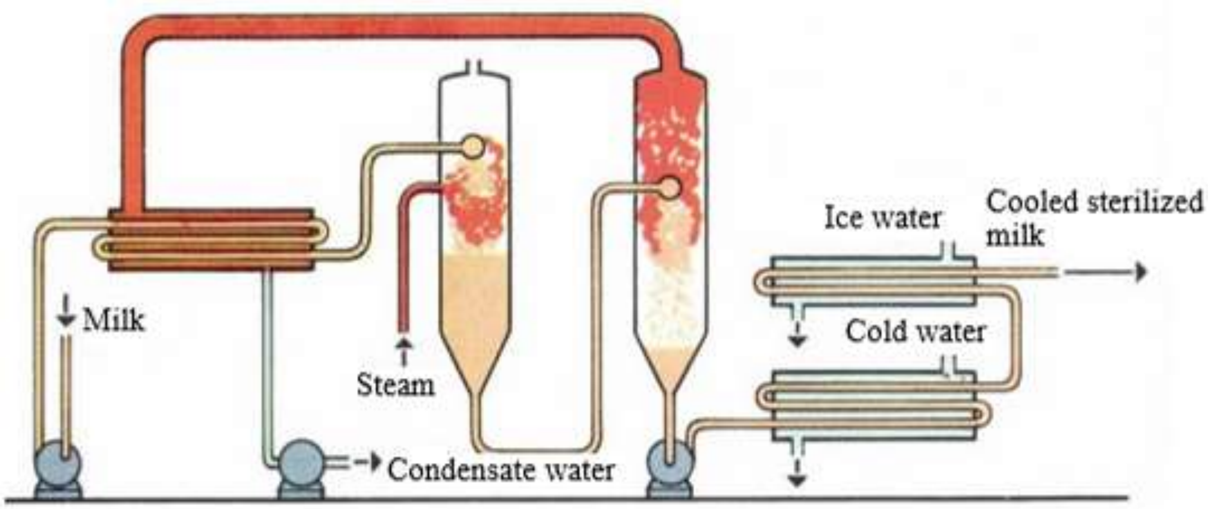

Fig.8 – Sterilization of milk with steam injection

CONCLUSIONS

To ensure high quality food products and preserve its quality for a long time, processors are forced to use aseptic packaging technology lines. It is necessary to sterilize both food product, before filling the packages, as well as sterile packaging, but for aseptic packaging it is also necessary to sterilize the packing machines and the enclosure where filling and closure takes place.

There is an essential difference between hermetic and aseptic. The aseptic term implies the absence or elimination of any unwanted organism in the product, packaging or other specific areas, while the term hermetic is used to indicate mechanical properties corresponding to the exclusion of the microorganism penetration into a packaging and of the gases or water vapours into and out of the packaging. So, it is not sufficient to seal the packing to ensure the quality of packaged products, but also the sterilization of the three elements involved in the packaging process: product, packaging, packaging environment.

Both processors, as well as manufacturers of packaging or packaging materials together with manufacturers of packaging machines must work together to meet the goal of producing aseptic food products with a longer conservation period and improved qualities.

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THEORETICAL GROUNDING OF RATIONAL DESIGN OF WORKING ELEMENTS OF STRAW DISPERSER OF GRAIN COMBINE HARVESTER
/
ТЕОРЕТИЧЕСКОЕ ОБОСНОВАНИЕ РАЦИОНАЛЬНОЙ КОНСТРУКЦИИ РАБОЧИХ ОРГАНОВ ИЗМЕЛЬЧИТЕЛЯ-РАЗБРАСЫВАТЕЛЯ ЗЕРНОУБОРОЧНОГО КОМБАЙНА

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Keywords: *grain combine harvester, straw disperser, chopper; deflector, guide plate, tailings, uniformity of dispersion.*

ABSTRACT

The article presents the theoretical description of the process of interaction of straw particle and concave surface of guide plate of deflector of grain combine harvester disperser. The equation of particle present velocity is obtained. It is proved that particle velocity decreases by 8.5% at plate radius reduction from 5 m to 4 m, and by 15%. and particle angle of attack convergence reduction from 25° to 50°. To decrease adverse effect of particle interaction with guide surface, we suggest the usage of bladed choppers with slantwise set cast blade

РЕЗЮМЕ

Выполнено теоретическое описание процесса взаимодействия соломистой частицы с вогнутой поверхностью направляющей пластины дефлектора измельчителя-разбрасывателя зерноуборочного комбайна. Получено уравнение текущей скорости частицы. Установлено. что скорость частицы снижается на 8.5% при уменьшении радиуса пластины с 5 м до 4 м. и на 15%. при уменьшении угла атаки частицы с 25° до 50°. Для снижения вредного влияния взаимодействия частиц с направляющей поверхностью. предложено использование лопастных ножей с косо установленной швырковой лопастью.

INTRODUCTION

One of the most important indicators of performance quality of straw disperser of grain combine harvester is the uniformity of dispersion of grinded parts of tailings (T) along field surface (Skorlyakov V.I.. 2015; Skorlyakov V.I. et al. 2013; Yagelsky M.Yu. and Rodimtsev C.A.. 2016).

According to agro technical requirements (Yagelsky M.Yu. and Rodimtsev C.A.. 2015; Cherkasov G.N. et al. 2013; Maslov G.G. and Trubilin E.I.. 2016), non-uniformity of straw dispersion should be not more than 20 %. However, field tests data demonstrate sufficient excess of the permitted indicators for some types of grain harvest machinery. Thus, some authors' investigations (Lovchikov A.P. et al. 2016; Sadretdinov D.R.. 2016; Yagelsky M.Yu. and Rodimtsev C.A.. 2016) proved that for grain combine harvesters of some brands variation coefficient of straw dispersion across the mowing width can be up to 75 % and more. Herewith maximum deviation from mean value M_{mean} reaches 137 %, causing the largest mean weight variation of shredded straw on the meter long distances from mean value.

For design solution development, that provides the improvement of shredded straw dispersion across the mowing width, it is necessary to analyze particle interaction of tailings with working elements of straw disperser. The investigation targets were grounding the rational design of choppers of the tested device.

MATERIAL AND METHOD

To carry out the investigations we used the improved design of straw disperser of grain combine harvester (fig. 1).

In the improved design of straw disperser, choppers are manufactured with blades that are set to an angle α to chopper surface. For each pair of choppers of one suspension, choppers located sidewise the rotor periphery have angle α of setting blade less than 90°, choppers located sidewise the rotor center have angle α of setting blades more than 90°. Blades of the pair of choppers of any suspension are located in a single surface. oriented from the rotor center to its periphery, aside from choppers of suspensions located along the rotor center. In this context, for every suspension, angle α of blade setting, in relation to the chopper blade surface is less than 90°. Herewith blade surfaces are symmetrical each other and oriented to rotor off-center.

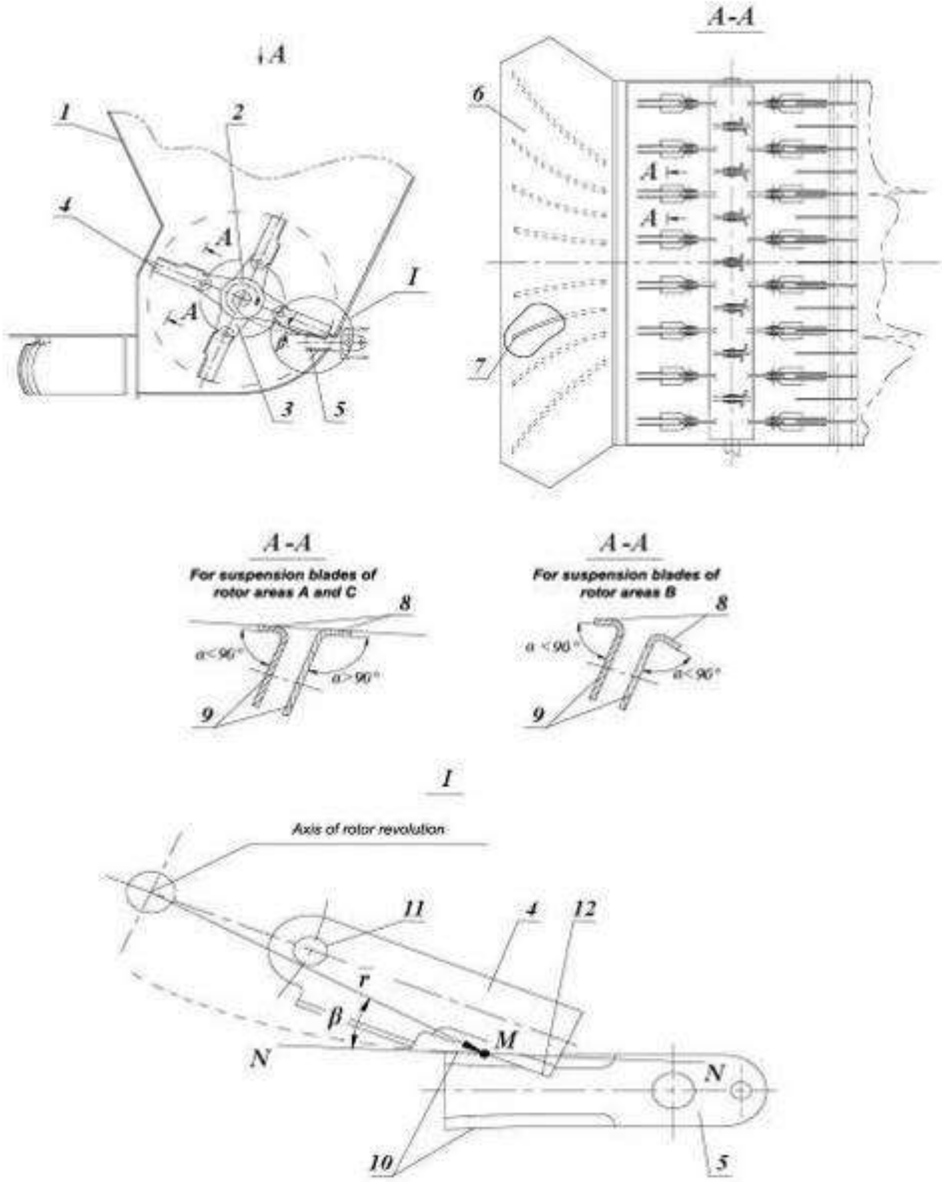

Fig. 1 - Scheme of improved design of straw disperser of grain combine harvester

1 – case; 2 – rotor; 3 – bracket; 4 – chopper; 5 – fixed counter blade of chopper; 6 – straw disperser; 7 – disperser guide plates; 8 – blades of pendular choppers; 9 – blade body; 10 – cutting edge of fixed counter blade; 11 – blade opening; 12 – chopper cutting edge

The increase of the cutting process efficiency and increase of straw disperser efficiency are achieved due to concave cutting edge 10 of fixed counter blades 5, done in the form of logarithmic spiral with pole located on rotor revolution axis 2. Angle α of material pinching in cutting pair opening remains constant along the full length of cutting edge 10 of fixed counter blade 5. This provides equal kinematic cutting mode at the initial and final stages of the process. The extended length of the curved surface of cutting edge 10 of fixed counter blade 5. and provides more complete usage of technological potential of the cutting pair.

The qualitative straw dispersion behind combine harvester is achieved by directed airflows, which are formed with blades 8 of pendular choppers 4, which surface vectoring is directed sideway from rotor center 2. They together with guide plates 7 of disperser 6 provide uniform dispersion of the chopped mass in full bandwidth.

Usage of logarithmic spiral with pole located on rotor revolution axis for concave cutting edge of fixed counter blade allows obtaining the next positive result. Because of the known property of logarithmic spiral, angle β between radius-vector $\bar{r}$. drawn from rotor revolution center 2 to any point *M* on cutting edge line 10 of fixed counter blade 5 and tangent N-N to the line of cutting edge 10 at the same point, is the same.

Because of the radial position of longitudinal axis of chopper 4 towards the axis of rotor revolution 2 and its parallel position towards radius-vector $\bar{r}$, angle α of pinching between cutting edge 12 of chopper 4 and tangent to cutting edge 10 of fixed counter blade 5 at any point, will be the same too.

General view of the set of the experimental working elements for straw disperser of grain combine harvester "John Deere W650" is presented in fig. 2.

Fig. 2 - Set of experimental working elements for straw disperser of grain combine harvester "John Deere W650"

RESULTS

Theoretical analysis of interaction of stem materials and the working elements of disperser of grain combine harvester is carried out with application of known methods of theoretical mechanics, particularly – chapter «Differential equations of particle dynamics».

Coming off straw rack or separate part of rotor, straw is captured with rotating vertically straw chopper rotor blades and is taken into gap between counter cutting elements and then to the equipment bottom.

Being pinched in the opening of the cutting pair «blade - counter blade», straw stems are chopped fast and having got kinetic energy increment at the account of impulse from the chopper working element linear velocity and impact of directed airflow, are thrown into deflector opening. Falling on disperser guide plates. grinded particles of tailings change the path of original motion and get scattered throughout the field surface.

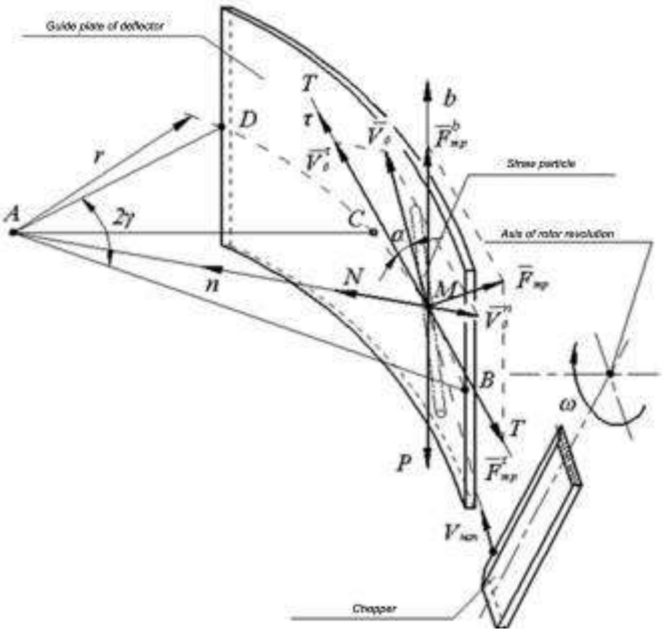

Fig. 3 - Scheme of velocity determination of particle motion along guide plate surface of disperser deflector

It is necessary to point out that, velocity vector $V_{initial}$ of particles of tailings, coming from rotating rotor blades is directed perpendicular to its revolution axis. Thus, particle contact with curved surface of guide plate of deflector will be associated with velocity loss caused by influence of sliding friction force, at particle movement along guiding line. Herewith particle energy losses will be higher the more the angle between particle velocity vector $V_{initial}$ and tangent guide plate at the point of initial contact is.

Velocity reduction of particles coming off deflector guiding predetermines the reduction of their flying range and dispersion width and thus. increase of distribution nonuniformity.

To estimate in the first approximation the velocity change of particle at its relative movement along the concave surface of the guiding, we should examine the process of their interaction after particle coming off the rotating chopper (fig. 3).

For simplicity of the problem to study particle dynamic characteristics, some assumptions were admitted. Considering particle as material point. because of its small mass and short duration of impact time, energy input for particle deformation on meeting with guide plate was not taken into account. Particle velocity $V_{initial}$. at its coming off rotating blade was taken to be equal to linear velocity of blade and initial velocity of particle V_0. on its meeting with guide plate:

$$V_{нач} = V_0 \tag{1}$$

Curvature radius of guide plate of disperser was admitted constant (r=const) along the plate length. Solving the problem in the simplified position, airflows influence was not considered and it was assumed that maximum value of friction force did not exceed particle gravity force.

Point with mass *m.* gets on disperser guide plate, which is a part of cylindrical surface of radius r. with initial velocity V_0. Mutual disposition of vector V_0 and generating T-T guide plate at the contact point are determined by angle α.

In motion of point along curved path, its velocity changes along the direction. Decomposing vector $\overline{V}_0$ in to two constituents: $\overline{V}_0^{\tau}$ – directed along guiding (tangential velocity component $\overline{V}_0$) and $\overline{V}_0^{n}$ – directed perpendicular to guiding (normal velocity component $\overline{V}_0$), we obtain:

$$\overline{V}_0 = \overline{V}_0^{\tau} + \overline{V}_0^{n} \tag{2}$$

Models of velocity components $\overline{V}_0$. are equal correspondingly:

$$V_0^{\tau} = V_0 \cdot \cos\alpha\,; \tag{3}$$

$$V_0^{n} = V_0 \cdot \sin\alpha\,. \tag{4}$$

In motion along the curved surface. material point is effected with the following forces: gravity force $\overline{P}$, normal reaction of curved surface $\overline{N}$ and friction force $\overline{F}_{тр}$.

Obviously, gravity action $\overline{P}$ determines point shift vertically. Thus, sum vector $\overline{F}_{тр}$ of friction force will be formed by tangential component $\overline{F}_{тр}^{\tau}$ and binormal $\overline{F}_{тр}^{b}$, directed upward vertically:

$$\overline{F}_{тр} = \overline{F}_{тр}^{\tau} + \overline{F}_{тр}^{b} \tag{5}$$

Taking into consideration the made assumptions, point moves along curved plate surface formed with BCD circle arc, radius *r*. with central angle equal to *2γ*. At curvilinear motion of constrained point, it is easier to solve the problem in projection on an axis of true trihedral.

Differential equation of material point motion in projections on an axis of true trihedral is written in the following form:

$$m\frac{dV_{\tau}}{dt} = \sum Fk_{\tau}\,; \tag{6}$$

$$m\frac{V^2}{\rho} = \sum Fk_n\,; \tag{7}$$

$$0 = \sum Fk_b \tag{8}$$

where V_{τ} – velocity projection on direction of tangent to the path;

$\overline{V}$ – velocity module:

ρ – radius of path curvature at the given point.

Fk_{τ}; Fk_n; Fk_b – projections of force F on axis of true trihedral (τ – tangential; n – principal normal; b – binormal).

Since the analysis aim is determining the dependence of particle traverse velocity from applied forces impact, the given problem is referred to inverse dynamic problems of material point.

The second axiom or basic law of dynamics, belonging to Newton, establishes dependence of particle acceleration $\bar{a}$ relatively inertial reference frame from the force affecting it (resultant force) $\bar{F}$ and mass *m* of point:

$$m\bar{a} = \sum_{k=1}^{n} \bar{F}_k \tag{9}$$

According to basic law of dynamics and superposition law (9), we obtain:

$$m\bar{a} = \bar{P} + \bar{F}_{тр}^{b} + \bar{F}_{тр}^{\tau} + \bar{N} \tag{10}$$

Using expressions (6-8), projecting vector equality (10) on axes of natural trihedral, we obtain

$$m\frac{dV}{dt} = -f \cdot N; \tag{11}$$

$$m\frac{V^2}{r} = N; \tag{12}$$

$$0 = +P - F_{тр}^{b} \tag{13}$$

Using (12), we obtain equation (11) in the form:

$$m\frac{dV}{dt} = -f \cdot m\frac{V^2}{r} \tag{14}$$

Reducing left and right parts of equation (14) by m and reducing variables, we obtain:

$$\frac{dV}{V^2} = -\frac{f}{r}dt \tag{15}$$

Integrating left and right parts of equation (15)

$$\int \frac{dV}{V^2} = -\frac{f}{r}\int dt \tag{16}$$

we obtain:

$$-\frac{1}{V} = -\frac{f}{r}t + C \tag{17}$$

Correlation (17) is the first integral of differential equation (14) of material point movement m on axis τ of natural trihedral. To determine integration constant *C,* we substitute into equation (17) initial condition of movement (at $t = 0$. $V_0^{\tau} = V_0 \cdot \cos\alpha$), we obtain:

$$-\frac{1}{V_0 \cdot \cos\alpha} = -\frac{f}{r} \times 0 + C \tag{18}$$

From formula (18), integration constant value значение C:

$$C = -\frac{1}{V_0 \cdot \cos\alpha} \tag{19}$$

Then, expression (17) be as follows:

$$-\frac{1}{V} = -\frac{f}{r}t - \frac{1}{V_0 \cdot \cos\alpha} \tag{20}$$

Converting (17), we obtain:

$$\frac{1}{V} = \frac{f \cdot t \cdot V_0 \cdot \cos\alpha + r}{r \cdot V_0 \cdot \cos\alpha}. \tag{21}$$

Then equation of the current velocity of material point *M.* at its movement on guise plate of disperser deflector be as follows:

$$V = \frac{r \cdot V_0 \cdot \cos\alpha}{f \cdot t \cdot V_0 \cdot \cos\alpha + r} \tag{22}$$

From expression (22), it follows that velocity of tailing particle moving along the deflector pate decreases with the course of time being on the plate and with decrease of radius of concave surface.

The equation graphical form (22) demonstrates the decrease of particle current velocity about by 13% at contact time with plate 0.1 sec (fig. 4). Reduction of radius of concave surface from 5 m to 4 m results in decrease of particle movement velocity by 8.5%. Herewith, due to hyperbolic character of function *V(r)*. variation of curvature radius of guide plate in its minimum values provides maximum degree of such a dependence.

Herewith, it should be pointed out that the intensity of decrease of particle velocity at the deflector contact with plate is conditioned by angle *α* between velocity vector $\overline{V}_0$ and guiding that generates surface T-T. For example, increase of angle of attack *α* from 0° to 25° (fig. 5) results in reduction of particle movement velocity by 4.2%; at changing *α* from 25° to 50°, particle movement velocity reduces almost by 15% or in 3 times. Further increase of the angle between particle velocity vector and guiding that generates surface at the contact point causes the faster decrease of particle movement velocity.

The carried out analysis demonstrates negative influence of interaction of tailing particle and the deflector guiding plate on the parameters of its movement. The stated above allows to maintain that the reduction of negative influence of guiding plates can be achieved for example by changing the direction of tailing particles flight after their coming off the chopper.

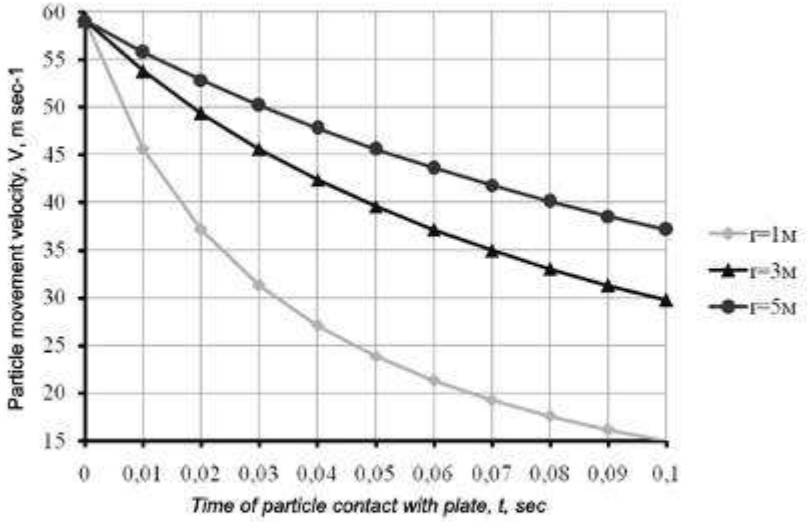

Fig. 4 – Influence of radius (r) of curved surface of deflector guiding and contact time (t) with straw particle on its movement velocity (V)

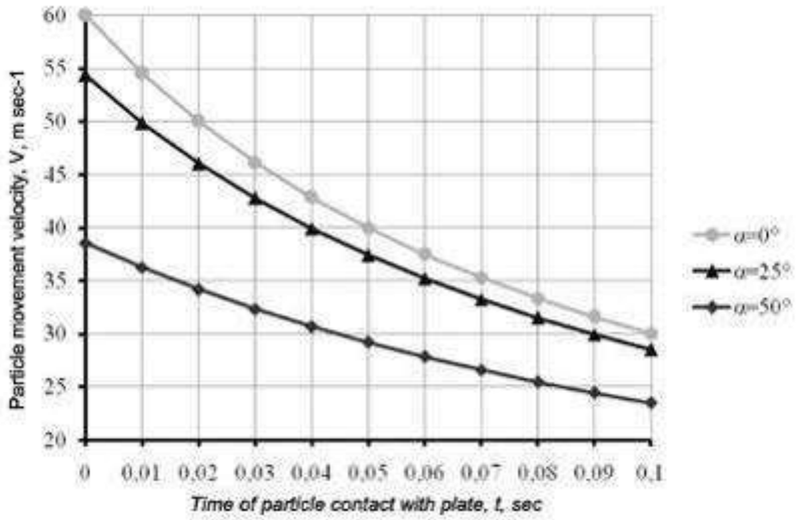

Fig. 5 – Dependence of straw particle movement velocity (V) rom contact time (t) with guide plate surface and attack angle (α), at the moment of the beginning of their interaction.

The particle movement path from rotating blade to periphery of disperse area (fig. 6) reduces the probability of interaction of chopped stems and guiding without decrease of quality of straw disperse on the field area. Therewith, the direction of particle flight under some angle *β* to apical axis of combine harvester reduces angle α between velocity vector $\overline{V}_0$ of particle and generating T-T deflector guiding at the contact point. This will also provide the decrease of negative influence of interaction of guiding and particle on its movement velocity. Thus, the conditions for increasing uniformity of straw dispersing along the field surface will be created.

Technically, the flight direction change of chopped tailing particles can be achieved by using blades that can combine this task with the main function– straw chopping.

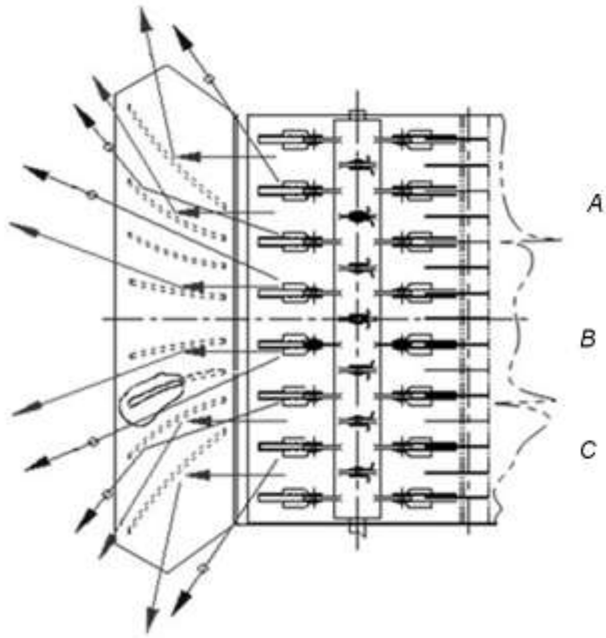

Fig. 6 – Comparative technological schemes of disperser operation using bladed choppers of series and suggested design

path of chopped particles movement. using bladed choppers with angle α=90°;

path of chopped particles movement. using bladed choppers with angle α≠90°

Blades design with blades. located perpendicular to choppers plane in its front part is known (Sadretdinov D.R.. 2016; Skorlyakov V.I. and Yurina T.A.. 2016; Yagelsky M.Yu. and Rodimtsev A.A.. 2017). This blade drawback is airflow formed by it, which direction as well as the path of chopped particle movement at coming off chopper blades are strictly parallel to combine harvester symmetry axis. This provides low degree of straw distribution uniformity across the width of disperse zone.

The suggested design of chopper blades of straw disperser of grain combine harvester provides the following advantages:

- decrease of degree of nonuniformity of chopped straw distribution without violation kinematics of cutting process;
- decrease of energy input for chopped straw dispersing at the account of formed powerful airflows of direct effect;
- proposed technical solution does not cause serious design alterations, but its working elements enhancement is possible in the conditions of any machine work-shop and does not require some extra materials.

CONCLUSIONS

1. The expansibility of chopped straw dispersion width at the account of reduction of the particle contact with deflector guide plate is theoretically substantiated. The equation of material point current velocity at its motion along guide plate of disperser deflector is obtained.

2. On the ground of the experimental data of the field investigations we plotted diagrams of dependences of chopped particle movement velocity from duration of its contact with deflector plate for different curve radii of the plate and attack angles at the beginning of interaction of particle and the plate.

3. To decrease adverse effect of interaction of straw particle and the surface of deflector guide plate of disperser of grain combine harvester, the usage of bladed choppers with slantwise set cast blade is proposed.

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SECTION FOR SEED BED MILLING CUTTER AND MAINTENANCE IN VEGETABLE CROPS
/
SECȚIE PENTRU FREZA DE PREGĂTIREA PATULUI GERMINATIV ȘI ÎNTREȚINERE ÎN LEGUMICULTURĂ

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***Keywords**: vegetable milling, vertical rotors, rotating mechanism of the rotor system.*

ABSTRACT

The paper presents a theoretical study on the possibility of making an agricultural milling cutter for germinating bed preparation and crop maintenance in vegetable growing. The studies were done starting from the frying cutter in FPL-4 vegetable growing.

Only part of the transmission of the machine from the power take-off of the tractor will be used from the FPL-4, the rest of the components being completed by the author, ie the components of the work section, the transmission components and the rotors with the work bodies grouped by two on a mechanism which allows them to rotate horizontally, so that a plant protection zone can also be provided during maintenance.

REZUMAT

În lucrare este prezentat un studiu teoretic privind posibilitatea realizării unei freze agricole pentru pregătirea patului germinativ și întreținerea culturilor în legumicultură. Studiile au fost făcute pornind de la freza de prășit în legumicultură FPL-4.

S-a reținut de la FPL-4 numai o parte din transmisia mașinii de la priza de putere a tractorului restul elementelor componente fiind completate de către autor. respectiv componentele secției de lucru. componentele transmisiei și rotoarele cu organele de lucru grupate câte două pe un mecanism care permite rotirea lor în plan orizontal astfe încât să poată fi asigurată și o zonă de protecție a plantelor în timpul lucrărilor de întreținere.

INTRODUCTION

The main destination of the proposed agricultural machine is to prepare the germinative bed in plowing or chopping soil and to perform the maintenance of the vegetable crops after the planting or planting when the distance between the rows is 45-70 cm. It can be inserted into the class (*D.Toma1975*). The drive of agricultural machinery refers to the required power of the energy source, the engine to act the working parts of agricultural machinery (*I.Saracin 2005*).

This power is calculated based on the torque that is transmitted from the tractor's power take-off shaft to the work bodies.Workbenches consist of a frame that supports the active body (the rotor of the cutter) and the transmission. The milling cutters are of the bent type and are mounted by means of flat discs on the hexagon shaft *(FPL-4 Technical Note).* The correct milling of the milling cutter, correct and timely verification and maintenance creates the possibility to work continuously, while increasing their working capacity (*M.Glodeanu and others 2015).*

MATERIAL AND METHOD

As a material, the FPL-4 vegetable broom was used, a vertical rotor from a Maschio Gaspardo Aliante 300 vertical rotor harrow.

For calculating the sides of the triangles resulting from the change of the position of the rotors in the orizotals plane, it was used the Generalized Itagora Theorem (Cosine Law). namely:

$a^2 = b^2 + c^2 - 2cx$; when the side opposes a sharp angle (fig.1)

$a^2 = b^2 + c^2 + 2cx$; when the side opposes a obtuse angle (fig.2)

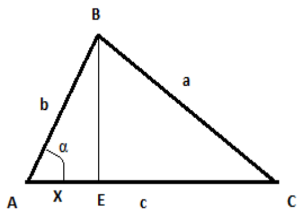


Fig.1

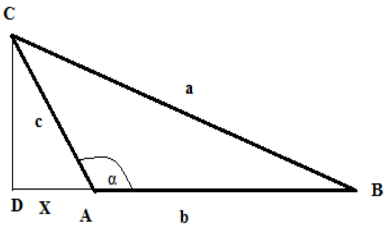


Fig.2

From the studies carried out using the literature and other sources of information, for the preparation of the germinating bed and maintenance of the crops in the vegetable-growing it is proposed an agricultural machine carried on a tractor with a number of sections, depending on the power of the tractor; it serves the preparation of the germinative bed before sowing or planting and can be used for crop maintenance in vegetation, when the distance between the rows is 45-70 cm

Milling construction:

-frame fitted with three-point tractor attachment, hexagonal or square sectional shaft consisting of several sections that can be coupled together. Each frame of the frame is provided with a conical group through which the movement is transmitted to the rotors of the sections (fig. 3).

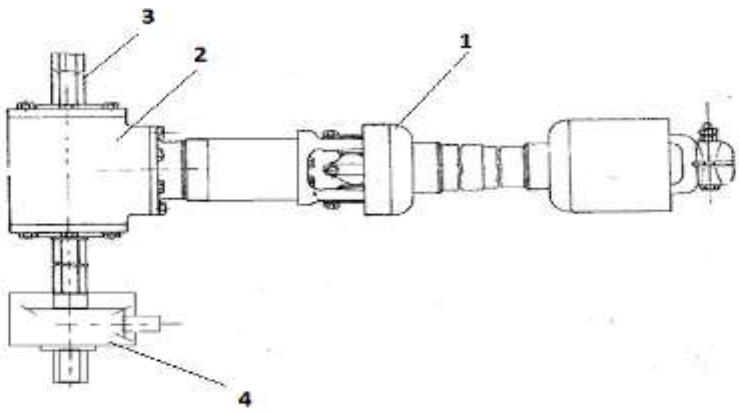
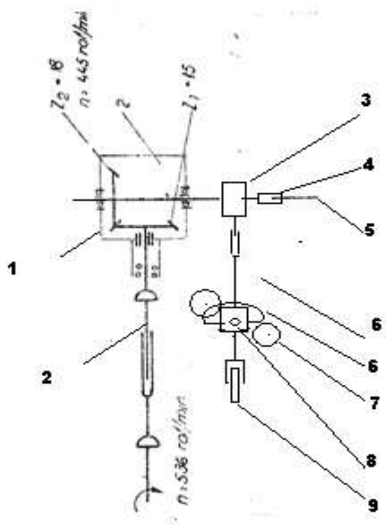


Fig.3 - Transmission of the power cutter

1 cardan shaft. 2 main conical group. 3 hexagonal shaft. 4 conic group for transmission of the rotation motion

Transmission of the cutter by a cardan shaft from the power take-off of the tractor provided with a main conical group that takes the movement from the power take-off and transmits it to the hexagonal or square shaft on which the conical groups that transmit the movement to the active parts, are located. (fig. 4).



Fg.4 -Transmission of the cutter to the section and to the active bodies

1 cardan shaft. 2 main conical group. 3 conic group for transmission of rotor motion. 4 hexagonal shaft couplings. 5 shaft with hexagonal section. 6 shaft. 7 rotors. 8 conical group of the rotors. 9 the rotating wheel

The work section consists of a frame supporting the cardan shaft which assumes the movement from the conical group on the hexagonal shaft and transmits it to the conic group acting on the rotors on which the knives are located (fig. 5).

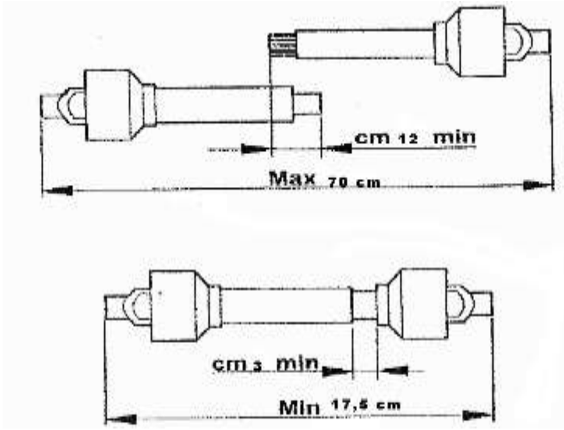


Fig.5 - Cardan shafts

In the rear part of the frame is mounted the section support wheel provided with a screw screw mechanism for the depth of work. It has the possibility to move the position to the front part of the rotors (fig.6).

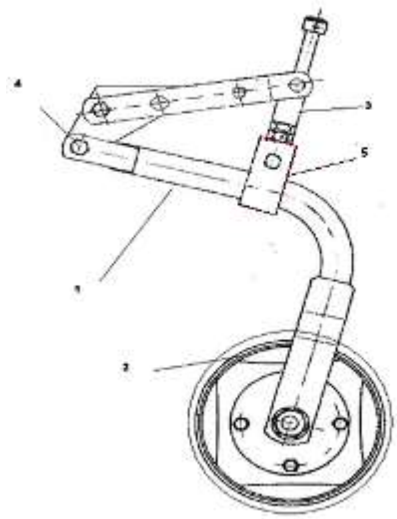


Fig.6 - Ground copying wheel

1-frame. 2-wheel with tire. 3-nut screw mechanism. 4 frame mounting system. 5-wheel changing wheel

The rotors (Fig.7) that are each provided with a conical group and receive the rotation movement from the conical section, are mounted on a matal support with several holes so that by rotation in horizontal plane the protection zone (it is possible to state the degree of each hole is realistic), thus knowing the width of the protection zone or the on-site tests shown in Figure 7. The engine speed is 300 rpm, the rotor working width is 35 cm.

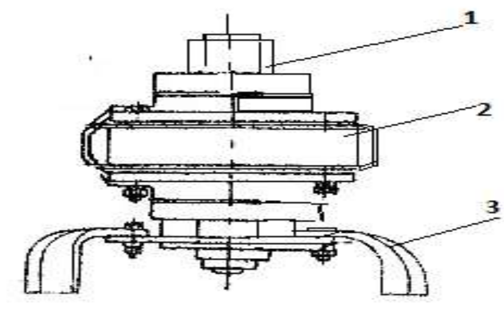


Fig.7 - Rotor of section 1: shaft. 2-body. 3-knife

The working process shown in Figure 8 exemplifies how the milling cutter can be used for germinating bed preparation when all the rotors are positioned in a line processing the soil across the entire working width or in a rotated position on the orifice holder when the protection area is secured.

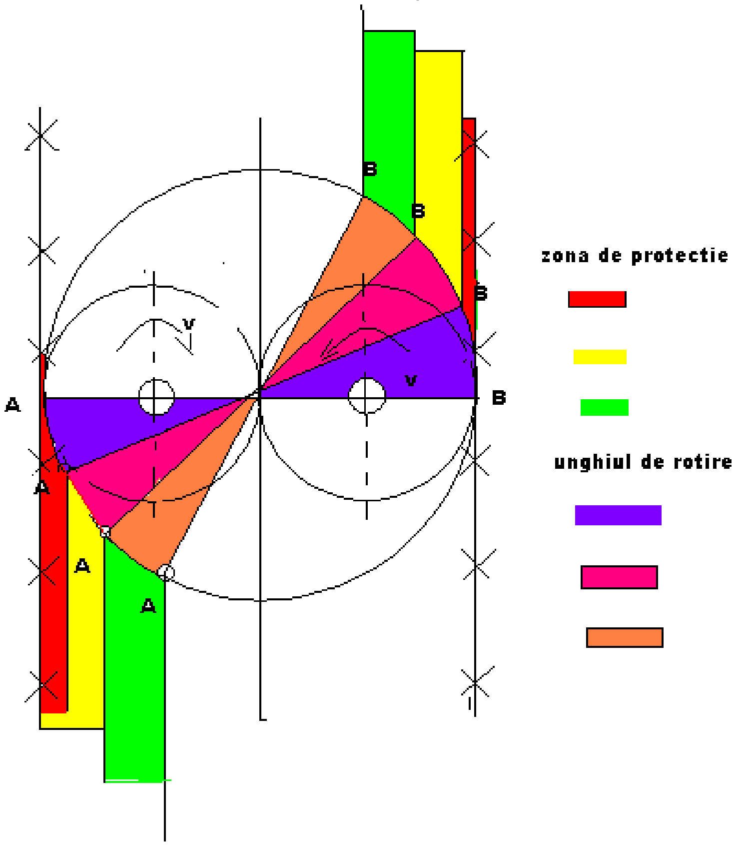


Fig. 6 - Milling process (theoretical study)

CONCLUSIONS

• From the studies carried out, it has been found that until now there is no vertical rotor milling cutter for the preparation of the germinating bed and the maintenance of the vegetable crops;
• The milling cutter can be made and through the component parts ensures long service life;
• Some of the components require periodic maintenance;
• It is advisable to use tractors equipped with a hydraulic system with automatic position control;
• Higher working depths can also be achieved by changing knives.

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TECHNICAL IMPLEMENTATIONS FOR IMPROVING THE WORK PROCESS OF VERTICAL ROTARY HARROWS
/
REALIZARI TEHNICE PENTRU ÎMBUNATATIREA PROCESULUI DE LUCRU LA GRAPELE CU ROTOR VERTICAL

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Keywords: *harrow, rotor, knife, power socket,rotation*.

ABSTRACT:

The paper presents the most important technical improvements brought to the vertical rotor harrows for improving the qualitative working indices, increasing the working capacity and reducing the energy consumption per unit area. There are presented constructive changes on the shape of the working parts, the number of knives on the rotor, the transmission of the movement, the speed of these and the direction of rotation of the knives.

Conclusions have been drawn and proposals have been made regarding other technical improvement solutions.

REZUMAT:

În lucrare sunt prezintate cele mai importante îmbunatațiri tehnice aduse grapelor cu rotor vertical pentru înbunătățirea indicilor calitativi de lucru, .creșterea capacității de lucru și reducerea consumului de energie pe unitatea de suprafață. Sunt prezentate modificări constructive asupra formei organelor de lucru, numărului de cuțite pe rotor, modul de transmitere a mișcării, a turației acestor și a sensului de rotație al cuțitelor.

Au fost trase concluzii și s-au facut propuneri privind și alte soluții de îmbunătățire tehnica.

INTRODUCTION

The main destination of vertical rotor harrows is germination bed preparation, optimal consolidation without compaction (Sărăcin I.. and Pandia O.. 2010). This is a key factor in the efficiency of crop germination (Sărăcin I.. and Pandia O.. 2013). A properly prepared germination bed is the base of crop-rich crops (Pandia and Sărăcin. 2015). Prepared soils must be equal, strong and un compacted throughout the length and depth of soil preparation equipment. The studies were made from the literature, from the brochures of Maschio Gaspardo. khun. lemken.

MATERIAL AND METHOD

As a material, the catalogues of the companies producing vertical harrows and the literature were used.

From the studies carried out, in 1905. Benjamin F and Gnonen L of the United States patented a two-wheeled harrow at which the rotors were driven from the transmission wheels by means of a pinion gear and a ratchet mechanism to interrupt the transmission of motion to the rotors when the harrow moves back, for return or for other reasons. Adjustment of work depth is done manually by the operator by lifting or lowering the transport wheels.

Because to the low speed and rotation speed were small, 50 years after Benjamin F, Amandus Peters, Benjamin Strotman and Babe Forbach have built a trailed vertical harrow that works in aggregate with the agricultural tractor on a plowing ground and the work depth is controlled by the tractor's suspension mechanism. Rotation of the rotors was received from the power take-off of the tractor, thus achieving a constant and increased rotation speed of the rotors The vertical harrow consists of a rectangular shape frame, two wheels which are provided with a adjusting screw and two rotors on which are fixed the active harrow parts.

In 1971, Ary Van Der made a rake with ten vertical rotors, each rotor having two work parts in which the movement was transmitted from the power take-off of the tractor to the gearbox, which was mounted on the harrow, where the movement was transmitted to the rotors by a gear mechanism operated in an oil bath

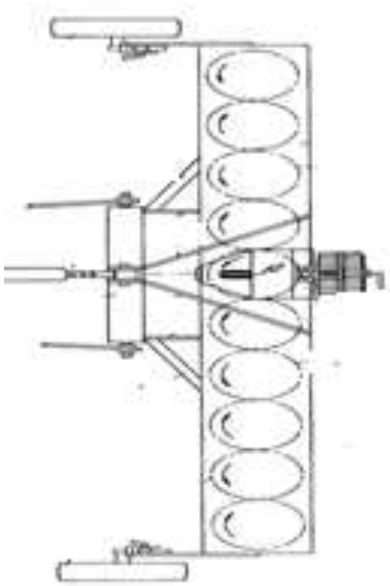

Fig.1 - Ary Van Der Lely, 1971

Aly Van Der Lely produced in 1982 a 30- a single-bladed rotor mounted at a distance of 15 cm with the rotation distance of the element of 12 cm and at the rear part being mounted a roller with which the working depth is achieved by means of adjusting screws. The minimum rotation speed of the rotors is 400 rpm.

Today's harrows have working widths ranging from 100 to 8000 mm, the large ones being folding in the case of transport and needing tractors with power ranging from 22 to 404 kw depending on the harrow model. Maschio's harrows are equipped with stone deflectors that protect the rock transmission and provide a good behaviour.

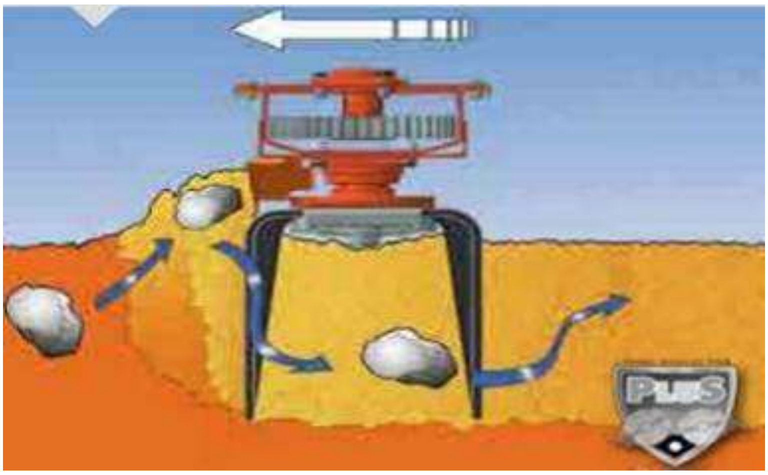

Fig. 2 - PLUS stones collectors (http://www.titanmachinery.ro/files/home/brosura/MASCHIO-ASPARDO.pdf)

The Maschio harrows are equipped with 4 rotors per meter which ensure very good shredding of the low-energy terrain and the maximum working depth is 28 cm. The power take-off shaft speed is 1000 rpm.

The rotary movement of the knives does not exert a vertical pressure on the ground but a horizontal pressure.

At the 6-8m wide harrows, there is a camshaft clutch system located on the side of the transaxle, which provides efficient transmission protection.

Lemken has mounted the Dual transmission on vertical harrows to change the direction of rotation of the rotors, but also to change the speed of the rotors

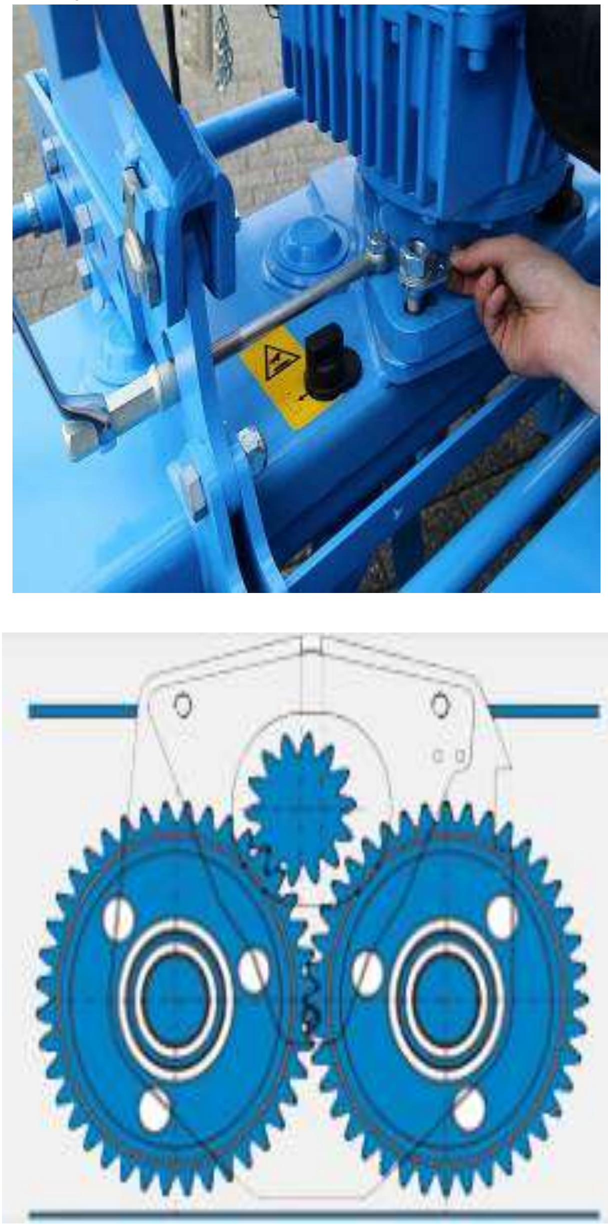

Fig. 3 -The Lemken Zirkon Change of the Rotation Direction
(https://lemken.com/en/technology/zirkon-dual-shift/)

The Dual Shift transmission can be changed by loosening three nuts and moving the gear through a 20 mm shaft between two limiters.

Changing the direction of rotation is achieved because the gears do not direct the rotor shaft, but a pinion between two rotor shafts. Shifting the gear rotates the left or right rotor, giving the desired rotation direction.

A gear lever also offers a quick and easy rotor speed change.

At the Khun harrows are mounted track traps designed to loosen the compacted soil from the tractor wheels. They are safely equipped with a traction bolt or spring.

CONCLUSIONS

-The use of the gearbox in the cutter transmission

Using the Dual Shift transmission to change the direction of rotation of the knives

-The use of rock deflectors, which are designed to protect the transmission and provide better latching.

-Mounting track traps to the wheels, which have the role of loosening compacted ground.

RECOMMENDATIONS

-Mounting three or four knives on the rotor which would lead to better soil shredding.

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FINAL BREAD DOUGH FERMENTATION – REQUIREMENTS, CONDITIONS, EQUIPMENT. A SHORT REVIEW

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FERMENTAREA FINALĂ A ALUATULUI DE PÂINE – CERINȚE, CONDIȚII, UTILAJE.

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Keywords: bread, wheat dough, proofing, parameters control, proofing equipment.

ABSTRACT

Bread is a food consumed daily and bread making industry occupies an important place in the consumption department. This industry is in a full process of expansion and automation; solutions for control and optimization of technological processes are continuously searched for obtaining good quality and cost-efficient products. Dough fermentation represents the largest stage of the technological process starting from kneading and continuing during all the other operations and the first part of baking. Intrinsical knowledge of the elements of influence over the fermentation process represent key points in obtaining superior quality products.

REZUMAT

Pâinea constituie un aliment consumat zilnic. iar industria de panificație ocupă un loc important în cadrul producției bunurilor de larg consum. Această industrie se află în plin proces de expansiune și automatizare; se caută în permanență soluții de optimizare și control a proceselor tehnologice pentru obținerea de produse corespunzătoare la un cost eficient. Fermentarea aluatului reprezintă cea mai mare etapă a procesului tehnologic deoarece începe cu frământarea semifabricatelor și continuă în cursul tuturor operațiilor tehnologice ulterioare și în prima parte a coacerii. Cunoașterea intrinsecă a elementelor de influență asupra procesului fermentativ reprezintă puncte cheie în obținerea produselor de calitate superioară.

INTRODUCTION

Bread making can be viewed as a series of aeration stages in which bubbles are incorporated during mixing, inflated with carbon dioxide gas during proofing and the aerated structure modified and set by baking. (Campbell. G. M.. 1991).

Wheat flour is the most commonly used in bread making because it is the only cereal capable of delivering a highly aerated structure in the baked loaf. This is due to the unique properties of its protein content, which has the ability to form a continuous macromolecular viscoelastic network called gluten, when mixed with enough water and subjected to sufficient mechanical work. (Cuq et al 2003).

The yeast used for bread manufacturing is Saccharomyces cerevisiae,, which can convert the fermentable sugars present in the dough into carbon dioxide and ethanol as the main products. The fermentation intensity depends on the form of the yeast and the availability of fermentable sugars in the flour, including maltose produced by starch hydrolysis (Hutkins. 2006). The increase in volume is the most apparent physical change related to the development of fermentation in the dough.

This review aims to highlight the importance of final bread dough fermentation and some necessary aspects that need to be considered regarding this stage of the bread making process.

MATERIAL AND METHOD

Mandatory requirements for obtaining high performance during proofing

The basic ingredients used to create a dough mix are flour, water, leavening agent (yeast or chemicals) and sodium chloride (Voicu Gh. 1999).

The typical white flour is comprised of approximately 71% (of flour weight) carbohydrates (of which the vast majority is starch), 13% protein. 1% lipids and 14% water with a number of components making up the remainder (Blanchard et. al.. 2012). Each component participates in overall's flour quality and has a greater or smaller influence on dough behavior during processing.

The proteins, glutenin and gliadin occupy a leading role in flour quality evaluation. Glutenin is responsible for dough extensibility and gliadin for dough elasticity. (Burluc R.M. 2007). Because the structure and bread quality is much based on gluten matrix, the quantity of gluten and ratio of glutenin to gliadin will affect the breadmaking quality of wheat flour. (Xu et al.. 2007. Bordei D.. 2007). Another important parameter is the hydration capacity of flour, which represents the quantity of water absorbed by the flour components and can be determined using the Brabender farinograph (SR ISO 5530-1/1990); according to the standard procedure, the quantity of added water is determined for an optimal dough consistency of 500 B.U. Because of different technologies applied in industrial bread making, in many cases, the hydration capacity of flour requires some adjustments. (Burluc R.M.. 2007).

Studies performed by Chin and co-workers (2005) show that using 2% less water than optimum negatively affected the production of carbon dioxide in dough during proofing, producing loaves of lower volume. Due to inadequate gluten hydration, the retention of carbon dioxide is affected also. (Peighambardoust et al.. 2010).

Dough development during kneading is a key step in obtaining a good quality loaf of bread and is decisively influenced by type of kneader, speed rotation of the kneading arm, time of kneading, added water and specific energy input. (Hwang C. H. and Gunasekaran. S.. 2000). It is believed that 90% of the final bread quality depends upon mixing. (Cauvain. 2000).

During kneading, air bubbles are incorporated in the dough (Cauvain et. al.. 1999) and are considered to be the nuclei of the gas bubble which will build during fermentation stages. Doughs from strong flours incorporate less air during mixing than doughs from weak flours and give larger loaf volumes, finer crumb structures, or both. The leavening agent generates gas (CO2) within the liquid phase, which diffuses in solution to the nuclei due to a concentration gradient (Shah et. al.. 1998). As a result, the nuclei expand into gas cells and the density of the dough is reduced. The next processing stages like punching, sheeting and molding will be carried out to redistribute gas cells so as to improve crumb appearance.

The final proof stage is responsible for determining the structure of the bread crumb (Shah et al.. 1998), but all previous stages in the bread making process are equally significant.

Gas retention is of considerable interest due to its repercussion on the crumb structure and volume of bread (Giannou et al 2003) and depends on the rheological properties of the gluten matrix and its capability of expanding under carbon dioxide production and the growth of the internal surface of dough, which takes place up to a critical point.

The desirable loaf volume of yeast-fermented products is achieved only if the dough provides a favorable environment for yeast growth and gas generation and, at the same time, possesses a gluten matrix capable of maximum gas retention. (Sahlstrom, Park and Shelton, 2004). The fermenting power is characterized by the quantity of gas produced in a dough prepared from flour, water and yeast. fermented in certain conditions of temperature and humidity. The fermenting power depends on enzymes α and β – amylase, which transform a part of starch into maltose, as well as the quality of the yeast. (Voicu Gh.. 1999).

During fermentation, the metabolism of yeasts chemically transforms assimilable carbohydrates into carbon dioxide and ethyl alcohol as the principal finished products. As a related amount of alcohol forms, which is water-miscible, it influences the colloidal nature of the wheat proteins and changes the interfacial tension within the dough. In addition, carbon dioxide, which partly dissolves in the aqueous phase of the dough, migrates toward the initial nuclei of the air bubbles formed during kneading causing their growth. (Akbar A. et. al.. 2012). Approximately 95 % of fermented sugars are transformed in ethylic alcohol and carbon dioxide and the rest of 5 % in superior alcohols, organic acids, volatile compounds. (Voica D.. 2010).

RESULTS

Cconditions necessary for an optimal final fermentation

The dynamics and intensity of carbon dioxide formation are influenced by the flour properties, dough composition and technological process and proofing parameters; these factors are interdependent. The fermentation process takes place only if there are optimal conditions regarding the nutrition environment and the microclimate parameters.

Under favorable conditions, the proving time should allow for the action of the yeasts and enzymes in the dough. (Sluimer 2005).

Proofing of the dough should be optimized for the production of good quality baked products. An insufficient proofing time results in products with a reduced volume and poor crumb structure, whereas excessive proofing can produce sticky doughs with low viscosity, which are difficult to handle. Excessive proofing times also represent unnecessary cost to the bakeries (Sinelli et al. 2008).

The parameters necessary for a good control of the proofing process are the proofing time, temperature and relative humidity.

The usual final proofing time can vary between 15 min and 60 min, depending on the weight of dough loaf, dough consistency and quantity of yeast, the bulk fermentation degree, temperature and relative humidity.

If the bread making process implies a multi-phase technological process (with bulk fermentation time), the proofing time is greater than in the case of direct technological process (which uses intensive kneading, no intermediate fermentation and greater quantities of yeast).

The normal proofing temperatures are 30–35 °C and a relative humidity of 70 – 85 %. (Burluc R.M. 2007). The relative humidity varies directly with temperature and air distribution speed inside the proofing chamber. The values must be chosen so as to avoid or limit humidity losses from the loaves to the environment, which results in crust formation on the surface of the loaf and affects the product quality. Also a higher humidity level (e.g. 90%) will wet the surface of the loaf, resulting in higher degrees of stickiness and irregular baking. For example, if the proofing temperature is 35 °C and the air distribution speed is 1.5 m/s, the optimal value for relative humidity should be between 73 % and 75%.

Equipment used for final fermentation of dough

Final fermentation (final proofing) takes place in enclosed spaces called provers. A general classification is presented in figure 1.

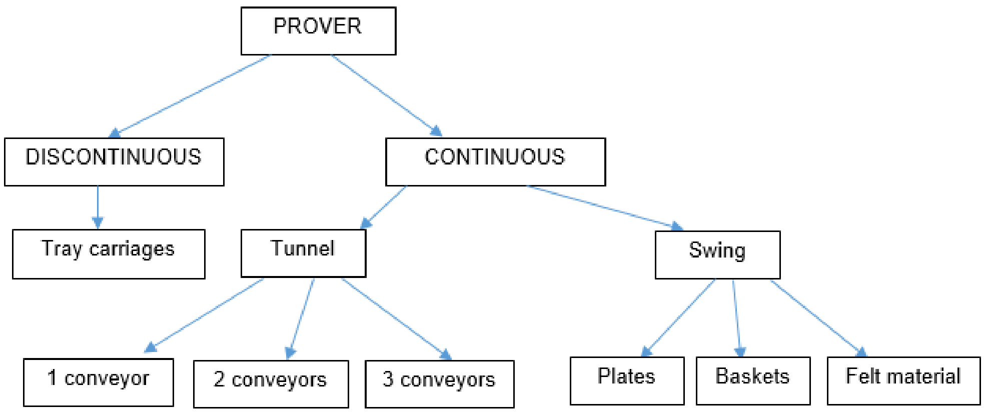

Fig. 1 - Prover classification

The discontinuous provers (figure 2) uses tray carriages (figure 3) on which the dough loaves are placed. This type of prover is mainly used for small production units.

Fig. 2 - Discontinuous prover with two doors. (source: internavytec.ro; castgrup.ro)

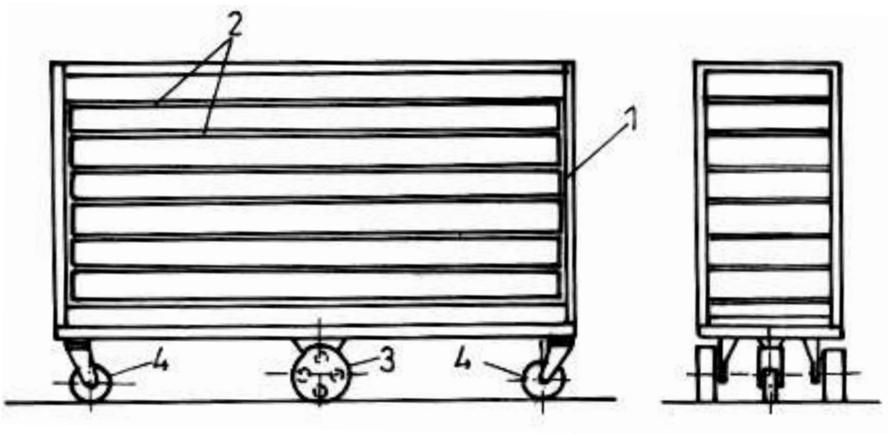

Fig. 3 - Mobile carriages for discontinuous prover: 1 – metallic frame. 2 – plates. 3 – movement wheels. 4 – guidance wheels. (Voicu Gh.. 1999)

The air conditioning systems are of small capacity but the control panel allows for temperature and humidity control. An improved air circuit inside the proofing chamber is shown in figure 4.

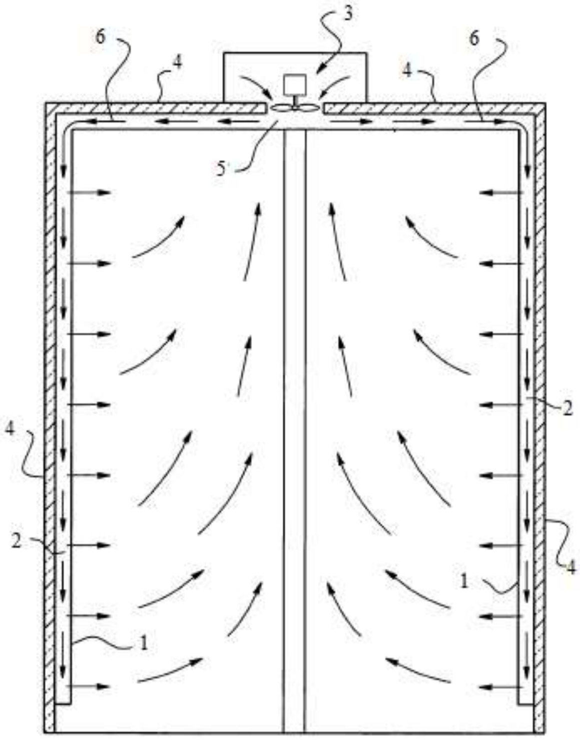

Fig. 4 - Improved air circulation inside discontinuous prover / Dospitor discontinuu cu sistem îmbunătăţit de ventilaţie în incintă: 1 – ventilation grids; 2 – air distribution pipes; 3– fan; 4 – isolation panels; 5 – aspiration grid; 6 – air distribution. (Thompson Hine Llp. 2004)

Continuous provers are used in high capacity production units where usually, the processing stages are chained.

Tunnel provers are composed of an isolated tunnel through which travels one or more overlaid conveyors. The conveyor is charged at one end with dough loaves which are discharged at the opposite end. The proofing time is represented by the time it takes to cross the tunnel length. In order to facilitate the dough loaves transfer into the oven, the conveyor's width and speed must be the same with the oven's. In the case of tunnel provers, the leading element is represented by the oven. For example, if the oven's length is the same as the prover's, the proofing time will be determined as the baking time multiplied with the conveyor number.

Fig. 5 - Tunnel prover with three conveyors (source: Pani Enterprise. Arges)

The air conditioning unit has an automated control panel with integrated PLC (Programmable Logic Controller) which controls the input of temperature and humidity in the proofing chamber. The air is distributed in the prover using distribution pipes in arrangements that facilitate the uniformity of temperature and humidity values inside the proofing chamber.

A classic air conditioning unit is comprised of: gas-air heat exchanger (charged with steam at 105 °C), gas-air heat exchanger (charged with chilled water at 5-7 °C), a water cooling system, air filters, steam spray system (which charges the air with humidity up to 90%), flow fan, safety sensors and temperature and humidity sensors, electrical valves for heating, cooling and steam charge control.

A classic air conditioning system scheme is shown in figure 6.

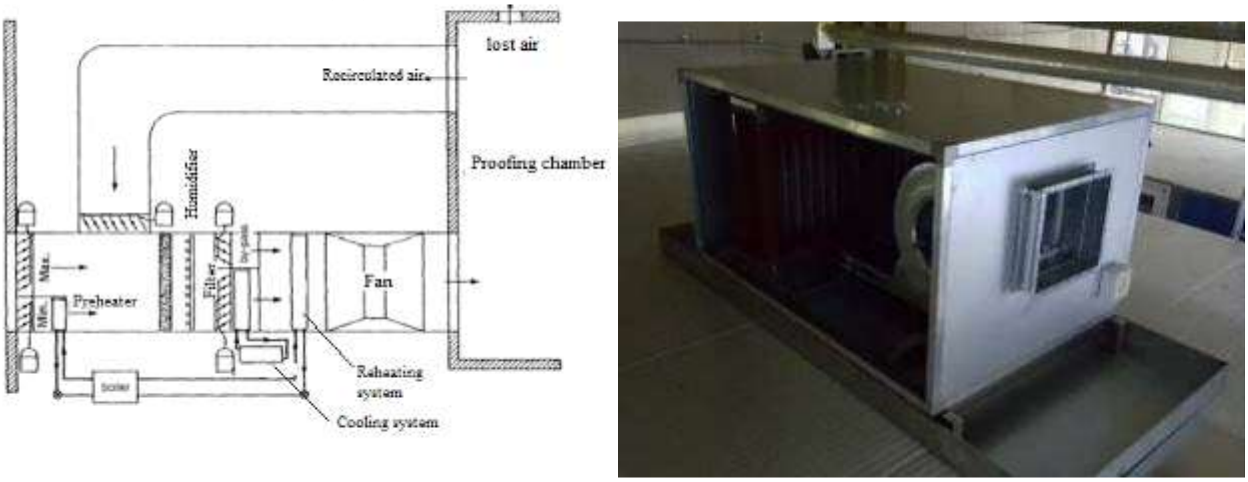

Fig. 6 - Classical scheme for air conditioning unit - left. (Jennings. B.H..1978) **and air conditioning unit for tunnel prover - right.** (source: S.C Biotehnologicreativ SRL)

The newest tunnel provers have automated systems for conveyor length adjustment and dough infeed and outfeed which are synchronized with the automated scoring system and the oven infeed conveyor.

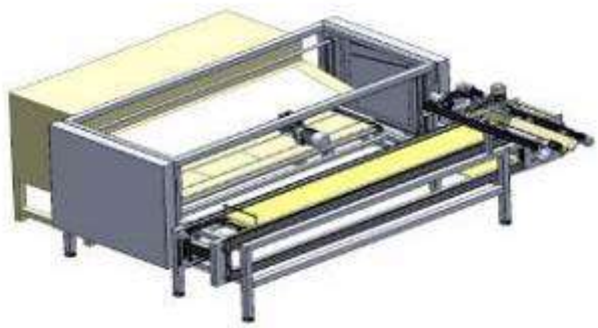

Fig. 7 - System for automated infeed of tunnel prover (source: Technobit Automatizari SRL)

The prover with swings is composed of two parallel chains which form a conveyor that circulate on a series of carriers. At certain distances, the swings for dough proofing are suspended on the conveyor chains and are driven with a step by step elevator system. (Voicu Gh.. 1999).

This type of prover can be adapted for different types of swings, as shown in figure 8.

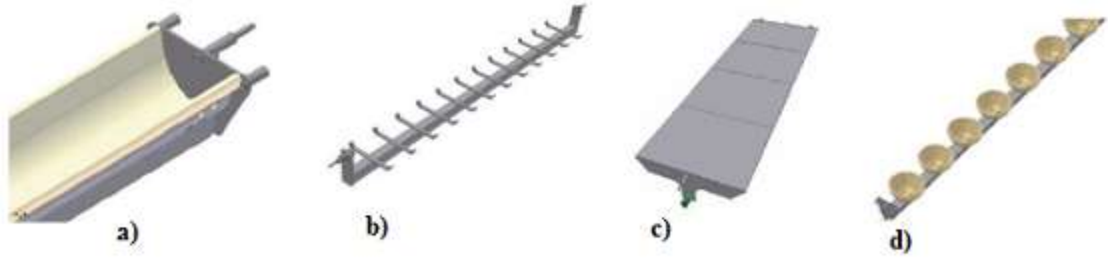

Fig. 8 - Swing types: a) Metallic concave form with felt material support. b) swing for trays. c) straight plate. d) swing with baskets

A relevant example of prover designed for trays is shown in figure 8. Due to the complexity of the prover's functioning, all systems are automated and controlled with the help of an integrated control panel.

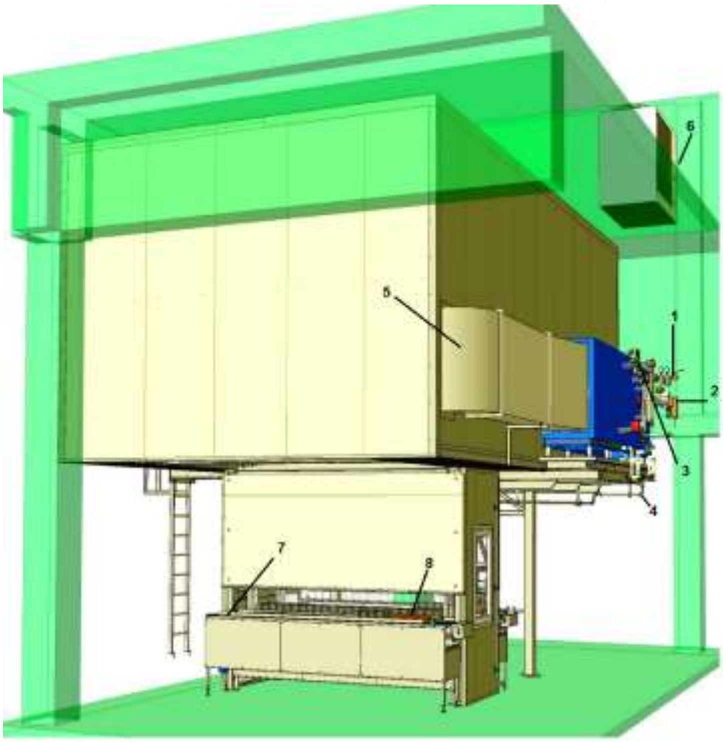

Fig. 9 - Suspended tray prover-general view: 1. Steam spray unit. 2. Steam infeed unit for heat exchanger. 3. Chilled water infeed unit for heat exchanger. 4. Condensed steam collector. 5. Ventilation unit. 6. Water cooler. 7. Withdrawal conveyor. 8. Pushing tray device (Gostol Gopan. 2014)

In the first phase, the air is charged with humidity thanks to the steam spray unit; in the next phase, the air passes through the steam based heat exchanger where is heated up to a set point level. The cooling system is automatically activated when the air temperature exceeds the set point value. The sensors for humidity and temperature permanently measure the values inside the prover, transmitting data to the PLC. which takes the appropriate decisions for keeping the temperature and humidity values within the set parameters.

Figure 10 shows the air circulation inside the prover.

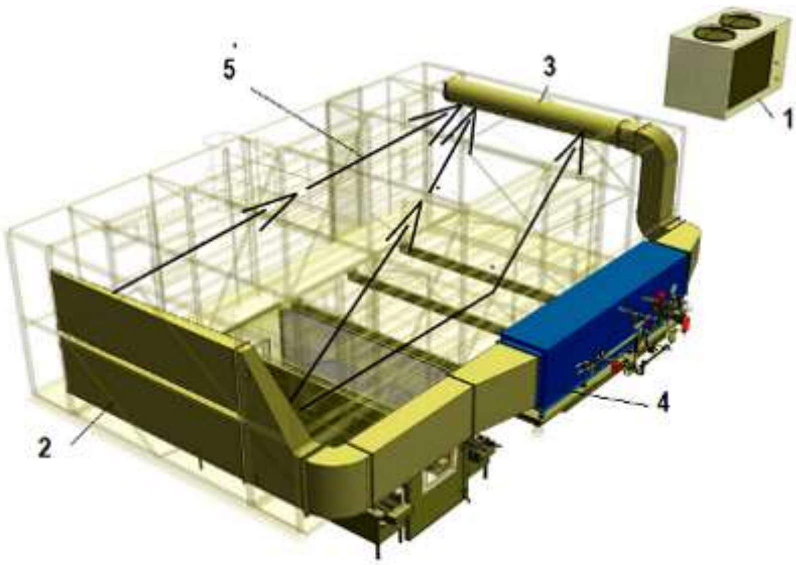

Fig. 10 - Air circulation inside the prover: 1. Chiller. 2. Treated air charging. 3. Air aspiration from prover. 4. Air conditioning unit. 5 Air currents inside prover. (Gostol Gopan. 2014)

CONCLUSIONS

Although a variety of cereal grains can be used in baking, wheat flour is most commonly used due to the quality of its protein content to form a viscoelastic matrix, called gluten, which is largely responsible for dough's behavior during processing stages and gas retention during proofing.

Flour quality, recipe used (quantity of added water and yeast), the technological process, dough development, inclusion of air bubbles during kneading, gluten network capability to retain gas during proofing, environment parameters and equipment proficiency are some of the most important factors which must be taken into consideration in order to obtain bread of good quality.

During proofing the increase in volume is a result of yeast carbon dioxide production. The yeast used for bread manufacturing is Saccharomyces cerevisiae. Yeast metabolizes the sugar in the dough and produces carbon dioxide causing the gluten walls to expand. The conditions for growth are warmth, moisture and food.

The proofing stage takes place in closed spaces, called provers which by design, can be discontinuous or continuous, with different shapes and sizes, dependent on the specific technology applied. The most performant provers are completely automated.

The proofing time is established according to the technological process and varies with dough mass, composition and consistency; in most cases, the proofing time is between 15 min and 60 min.

For optimal proofing results, the fermentation chamber must have a temperature value between 30 – 35 °C and a relative humidity of 70 – 85 %. A higher temperature requires a higher humidity level. The humidity level must not exceed 90%.

These parameters are insured with automated air conditioning units which are designed to continuously deliver the set point values established to suit the technological process.

Besides temperature and relative humidity, air circulation and the speed of air distribution inside the proofing chamber are of great importance because between these aspects there is an interdependence relation which influence the proofing process activity.

All stages in the bread making process are significant, but proofing is the defining operation that establishes crumb structure and overall appearance of the bread piece.

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PLANE SIEVES WITH SQUARE FRAMES – TECHNICAL EQUIPMENT FOR INCREASING THE EFFICIENCY OF SORTING MILLED MATERIALS
/
SITELE PLANE CU RAME PĂTRATE - ECHIPAMENTE TEHNICE DESTINATE CREŞTERII EFICIENŢEI SORTĂRII PRODUSELOR MĂCINATE

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***Keywords*:** sifted material, refusal, sieving operation, efficiency.

ABSTRACT
Sieving is the operation of sorting products resulted after the milling process. Sorting is performed depending on the size of particles obtained from milling, with the help of sieves. From the milling process result products more or less loose, where the stratification effect is intense and enables the separation of the particles not only due to the particle size but also to their specific weight as follows: in direct contact with the surface of the sieve will be placed the heavier and bigger particles and smaller and lighter particles will go to the upper layers. Hence, at the same granulometric fraction, the probability of sifting will be much higher for heavier particles, namely the richest in the endosperm.

REZUMAT
Cernerea este operaţia de sortare a produselor rezultate in urma măcinării. Sortarea se face după mărimea particulelor rezultate în urma măcinării. cu ajutorul sitelor. În urma procesului de măcinare rezultă produse mai mult sau mai puţin afânate. la care efectul de stratificare este intens şi face ca separarea particulelor să nu se producă numai după mărimea particulelor ci şi în funcţie de greutatea lor specifică astfel: în contact direct cu suprafaţa sitei se vor aşeza particulele mai grele şi mai mari, iar către straturile superioare particulele mai mici şi mai uşoare. De aici rezultă că, la aceeaşi fracţie granulometrică, probabilitatea de cernere va fi mult mai mare pentru particulele mai grele. adică cele mai bogate în endosperm.

INTRODUCTION
The technological efficiency of sifting is appreciated through basic factors: the degree of separating the sifted materials from the refusal and the sifting capacity.
Theoretically, the refusal should contain only particles with sizes bigger than the sieve's orifices. In this case, the sieving would be perfect. In reality, this net separation never takes place and always, where sifting loose, powdered products a part of the refusal will be found in the sifted material.

Researches conducted allowed to reach the conclusion that the decrease, depending on time, of the component resulting from the mixture subject to separation, is proportional to its initial quantity.

From this conclusion was determined the coefficient of extracting the sifted material particles:

$$\eta = \frac{kx}{v+kx} \tag{1}$$

where: k – sieve constant;
x –sieve length;
v feeding rate;

and:

$$k = w\psi \frac{V_s}{h} \tag{2}$$

where: w – coefficient depending on the correlation between particle size and orifice size;
ψ-active sieve section coefficient;

Therefore, sifting effect can be improved after applying two methods:

- increasing the sifting duration, namely increasing the length of the sieve or reducing the feed rate of the product;

- Increasing sieve constants, namely reducing the "*h*" load or the speed of particle passage through the orifices of the sieve "v_s".

By sifting capacity is understood the amount of sieved material that passes through the surface unit of the sieve, in the unit of time. It depends on a series of factors concerning both the product to be processed (granulometric composition, moisture), as well as the dimensional and kinematic elements of the machine that carries the sifting surface.

Existing calculation methods for sifting equipment are based on the motion laws of a material point situated on a rough surface in motion that does not correspond to the motion laws of the loose bodies.

However, the optimal kinetic parameters of plane sieves can be theoretically determined in the first approximation, provided that the thickness of the product layer and the correlation between the particle size and the aperture of the mesh are taken into account, so that two main conditions are satisfied: on the one hand , the relative movement speed of the particles moving on the surface of the sieve shall be such as to ensure maximum sieving of the sieve particles in the fabric orifices; on the other hand, the acceleration of the sieve surface movement must ensure that the sifted particles are pushed out of their orifices.

MATERIAL AND METHOD

Currently, plane sieves with square frames represent one of the most efficient equipment for sifting milled products.

In order to reduce material costs per ton of milled product, the researches undertaken were directed towards reducing the overall weight of the plane sieve in parallel with increasing the processing capacity by increasing both the number of compartments and the number of frames in each compartment.

This was achieved by reducing the gyration radius of the site. However, in order not to influence the technological efficiency of the sifting, the calculation relations for the other kinematic parameters are determined taking into account the interaction between them.

The movement of a particle on the sieving surface

We consider a "M" particle situated on the sieving surface moving with this surface on which a centrifugal force "Pc" acts, its own weight "G" and friction force "Fr".

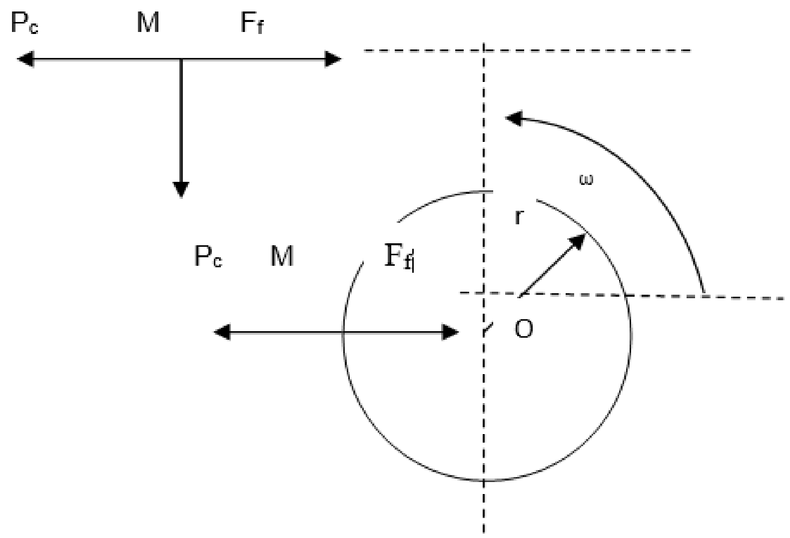

Fig.1 – Particle movement on the sieve surface

The condition for the particle to move on the sieve is that the centrifugal force is bigger than the friction force:

$$P_c > F_f$$

from wher, following the calculations, the minimum plane rotational speed shall be obtained according to its "r" eccentricity and the coefficient of friction "f":

$$n_{min} > 30\sqrt{\frac{f}{r}} \tag{3}$$

Relative motion speed of screening particles

The maximum relative speed of sieved material particle moving in the inferior layer of product on the sieve will be determined. Supposing that the examined particle moves at a constant relative speed "v_0" and describes a trajectory II-II with radius r_1 (fig. 2).

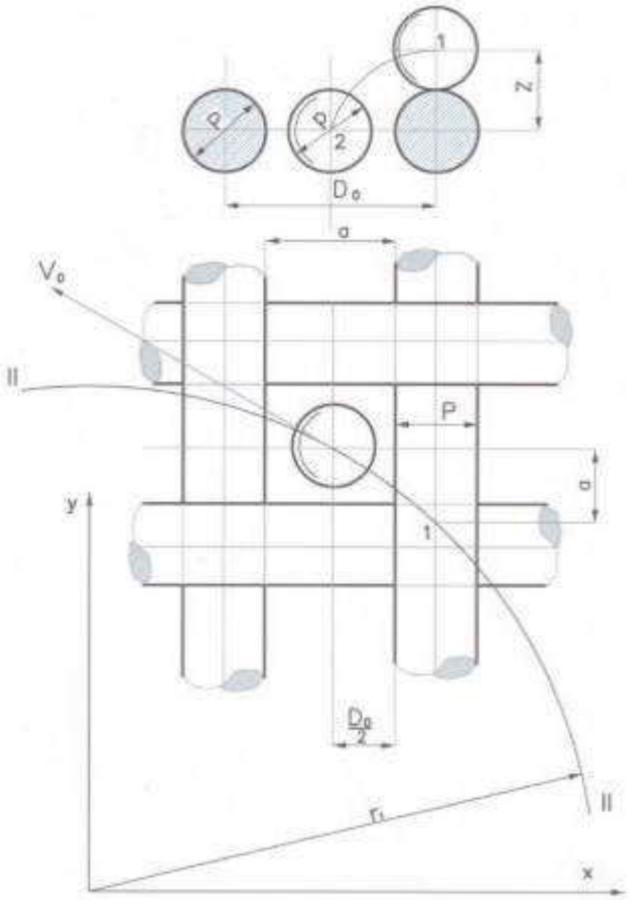

Fig.2 – Passing of the particle through the mesh orifice

The mesh orifice through which the trajectory II-II passes the particle motion will be examined. For the unconditional passage of the particle through this orifice, it is necessary that in the moment when it is situated above the center of the orifice, it falls with the value

$$Z = \frac{p+P}{2} \tag{4}$$

where: p – spherical particle diameter;

P – thickness of the mesh's silk thread.

To meet the indicated condition, it is necessary that when the center of the particle on a horizontal plane crosses the path equal to the length of the arc 1-2 = S, the particle descends vertically with the value Z. Noting this interval with "t", it results:

$$Z = \frac{gt^2}{2} = \frac{p+P}{2} \tag{5}$$

$S=v_0t$. where:

$$S = \sqrt{\frac{D_0^2}{4} + a^2} \tag{6}$$

$D_0=D+P$

Eliminating "t" from equations 5 and 6.

$$t = \sqrt{\frac{r_1+P}{g}} = \frac{\sqrt{\frac{D_0^2}{4}+a^2}}{V_0} \tag{7}$$

The value of v_0 is obtained:

$$v_0 = \sqrt{\frac{g\left(\frac{D_0^2}{4}+a^2\right)}{r_1+P}} \tag{8}$$

where „a" is the distance on the ordinate from the axis of the orifice to point 1. The relative particle speed should ensure in falling through the orifice in all cases, therefore also when a=0.

Thus, particle movement speed should be approximately equal to:

$$v_0 = \frac{D+P}{2}\sqrt{\frac{g}{r_1+P}} \tag{9}$$

Having the corresponding speed of this expression, the sieved material particle r1 <D enters securely through the mesh orifice.

The optimal speed of any sieved material particle is determined through the condition r_1=D, namely when:

$$v_0 = \frac{1}{2}\sqrt{g(D+P)} \tag{10}$$

It results that the particle displacement speed varies from one frame to another according to the geometric parameters of the mesh. The maximum speed to be considered is less than that corresponding to the finest mesh, because otherwise the particles of flour would not be sieved.

Critical acceleration of sieve movement

Figure 3 presents the mesh orifice having a refusal particle caught, impeding the passing of sieved material through this orifice.

An examination of forces acting on the particle situated in the sieve orifice is necessary. We imply that this particle is spherical with a diameter d_1. Fiber thickness is also noted with P and the pass D_0= D+P. On the particle presses the layer of product. If its height is noted with "h" and the specific weight situated in motion with "y" , then the load for square sieve unit will be equal to *yh.* and the vertical pressure exerted of particle can be approximated thus:

$$N = \frac{\pi p^2}{4}\gamma h \tag{11}$$

If besides this we keep the particles own weight "q", on it will act the force Q=N+g. from the moment when the particle will stop inside the mesh orifice, on it will act, due to the internal friction force, the layer of product that moves on the relative trajectory II-II:

$$T = \mu N \tag{12}$$

where: T – internal friction force;

μ – material dynamic internal friction coefficient;

For simplification, we will assume that the friction force "T" acting on the horizontal plane that passes through the center of the examined particle.

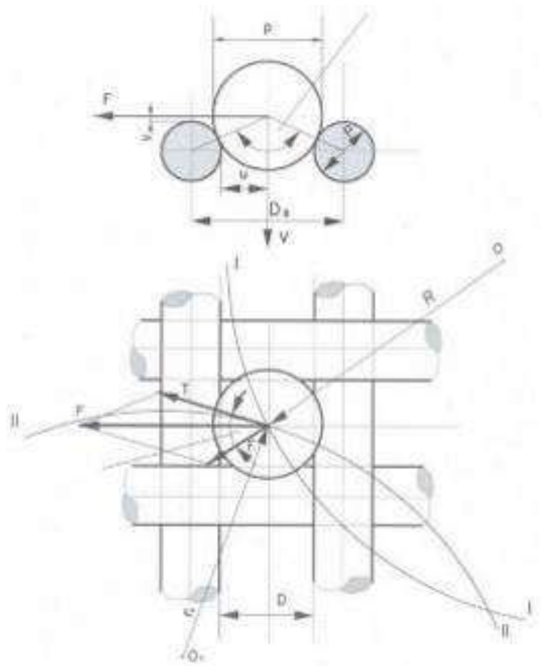

Fig.3 - Scheme for the distribution of forces acting on the refusal particle trapped in the mesh orifice

As is well known, the direction of the friction force corresponds to the tangent to trajectory II-II. On the particle acts, at the same time, the inertia force Fi directed at the "R" point of the absolute trajectory of the I-I sieve, which is:

$$F_i = m\omega^2 R \tag{13}$$

where:

$$m = \frac{q}{g} = \frac{\gamma_0}{g}\frac{\pi p^3}{6} \tag{14}$$

where: *m* – particle mass;

γ_0 - particle specific mass;

g - gravitational acceleration.

In addition to the forces listed, electrostatic forces of mutual attraction between the particle and the surface of the sieve (usually silk) also act on the particle, which, when moving the mixture consisting of small endosperm particles, exceed several times the weight of each particle.

Highlighting these forces complicates the issue examined. Therefore, the electrostatic forces of mutual attraction are neglected, which is admitted at first appreciation, because these forces, compared to the force N considered, are much smaller.

In this way, force "F". whose magnitude is equal to the geometric sum "Fi" and "T" acts on the particle in horizontal plane, namely:

$$F = \sqrt{F_i^2 + T^2 + 2T\cos\alpha F_i} \tag{15}$$

where angle α formed between forces „F_i" and „T". is determined using the formula of N.E. Jucovschi:

$$\cos\alpha = \frac{\mu g}{\omega^2} \tag{16}$$

Taking that into account and taking into consideration the formulas above, force "F" is:

$$F = \sqrt{(m\omega^2 R)^2 + (\mu N)^2 (1 + \frac{2q}{N})} \tag{17}$$

This way, two force moments act on the examined particle: on the one hand, the moment of forces M_1=Pa, which tends to turn the particle around point A and to throw it from the mesh orifice.

On the other hand, acts the opposed moment of force V, which tends to keep the particle in the orifice. The arm of this force is “u”, therefore the moment will be M_2=V_u. Particle exit from the position occupied in the mesh orifice will begin when moment M_1 will be bigger than the moment of the weight M_2, namely:

$$F \geq V\frac{u}{a} = Vtg\varphi \tag{18}$$

where tgφ is the coefficient of particle fixing expressed through particle dimensions and the dimensions of the orifice as follows::

$$tg\varphi = \frac{1}{\sqrt{\left(\frac{r_1+P}{D+P}\right)^2-1}} \tag{19}$$

It is necessary to note that the direction of motion, in the case of the exit of the particle from the mesh orifice, will coincide with the direction of the force “F” at that given time. Since the vector of force "F" during a sieve speed describes the angle 2π, it is assumed that the greatest probability of particle output in the orifice will be when the force direction "P" will coincide with the direction of the diagonal of the square hole, a force less than "F". However, the calculation value of force "F" is chosen for the worst case, namely, for the moment when the force is perpendicular to the axis of the thread. This calculation is made in order for the particles to be pinpointed from the orifices that they occupy.

Necessary replacements are made in inequality “17” and after simple transformations, the critical acceleration will be obtained:

$$a_k = \omega^2 R = gtg\varphi\sqrt{1 + C_0\left(1 - \frac{\mu^2}{tg^2\varphi}\right)} \tag{20}$$

where:

$$C_0 = 3\frac{\gamma h}{\gamma_0 r_1} + \frac{9}{4}\frac{\gamma^2 h^2}{\gamma_0^2 r_1^2} \tag{21}$$

Therefore, the critical speed of the planar axis will be:

$$n_c = \frac{30}{\pi}\sqrt{\frac{a_c}{R}}$$

(22)

As observed, in the case of plane sieves, the size of eccentricity is inversely proportional to the value of speed, namely to the relative movement speed of particles on the mesh surface.

That is why it is very important to set the speed value closer to the maximum admissible value so as to obtain an increase of specific load of the machine without affecting its technological performance.

Based on interpretations on the relations presented above, was achieved, for the new families of sieves with square frames, the reduction of gyration speed from 45 mm to 32 mmm, simultaneously with increasing speed from 220 rot/min to 245 rot/min.

Factors influencing technological effect for plane sieves with square frames

The optimal sifting effect of working surfaces of plane sieves depends on the following factors:

- Product feed to be done continuously and in even quantity;
- Sieves to be pulled-up on the frames with the same intensity (expansion) in all directions;
- Cleaners to operate continuously to avoid orifice clogging and working surface diminishing;
- Product movement on the working surface to be done evenly and through auto sorting;
- Plane sieve ventilation to be done in good conditions;
- Products not to get clogged at the entrance and exiting of the sifting compartment;
- The internal circulation of products corresponds to the technological diagram of the mill;
- Sieves not to have uncalibrated orifices;
- Frames to be perfectly plane;
- To ensure sealing between compartments and frames;
- The length of the feed and outlet bellows to be the one necessary as not to prevent the rotating motion of the sieve;

- Sieve revolution to be constant;
- Suspension bars to be equal and elastic enough;
- The sieve needs to be perfectly balanced.

RESULTS

Plane sieve with square frames - SPP 618 A is a complex machine, specific to the milling industry, being one of the basic machinery in the technological mills of the milling plant.

It is used for the granular separation by sifting of the mixture of products resulting from the grinding operations of wheat.

In essence, the plane sieve with square frames sorts by sieving and is designed to obtain both flour and other types of granulation for intermediate products.

The sifting of ground products using the plane sieve with square frames is a newer process that meets the current requirements of improving product quality, production capacity, specific load and energy consumption reduction.

Plane sieve with square frames - SPP 618 is part of the group of 6-compartment planar sieves, which is a multi-layered sieve with circular planar motion. It sums up a large number of overlapping (18 pieces) screened surfaces simultaneously and perfectly horizontal.

The planar circular motion of the sieve is smooth, the product shifting from end to end of the frame of each frame in a layer whose thickness decreases from the entrance to the exit as the product is separated by sieving. The scanning is repeated within the same system from a number equal to the number of stacked sieves. The machine is composed of 6 (six) compartments and each compartment of 18 interchangeable and removable frames.

Sieve support frames have three lateral channels which, together with the side walls, have a total of seven channels, enough to do any sort of product routing. The sieve enters the frame port (sieve port) along with the shake system. Each frame is divided into four compartments, in each compartment moving plastics cleanings with a high coefficient of elasticity.

The initial feeding of the planar plane with square frames is done at the center of the frame, scattering on the scraping surface uniformly without the intervention of any special guidance system and only due to the circular movement. In principle, the product subjected to sifting falls through the feed openings of the compartments where it is distributed on the surface of the sifting sieves.

Due to the circular oscillatory movement in the horizontal plane that the sieve has during operation and the gravitational force, the products move to the lower part of the passage respectively successively to the outlet frame.

Separation of the product by particle size is made according to the orifice size of the mesh on the frames. Products smaller than the size of the meshes pass through them and form the sieve and the ones that are larger are directed to the dump channels formed in the frame set compartment. For better sifting, the product passes successively and simultaneously on 2 to 7 frames depending on the product's technological scheme inside the machine.

The advantages of this flat plane square frame consist in the high yield of sifting, double than the one of classic sieves, due to the lack of pallets that allows a gravimetric stratification of the products and consequently the contact with the surface and the holes of the sieve intensifies the sifting process, evacuation of the refusal of the sieve is made as soon as the separation takes place due to the special evacuation channels both at the ends and the side, the higher sieve net area, the rotation speed is higher and the inner pattern can easily be changed by replacing the frames on which the sieves are mounted. It was found that due to the high intensity of sifting of the square frames, compared to the classical (long and short rectangular) frames, they do not correspond to the same product sifted by square frames, their sieved material having the higher ash content for the same chambers sieve. In order to eliminate this shortcoming, it is recommended that 1 to 2 sieves with denser orifices are required to obtain the same quality product without reducing the production capacity of the SPP 618 A.

For the sifting efficiency, the mesh applied to the sifting frames is continuously cleaned (shaken) by means of plastic-molding (moldotan) swinging cleaning parts. The products resulting from the sifting process are directed towards evacuation channels, which are connected to the free fall tubing in the technological flow of the respective mill.

CONCLUSIONS

Researches conducted aimed at increasing the technological efficiency of sieving, simultaneously with reducing the material costs per ton of processed material. Both interaction between the kinematic parameters of plane sieves as well as the constructive solutions of active working bodies were analyzed.

The results of researches lead to the reduction of gyration radii for the new square frame sieve families from 45 mm to 32 mm, simultaneously with increasing rotation speed from 220 rot/min to 245 rot/min.

At the same time, new constructive solutions were adopted for the active bodies of square frames, ensuring an increase of about 17% of the total sifting surface.

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CONSIDERATIONS REGARDING THE NUMERICAL COMMAND MACHINES / *CONSIDERAȚII PRIVIND MAȘINILE CU COMANDĂ NUMERICĂ*

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Keywords: *lathe, milling machine, numerical command.*

ABSTRACT

The paper presents some considerations on current stage of numerical command machines. Numerical control has appeared before inventing microprocessors used in current computers, due to necessity of developing machine-tools able to perform complex parts of high precision. US Air Force boosted their development, due to financial resources they made available for stimulating the researches.US Air Force needed to improve the structure of jet planes. Initially, the first CNC machines made use of electronic lamps and vacuum. These machines had a series of disadvantages, such as: they produced excessive heat, occupied a rather big space, had low reliability, could perform only one operation. The next generations of machines were endowed with transistors (that replaced the electronic tubes) and the controller took small room. Nowadays, the numerical command machines are based on technology of microprocessors and current computers.

REZUMAT

În lucrare sunt prezentate considerații privind stadiul actual al mașinilor cu comandă numerică. Controlul numeric a apărut înainte de inventarea microprocesoarelor utilizate in computerele actuale, datorită necesității dezvoltării unor masini-unelte capabile să realizeze piese complexe de înaltă precizie. Un mare impuls pentru dezvoltarea acestuia a fost dat de US Air Force, care dispunea de de suficiente resurse financiare pentru stimularea cercetarii.US Air Force avea nevoie de îmbunatatiti în constructia avioanelor cu motoare cu reacție. Initial, primele mașini CNC utilizau lămpi electronice și vacuum. Aceste mașini aveau o serie de dezavantaje precum: producerea de căldură în exces, ocuparea unui volum destul de mare, fiabilitate scăzută, executarea numai a câte unei instrucțiuni. Următoarele generații au fost dotate cu tranzistori (ce înlocuiau tuburile electronice), iar controller-ul ocupa un spatiu mai mic. În present, mașinile cu comandă numerică au la baza tehnologia microprocesoarelor si a calculatorelor actuale.

INTRODUCTION

By its definition, the numerical command machine-tool is a complex equipment endowed with numerical control systems of displacements. They are also called CNC s and are equipped with a memory able to store the software. Numerical control generally refers to automation of machine tool processes by programming a series of commands to be registered (Code-G), respectively programmed on an external device.

Numerical control consists in a continuous feeding" process of a special built controller programmable with a set of instructions (made of letters and figures) so that the movements of machine tool be controlled. (www.wikipedia.com)

These machine tools are able to achieve high precision production. At the current moment, machine-tools with numerical command assure a high performance processing precision starting from±(0.015–0.02) mm.in case of centres of processing up to la ±0.003 mm, in case of hole-punching machines according to coordinates. (Levente. 2010)

Researchers have been concerned to develop a calculation algorithm related to energy consumption of all actors involved in operations and production tasks in working places endowed with CNC machines. (*Safarov D. T.*. 2017)

Certain conventional machines and CNC were developed by using software 3D - CATIA V5. (*Morales-Palma D.*. 2017)

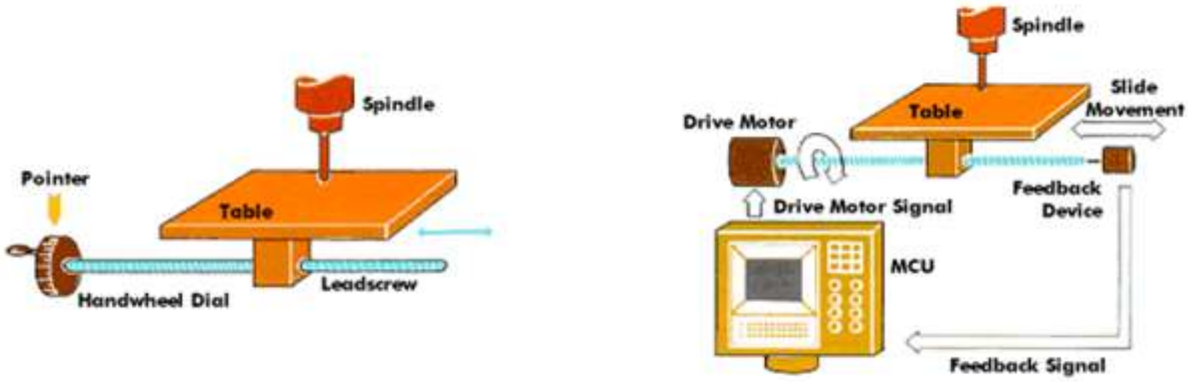
Integrated approaches of planning process and cutting parameters optimization process were proposed in order to diminish the total energy consumption of CNC processing and balance the machine working volume in workshop. (*Li L.*. 2017)

MATERIAL AND METHOD

CNC is the abbreviation of “Computer Numerically Controlled”. Denomination of CNC always refers to the machine operation manner, namely the basis method to control the movements, but does not refer to the type of machine: bending machine, lathe, milling machine or others.

Numerical control consists of a continuous” feeding'' process of a special built controller programmable with a set of instructions (made of letters and figures) so that the movements of machine tool be controlled. These machines lead the cutting tools towards certain paths previously established with a precise rotation speed and forward speed.

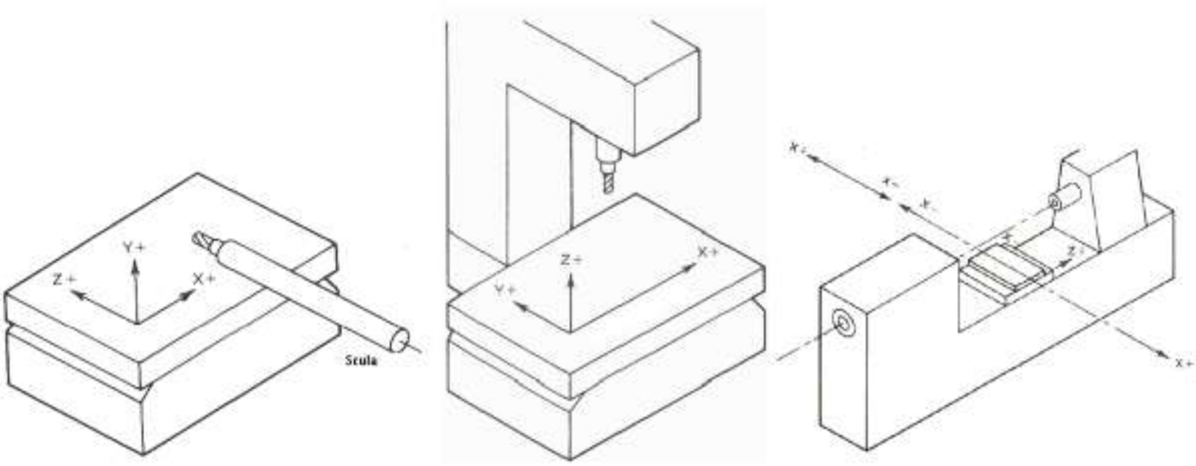
Precise and strict control of movement represents the most important function of any CNC machine. All CNC equipment has two or more movement directions, called axes. They can be moved with precision and placed exactly along the interval of displacement. The most known types of axes are linear and rotation axes (curvilinear motion).



(a) (b)

Fig.1 – Differences between a classic machine, manually actuated (a) and a numerical controlled machine (b) [5]

Most CNC machines are able to move in three simultaneous directions (x,y,z). These are called the axes of the machine.



(a) (b) (c)

Fig.2 – Examples of axes notations: milling machine with horizontal axis (a)-horizontal, (b)-vertical, (c)-lathe [5]

A CNC machine must be able to communicate with itself in order to operate. One central unit with computer for numerical control sends positioning commands to engines. Special transducers fixed on the machine axes should transmit to central unit the fact that engines have correctly operated and moved the axes at the commanded distance. The machine skill of displacing a central point (the processing tool) in three directions at the same time allows it to follow any trajectory or surface within the working space. All the motions are more rapid and more precise than those that can be performed by an operator.

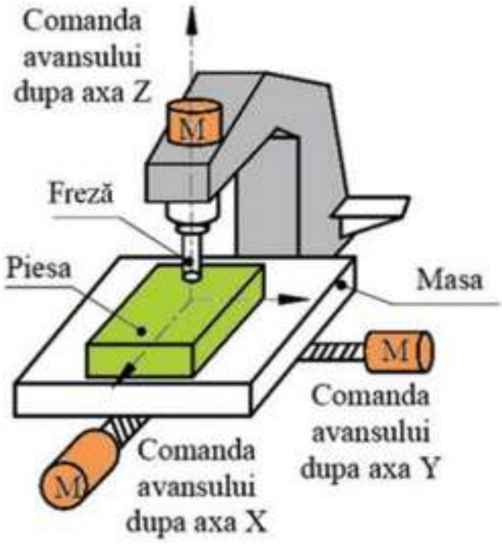


Fig.3 – Constructive scheme of a numerical control milling machine [6]
1. Advance control on axis Z; 2.milling device; 3. Part; 4mass;5. Advance control on axis Y;6. Advance control on axis X.

RESULTS

A CNC machine is made of two major components beside other auxiliary equipment. The first component is the machine-tool, namely a lathe, a milling machine, a punching machine, a boring mill, a grinding machine, a slotting machine, a cutting machine with water jet or laser, etc. The second component is the controller necessary to coordinate the cutting tool motion. Optional or necessary accessories may be added to the two components above. The machine tool has a special construction..

The first requirement in designing a high quality machine tool is the rigidity. Axis must have a minimum deflection under load for not influencing the processing precision. Axes are usually driven by a mechanism of screw-nut type with recirculation balls.

CNC universal lathes are endowed with an automated changing system of tool and tool supports, on which ten up to twenty different tools can be mounted. They can be used for tapping, drilling, threading, etc.

Fig.4 – CNC lathe [7]

Table 1

Example of a CNC lathe characteristics

CNC lathe	Characteristic
Automated feeding	1200 mm
Max. diameter of turning	85 mm
Axis inner diameter	42 mm
Revolution speed of main axis	4000 rpm
Maximum turning length	170 mm
Power of main engine	5.5 kW
Tool store (turret VDI)	10 positions

Fig.5 – CNC milling machine [7]

Table 2

Example of a CNC milling machine characteristics

CNC milling machine	Characteristic
Working table	600x360 mm
Displacement X/Y/Z	510x350x250 mm
Main engine power	5.5 Kw
Main axis revolution speed	12000 rpm
Tool store ATC	20 positions BT30

CNC universal milling machines have automated tool changing systems and are endowed with a tool store comprising tens up to hundreds of different tools. Often, the tool rotation axis is vertical. Some machines may have four or even five axes. The last two are rotation axes and enable the machine to punch holes and surfaces under different angles in the part. They can achieve both the roughness milling and also rectification (finishing). Such a machine with 5 axes can process by itself a boat propeller.

Fig.6 – CNC punching machine [8]

Table 3

Example of a CNC hole punching machine characteristics

CNC hole punching machine	Characteristic
Number of horizontal axes	1
Revolution speed	6.000 rpm
Hole punching run	920 mm x80 mm x 40 mm
Min/max. dimensions of drill	6 mm x 25 mm / 10 mm x 40 mm
Feeding vibration tank with taps	1
Pressing pistons for fixing the bench mark	4
Weight	450 Kg
Overall dimensions	1.850 mm x 1.600 mm x 1.850 mm

Fig.6 – Block boring machine CNC [9]

Table 4

Example of characteristics of a CNC boring machine

CNC boring machine	Characteristic
Maximum motion on vertical	670 mm
Table surface	1340 mm × 370 mm
Adjustable revolution speed of axis	75÷850 rpm
Boring interval	30÷170 mm
Main engine power	1 kW
Weight	1380 Kg
Overall dimensions	1860 mm x 1150 mm x 2170 mm

Fig. 7 – CNC oxigas and plasma plate cutting machine [10]

CONCLUSIONS

Advantages of using CNC machines are the following:

- flexibility in manufacturing one part according to program loaded. In order to manufacture another part is needed only a simple operation of reloading the new program within the memory;
- CNC machines are able to perform an operation that the machine tool cannot do (3D space outline - in three dimensions, which is impossible to obtain with a classical machine tool);
- repeatability: one CNC machine will perform 10, 100, 1000, or more identical parts, without any deviations (excepting the wear of the machine and tool);
- reduce and eliminate the costs related to stock production;
- diminish the costs of special tools and machine preparing time;
- reduce the qualification time of operators;
- reduce the workforce necessary (number of hours man-machine);
- increase products quality;
- increase productivity;
- increase reliability;

The advantages above are due, generally, to technical progress brought by numerical command and they are much more visible in case of computer programming.

Disadvantages of CNC machines:

- Big investments, the price of one CNC complex machine of large dimensions reaching hundreds of thousand of Euros;
- CNC machines must be programmed;
- They suppose great maintenance costs;
- High production costs for small series.

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PERFORMING METHODOLOGY BY 3D PRINTING TECHNIQUE OF SOME PARTS DESIGNED TO URGENT REPAIRS PROVIDED BY MECHANO-ENERGETIC SERVICE WITHIN MACHINES MANUFACTURING COMPANIES
/
METODOLOGIE DE REALIZARE PRIN TEHNICA IMPRIMĂRII 3D A UNOR PIESE DESTINATE UNOR REPARATII URGENTE FURNIZATE DE SERVICIUL MECANO-ENERGETIC DIN CADRUL UNOR INTREPRINDERI CONSTRUCTOARE DE MASINI

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Keywords: *3D printing, FDM technology, ABS material (acrylonitrile butadiene styrene).*

ABSTRACT

The 3D printing industry has grown in recent years developing also the ways in which an object can be created. FDM (Fused Deposition Modelling) technology, also called Thermoplastic Extrusion (Fused Deposition Modelling) is the most commonly used technology for manufacturing, technology also called 3D Printing. The paper presents a methodology for making parts designed to urgent repairs provided by the mechanic-energetic service within some machine building enterprises, by 3D printing with the FDM technology. The methodology addresses those services that want to accomplish in a short time some objects of high complexity and relatively small size, at lower prices than traditional methods, using modern computerized modelling and 3D printing

REZUMAT

Industria imprimării 3D a cunoscut o creștere in ultimii ani, dezvoltând-se si modalitățile prin care un obiect poate fi creat. Tehnologia FDM (Fused Deposition Modeling).denumita si Extrudare Termoplastica (depunere de material topit) este cea mai utilizată tehnologie de fabricare aditivată, tehnologie numita și Imprimare 3D. În lucrare este prezentată o metodologie de realizare a unor piese destinate unor reparații urgente furnizate de serviciul mecano-energetic din cadrul unor întreprinderi constructoare de mașini, prin imprimarea 3D cu tehnologia FDM. Metodologia se adresează acelor servicii care doresc să realizeze în timp scurt anumite obiecte de o complexitate ridicată și de dimensiuni relativ mici, la preturi mai mici față de metodele tradiționale, folosindu-se de tehnologia modernă de modelare computerizată și imprimare 3D.

INTRODUCTION

3D printing (Conner BP. et al.. 2014) is also known under other names, more or less similar, such as AM manufacturing (additive manufacturing), rapid manufacturing (rapid manufacturing), or rapid prototyping (RP) . Other less common names are digital manufacturing, layered manufacturing, or DMF manufacturing.

Given the multitude of technical terms, quite new for many Romanian users, we will continue to use English terminology (used by connoisseurs) as well as Romanian names, not yet generalized .

The 3D printing technologies used so far are the following (Hod Lipson and Melba Kurman, 2013):- FDM – Fused Deposition Modelling

- SLA – Stereo lithography
- DLP - Digital Light Processing
- SLS - Selective Laser Sintering
- SLM - Selective Laser Melting
- 3DP - Three-dimensional inkjet printing
- LOM - Laminated Object Manufacturing
- PJP - PolyJet Printing

FDM (Fused Deposition Modelling) or Thermoplastic Expanding Modelling (melting) is the most used manufacturing technology for its simplicity and affordability. It is used in modelling, prototyping, but also in production applications. Other names are: MEM (Melting Extrusion Modelling), Thermoplastic Extrusion (TPE), FFF (Fused Filament Fabrication). (http://3d4all.ro/2016/06/13/tehnologii-de-printare-3d/).

With a dedicated software application, the desired 3D model is initially sliced into cross sections called layers. The printing technology consists in passing a plastic filament through an extruder that heats it to the melting point. then applying it uniformly (over-extruded) over the coat with high precision to physically print the 3D model according to the CAD file Ian Gibson, David W, Rosen and Brant Stucker, 2010).

The head (extruder) is heated to melt the plastic filament, moving both horizontally and vertically, under the coordination of a numerical control device controlled directly by the CAM application of the printer. On the move, the head puts a thin strip of extruded plastic that cools immediately upon cooling, sticking to the previous layer to form the desired 3D model.

Materials used: ABS (acrylonitrile butadiene styrene), PLA (polylactic acid), PVA (soluble), PC (polycarbonate), polyethylene HDPE, polypropylene, elastomer, polyphenylsulfones (PPSU) http://www.print3dbucuresti.ro/tehnologii-materiale-printare-3d/materiale-printare-3d

This office-friendly silent and secure technology can produce objects and parts usable in a fairly wide range of materials. The price is extremely affordable for 3D printers (kits and assembled models) as well as supplies (plastic filaments). Production technology is simple, which means ease of use (https://www.3dhubs.com/trends).

In this paper, the design and production of a special key for the clamping of a KM30 bearing lock was carried out for urgent repairs provided by the mechanical-energy service. The 3D print of the piece was made of a material made of ABS (acrylonitrile butadiene styrene). The method of obtaining was as follows:

- 3D design of the piece in a CAD program (SolidWorks) and verification with a static analysis application (SolidWorks Simulation);
- Effective printing of the composite layer;
- Dismissing the piece.

MATERIAL AND METHOD

The 3D printer used is the 3D UP Box model (Figure 1), which uses FDM (Fused Deposition Modelling) technology. This technology has used ABS plastic glass fibre material. This type of material has good properties in terms of strength, flexibility, extrusion temperature, etc.

The printing process with FDM technology was as follows:

- Pre-processing: The 3D printer software has positioned and divided the piece obtained in 3D CAD design software (SolidWorks). It, then calculated the extrusion path of the thermoplastic material and the need for the support material, this information being shown in the printer software together with the working time for the model.

- Processing: The printer has heated the solid plastic (ABS), bringing it to a semi-liquid state, and is then deposited in the form of ultra-fine drops along the extrusion path layer overlay. Wherever a support was needed, additional material was deposited as a support material for the geometric construction.

- Post-processing: The support material was removed by breaking, after which the work piece was deburred and ready to use.

Fig. 1 - UP Box 3D Model Printer (http://www.zspotmedia.ro/printer-3d-profesional-desktop-p725.html)

For the design of the work piece a CAD program, namely SolidWorks, was used. In this program the sketch was drawn and the Extrude command made the piece to the desired thickness.

3D printing was performed at room temperature by communicating directly with a computer. At the end the piece was detached from the print bed with a cutter, and then it was deburred.

The main features of the ABS thermoplastic material used for 3D printing are shown in Table 1.

Table 1

ABS theroplastic material characteristics

3D printing material type	ABS-ALB
Printing temperature	240-245°C / 243-248°C
The temperature of the first layer	230°C / 232°C
Base material	Acrylic/ABS
Filament diameter	1.75mm
Printing capacity	net weight of 700 g; 1g-approx. 1cm^3

The mechanical properties of ABS as a 3D printing material are represented by high tenacity, good stiffness, high surface hardness and very good dimensional stability. ABS has a good resistance to heat.

RESULTS

The first stage consisted in building 3D model for the special key. In figure 2, an isometric axonometric view of the CAD model (Zhiyi P. et al.. 2015) is presented with the help of CAD system Solidworks 2013 (www.solidworks.com/sw/products/3d-cad/packages.htm).

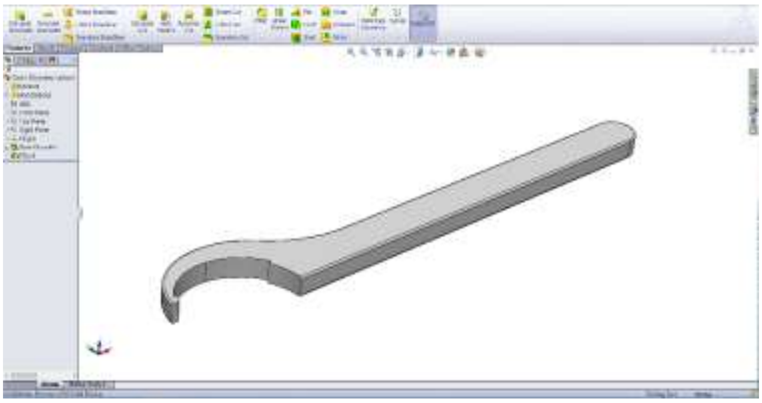

Fig. 2 - Isometric axonometric view of the CAD model

The static analysis assumed (Lăutaru M.. Babeu T. D., 2011):

- Selection of static options as a solid type for mesh type and FFEPlus solver (Figure 3);

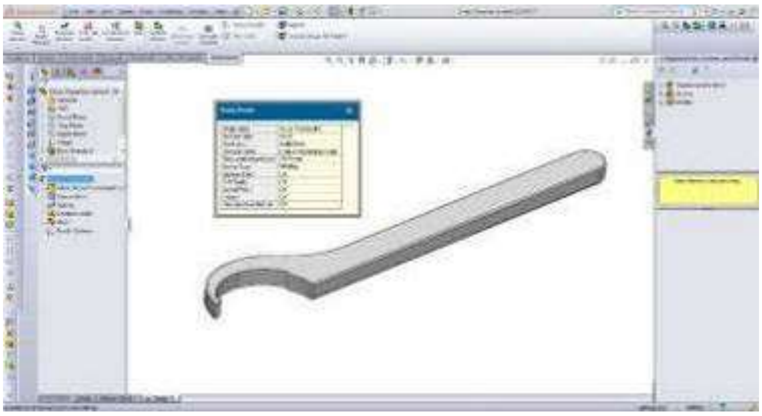

Fig. 3 - Selection of static options as a solid type for meshing type and FFEPI solver

- Selecting the material from the SOLIDWORKS 2013 library and automatically assigning it the properties defining the characteristics of the material (figure 4).

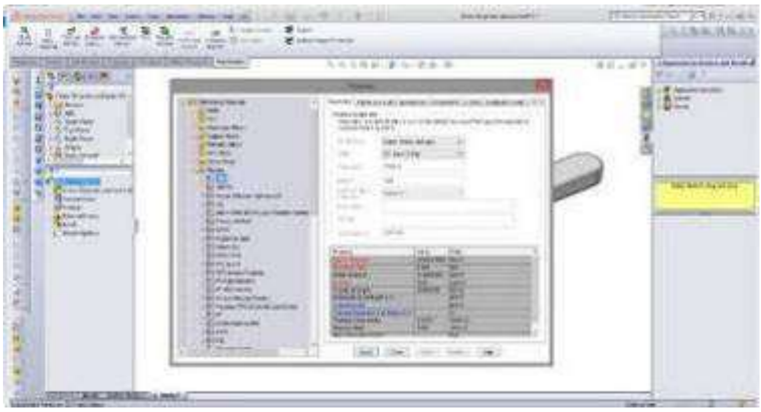

Fig. 4 - Material selection from SOLIDWORKS 2013 library

- The application of the corresponding resultant result of the elementary cutting forces R (figure 5). In accordance with the operation real mode of the special key, the simulation scenario was adapted accordingly. The load was applied at the point corresponding to the angle α formed by the horizontal force R (figure 5).

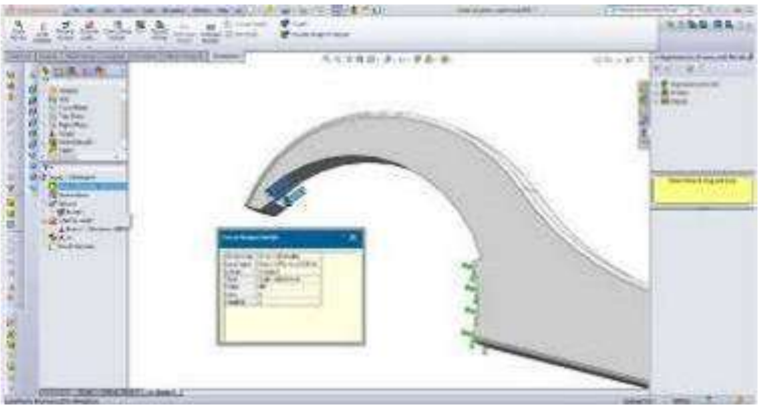

Fig. 5 - Applying the corresponding load result of the elementary cutting forces

- Using the „meshing procedure" to break the pattern into discrete elements. In general, a finite element model is defined by a network, which is completely accomplished from a geometric arrangement of elements and nodes. Nodes are points in which characteristics are calculated, such as displacements (Figure 6).

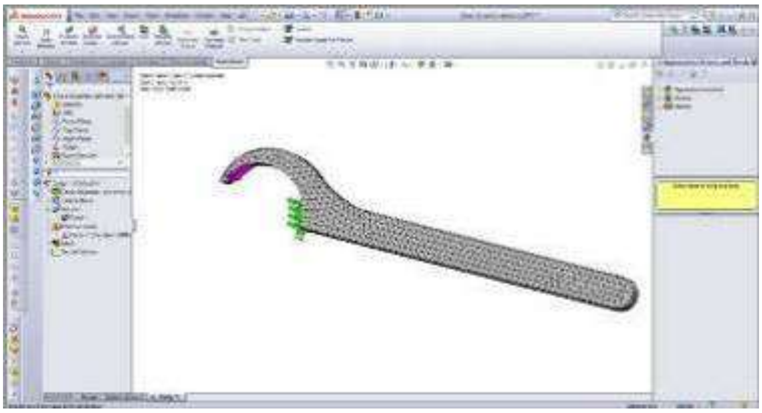

Fig. 6 - 3D model meshed into a finite element network

Running the analysis study to calculate the tension and displacement based on geometry, material, load, restriction conditions and meshing type (Figures 7, 8).

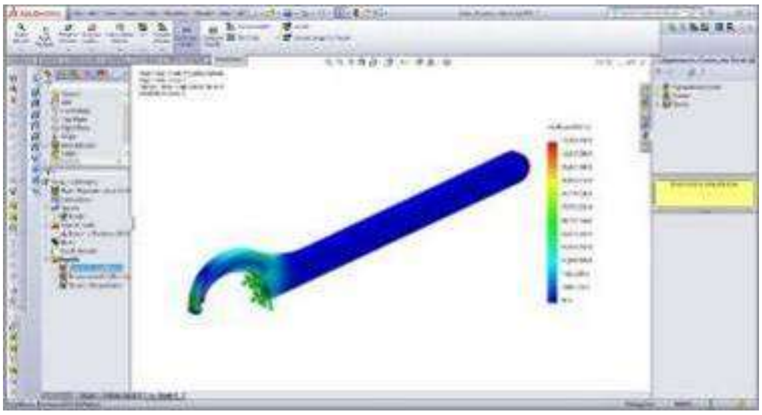

Fig. 7 - Sequence of voltage distribution von Mises

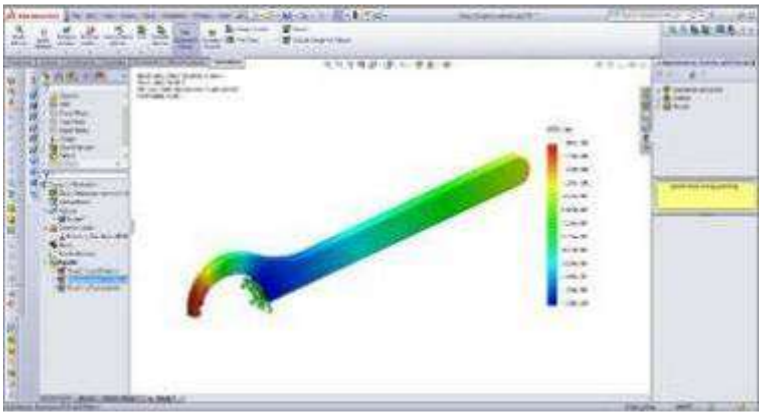

Fig. 8 -Sequence of displacement distribution

The second step was to set the print parameters (the size of the filament out of the nozzle, the extrusion temperature, the heated bed temperature, the filling degree and the inner topology, the print speed) manually entered commands in the printer program and effective composite printing, layer with coat. One aspect of the UP Box model preparation is shown in figure 9, and one aspect of the actual printing is shown in figure 10.

Fig. 9 - Aspects during print parameter settings

Fig. 10 - Aspect during printing

The third step was to detach the piece by means of a cutter, removing the support and debarring.

Nowadays, 3D printing is used only for prototyping and moulds and this is why in the present paper the authors come up with a proposal for printing methodology for any type of object. As far as the costs involved for materials and equipment are concerned, they are amortized by reducing processing time and resources, compared to standard classics.

CONCLUSIONS

"Such structures can be accomplished with little effort, in a short time and with a minimal loss of material, with the possibility of rapid manufacturing."

- The methodology addresses those services that want to achieve in a short time certain objects of high complexity and relatively small size, at lower prices than traditional methods, using modern computerized modelling and 3D printing technology.

ACKNOWLEDGEMENT

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ANALYSIS OF THE RESEARCH STAGE REGARDING THE CONSTRUCTIVE OPTIMIZATION OF TANK-CONTAINERS FOR LIQUID AGRI-FOOD PRODUCTS
/
ANALIZA STADIULUI CERCETĂRILOR PRIVIND OPTIMIZAREA CONSTRUCTIVĂ A CONTAINERELOR-CISTERNĂ PENTRU PRODUSE AGRO-ALIMENTARE LICHIDE

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Keywords: *tank-containers, constructive optimization, pressure vessels, stresses distribution, static and dinamic analysis.*

ABSTRACT

Choosing optimal structural characteristics of equipment of tank-container type for agri-food products continues to expose the need for research on their optimization.The paper presents the results and methods of experimental research approached at world level, on constructive optimization of tank-containers (static and mobile) used for liquid agri-food products.

REZUMAT

Alegerea optima a caracteristicilor constructive ale echipamentelor tip container-cisterna pentru produsele agro-alimentare expune in continuare necesitatea unor cercetari privind optimizarea acestora. In lucrare sunt prezentate rezultatele si metodele unor cercetari experimentale abordate la nivel mondial privind optimizarea constructiva a constainerelor-cisterna (statice si mobile) utilizate pentru produsele agro-alimentare lichide.

INTRODUCTION

Storage,transport and handling as quickly as possible and efficient agri-food products in a good condition to the user, leads research to find new optimization solution of tank-containers.

Tank-containers have been in wide use for many years in many applications such as irrigation, agriculture, agricultural farming, both for plants and livestock, chemical manufacturing, food preparation as well as many other uses. Factors such as vessel material, the shape, chemical composition and physical substances used in it, the environment of tank-containers factors among which each can have different effects on performance of pressure tank-containers.

In this paper I will highlight methods and optimization research of the construction parameters of the tank containers performed by researchers worldwide.

In order to achieve the optimization of results, they took into account both dynamic and static forces, that work on the tank containers. Irrespective of the nature of liquid agri-food products on the containers the following factors act.

Pressure vessel is a closed container designed to hold gases or liquids at a pressure different from the ambient pressure. It is applied with a differential pressure between inside and outside. In the field of pressure vessel design, welded pipe nozzles and welded nozzles of vessels are generally subjected to high loads, because of nozzle necessary for the exchange of fluid or gas causes high stresses at the edge of opening merely caused by operating pressure. This basic load is overlaid by additional loads due to connected pipe.[2]

Damaged tanks containing any hazardous material cause environmental polluation. Failure of tank results in very destructive hazards on life and property. Seismic study of tanks ise essential for strengthening the tank's performance and thereby damages can be reduced. Seismic analysis of tank-container is much complicated due the fluid structure interaction of the system. Fluid inside the tank is divided as impulsive and convective liquid mass, and both are induced hydrodynamic pressure on tank wall and base. Seismic energy is tranferred to the fluid from ground due to movement of tanks. Soil structure interaction is another parameter which significantly effects on tank's performance. Interaction of tank with surrounding soil structure will be different, based on soil properties such as elastic properties, cohesion, angle of friction, e.g. Response of elevated tanks and ground supported tanks are different, based on their support conditions provided. Container height, geometry, soil denseness, types of foundation, damping parameters are some of the factors influencing tank response under different types of loadings.[6]. [7].[8].[10].[11]

MATERIAL AND METHOD

Structural analysis of a tank-container is a common task in manufacturing industry as it is necessary to keep the design within standards, keep costs down and provide a robust and reliable design. It is also an interesting finite element analysis problem, since it requires the utilization of the shell meshing technology for accurate stress calculation, where a common solid meshing strategy turns out to be harder to implement and impractical regarding the computational cost for matching the accuracy levels of the calculations.[3]

Tanks will be constructed and manufactured in accordance with the provisions of the approved technical regulations so as to the choice of the material and the determination of the thickness of the walls are made according to temperatures of design and operating.

These tank containers are made of corrosion resistant materials with certain physico-chemical properties that do not allow their interaction with the fluids transported to alter their quality.

Tank are constructed from aluminum, carbon steel, stainless steel, or fiberglass-reinforced plastic, depending on the product being transported by the truck.

Food grade tank-container are required to meet stringent safety and sanitation codes before they are certified to transport foods.

The methods of analysis used to optimize the construction parameters of international tank-containers are as follows :

1. Design and analysis of a tank container pressure vessel using finite element method

In the article published in World Journal of Modelling and Simulation, researchers from Faculty of Electrical, Mechanical and Construction Engineering **[1]** used two types of analyses that are commonly applied to pressure vessels. The most common method is based on a simple mechanics approach and is applicable to thin-walled pressure vessels which by definition have a ratio of inner radius. R, to wall thickness. t. of r/t 10. The second method is based on elasticity solution and is always applicable regardless of the r/t ratio and can be referred to as the solution for thick-walled pressure vessels. Finite Element Analysis (FEA) is a practical tool in the study of pressure vessels, especially in determining stresses in local areas such as cavities. O-ring grooves and other areas difficult to analyze manually. Studies in the literature mostly involve analysis of temperature, stress and displacement of vessel's wall with transient boundary conditions and usually implement purely numerical methods that require complex calculations with powerful computers. On the other hand, if the boundary conditions are constant (the static condition), the temperature, stress and e.g. can be calculated using analytical methods. In this study,a new numeric-analytical method for calculating the transient stress and displacement is introduced, by which the calculation time is reduced compared to other numerical methods. For this purpose, the temperature variation with the time is calculated using finite difference method, and then by using stress and displacement equations as a function of temperature and radius of the wall, the wall static displacements and stresses are defined. In order to validate the results, those variables are also calculated by numerical "finite difference" method and MATLAB commercial software. Furthermore, finite element analysis of a thin-walled pressure vessel under simultaneous thermal and pressure loading is investigated using simulation-based method by FE-based computer code ANSYS. The Von-Mises yield criterion has been used to determine the distribution of stress intensity. The results are obtained and compared by both methods and a good agreement between them is noticed.[1].[12].[13].[14]

The ANSYS CAE(Computer- Aided Engineering) software program was used in conjunction with 3D CAD (Computer-Aided Design) solid geometry to simulate the behavoir of pressure vessel under thermal and pressure loading conditions. Since the shape of vessel and the applied forces are symmetric about the vertical axis and horizontal plane passing from center of the vessel, it is enough to model ¼ part of the vessel. Due to the mature of the vessel, the model was meshed with 125864 nodes three-dimensional shell structural elements.Each mode has three translational and three rotational degrees of freedom. The material is assumed to be isotropic and linear elastic. The vessel is made of stainless steel and its characteristics are presented in Table.1. [1].[12].[13].[14].

Table.1

Characteristics of stainless steel

Density	$\rho = 7750\frac{kg}{m^3}$
Young's Modulus	$190 \times 10^9 pa$
Poisson's ratio	0.305
Thermal expansion	$9.7 \times 10_{-6}\frac{1}{k}$
Specific heat	$486\frac{J}{kg \cdot K}$

Figure 1. shows the temperature distribution at t = 5 sec at the tank wall obtained by analytical and numerical method. The comparison of Von-mises stress at t = 5 sec for analytical and numerical methods is depicted in Figure 2.

Figure 3 and Figure 4 illustrate the variations of hoop stress and radial stress at the tank wall at t = 5 sec (the time when inner wall temperature reaches 500K) and after removing thermal load (i.e. t = 6 sec and t = 7sec) for both methods. Figure 5 shows the cooling of the inner wall with time. After removing the thermal load, due to the convection at the outer wall, stresses are rapidly reduced. Figure 6 demonstrates the comparision for tank deformation under thermal and pressure loadings at the tank wall. The results obtained indicate good agreement between analytical and numerical results.

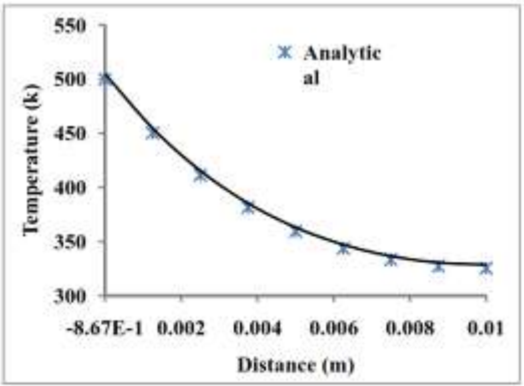

Fig.1 - Comparison of temperature distribution at the tank wall for two methods at t = 5 sec.

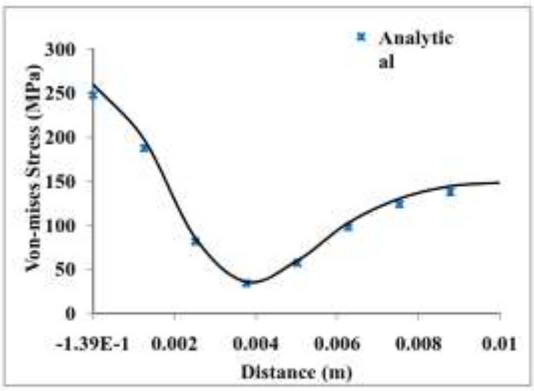

Fig. 2 - Comparison of Von-mises stress distribution at the tank wall for two methods at t = 5sec.

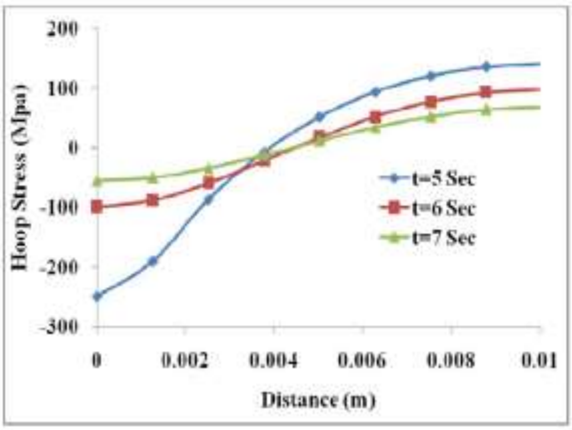

Fig. 3 - Comparison of Hoop stress distribution tank wall at t = 5,6,7 sec using analytical method

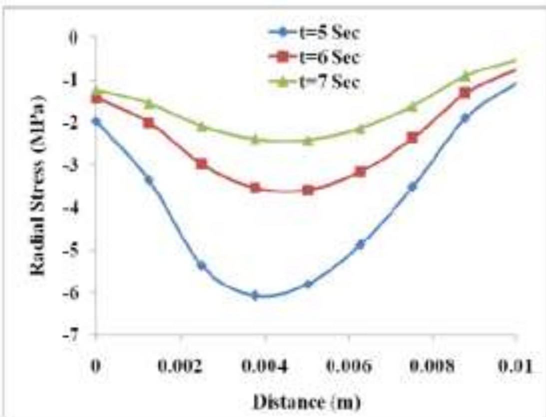

Fig. 4 - Comparison of Radial stress distribution at the at the sphere wall at t=5,6,7sec using analytical method

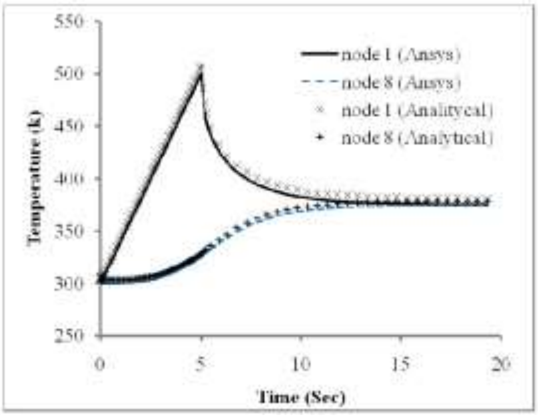

Fig. 5 - Comparison of temperature distribution sphere inner wall using analytical and numerical methods

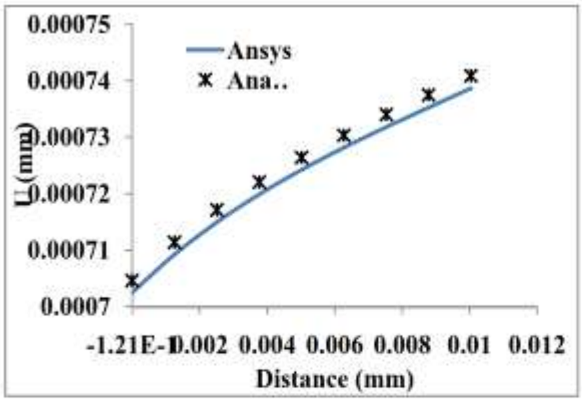

Fig.6 - Comparison of sphere deformation under the thermal and pressure loadings at the sphere wall using analytical and numerical methods

2. Static structural analysis of a tank container using SolidWorks

Reserchers from Faculty of Mechanical Engineering in the article published in American Journal of Mechanical Engineering [4] have analyzed three different thicknesses of walls of the tank designed for transportation on a truck in order to find appropriate stress and deformation states of structure. The structure was modelled according to drawing documentation Figure 7. The material used was stainless steel. The maximal lenght of the tank was 4533mm, the width in the top and bottom part of the body-2422mm,1005mm, respectively and the height of structure-1241mm.

The tank was modelled in SolidWorks. The walls were modelled as 3D bodies with ribs. Ribs are created from square tubes with dimensions 50x50x4mm.Thinckness of wall was set to 8mm for the first model. The boundary conditions for the structure are shown in Figure 8. The pressure is applied as nonuniform loading(i.e. hydrostatic pressure) with minimal value on the top and maximal value in the bottom (Figure 2).

The results of static analysis are given in the following figures. In Figure 9 is given the field of displacements and in Figure 10 -the field of equivalent von Mises stresses.The maximal displacement is 24.857mm and the maximal von Mises stresses is 370.635MPa. The maximal displacement (Figure 9) is on the front and the back side of structure,respectively. The maximal von Misses stress is again on these sides at the bottom part of rib in location of weld. The computed maximal values of displacements and von Mases for all variants are presented in Table 2. [4]. [5]. [9]

Fig. 7 - The 3D model (mesh) tank

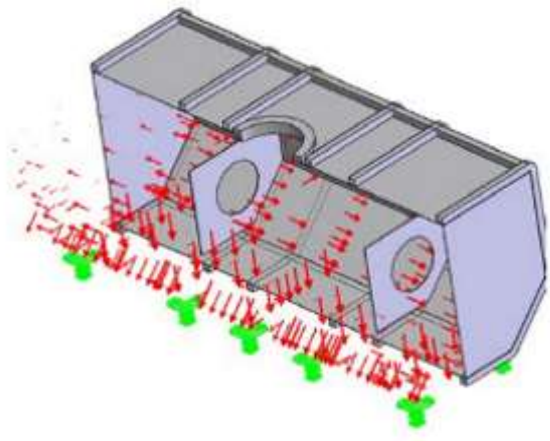

Fig. 8 - Boundary conditions applied of tank container

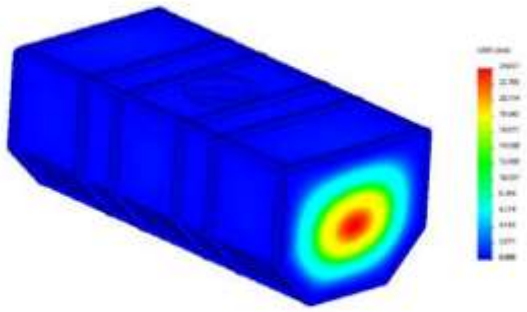

Fig. 9 - Displacement tank

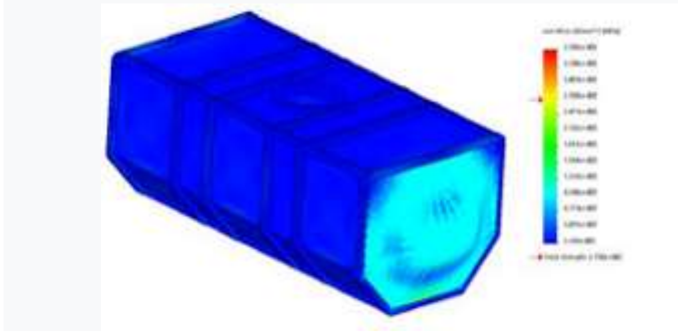

Fig. 10 - Stress plot for 8mm wall

Fig. 11 - The made tank on the truck

Table 2

Computed maximal values of displacements and von Mises stress for all variants

Var.	Thickness of sheets					
	3 mm	5 mm	8 mm	3 mm	5 mm	8 mm
	max. displacement (mm)			max. von Mises stress (MPa)		
0.	30.992	28.724	24.857	393.7	380.541	370.635
1.	7.828	3.361	2.468	183.872	127.277	108.066
2.	3.609	3.342	2.457	176.976	128.764	108.150
3.	3.609	3.342	2.457	176.369	128.290	108.031
4.	3.609	3.342	2.457	176.939	128.328	107.977
5.	2.788	1.623	1.261	145.764	68.471	54.047
6.	6.442	5.619	4.611	165.334	98.691	77.657
7.	2.791	1.480	1.047	145.379	68.091	49.252

RESULTS

Design and analysis of a tank container pressure vessel using finite element method

Nowadays, the finite element method (FEM) is the most popular and spread method of computation in continuum mechanics. A deformation variant has been expanded in practice. From numerical point of view it is numerical method of approximation of boundary problem.

The body (Figure 12) is replaced by union of set of subregions, which we call finite elements [4].[5]

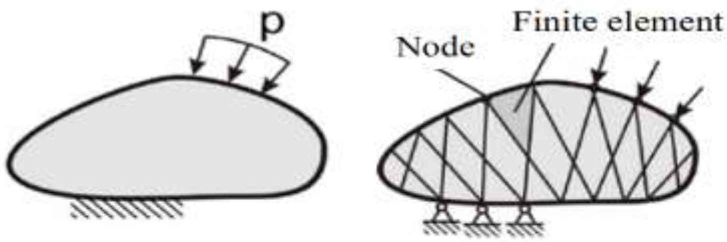

Fig. 12 - Solution of boundary problem [5]

The finite element method can be based e.g. on the principal virtual displacements. At the element level we can write equation

$$\iiint_V \delta\varepsilon^T \sigma dV = \iiint_V \delta u^T X dV + \iint_A \delta u^T p dA, \qquad (1)$$

Where $\delta\varepsilon.\sigma.\delta u$.X.p.dV.dA is variation of strain vector, stress vector, variation of displacement vector, body force vector, pressure vector,infinitesimal volume, infinitesimal area, respectively. [4].[5].[9]

Displacement u can be expressed as

$$\mathbf{u} = \mathbf{N} \cdot \mathbf{d} \qquad (2)$$

where N is matrix containing the shape functions and d is vector of node displacement.

Now, we have equation

$$\varepsilon = \mathbf{B} \cdot \mathbf{d} \qquad (3)$$

which expresses the dependence of the strain vector ε on the node displacement vector d and B is matrix containing derivatives of shape functions.

In case of linear elastic material, we have relation

$$\sigma = \mathbf{D} \cdot \boldsymbol{\varepsilon} \qquad (4)$$

where D is matrix of elastic constants.Further we use equation (3) and we get

$$\sigma = \mathbf{D} \cdot \mathbf{B} \cdot \mathbf{d} \qquad (5)$$

and final relation

$$\mathbf{k} \cdot \mathbf{d} = \mathbf{f} \qquad (6)$$

where k, f, is element stiffness matrix and nodal load vector, respectively. For the whole body we have equation

$$\mathbf{K} \cdot \mathbf{x} = \mathbf{F} \qquad (7)$$

where K is global stiffness matrix. F is resultant vector of load forces and x is displacement vector of the whole structure [4].[5].[9].

Design and analysis of a tank container using von-Mises yield criterion

Von Mises stress is a value used to determine if a given material will yield or fracture. It is mostly used for ductile materials, such as metals. The von Mises yield criterion states that if the von Mises stress of a material under load is equal or greater than the yield limit of the same material under simple tension — which is easy to determine experimentally —. then the material will yield.(Figure 13) [15]

The von Mises stress is a criterion for yielding, widely used for metals and other ductile materials. It states that yielding will occur in a body if the components of stress acting on it are greater than the criterion:

$$\frac{1}{6}[(\tau_{11}-\tau_{22})^2+(\tau_{22}-\tau_{33})^2+(\tau_{33}-\tau_{11})^2+6(\tau_{12}^2+\tau_{23}^2+\tau_{13}^2)]=k^2 \qquad (1)$$

The constant *k* is defined through experiment and τ is the stress tensor. Common experiments for defining *k* are made from an uniaxial stress, where the above expression reduces to:

$$\frac{\tau_y^2}{3}=k^2 \qquad (2)$$

If τ_y reaches the simple tension elastic limit. Sy. then the above expression becomes

$$\frac{S_y^2}{3}=k^2\frac{1}{6}[(\tau_{11}-\tau_{22})^2+(\tau_{22}-\tau_{33})^2+(\tau_{33}-\tau_{11})^2+6(\tau_{12}^2+\tau_{23}^2+\tau_{32}^2)]=\frac{S_y^2}{3}$$

Which can be substituted into the first expression

$$\frac{S_y^2}{3}=k^2$$

or. finally

$$\sqrt{\frac{(\tau_{11}-\tau_{22})^2+(\tau_{22}-\tau_{33})^2+(\tau_{33}-\tau_{11})^2+6(\tau_{12}^2+\tau_{23}^2+\tau_{13}^2)}{2}}=S_y$$

The von Mises stress. τ_y. is defined as:

$$\tau_v^2=3k^2$$

Therefore, the von Mises yield criterion is also commonly rewritten as:

$$\tau_v \geq S_y$$

That is, if the von Mises stress is greater than the simple tension yield limit stress, then the material is expected to yield.

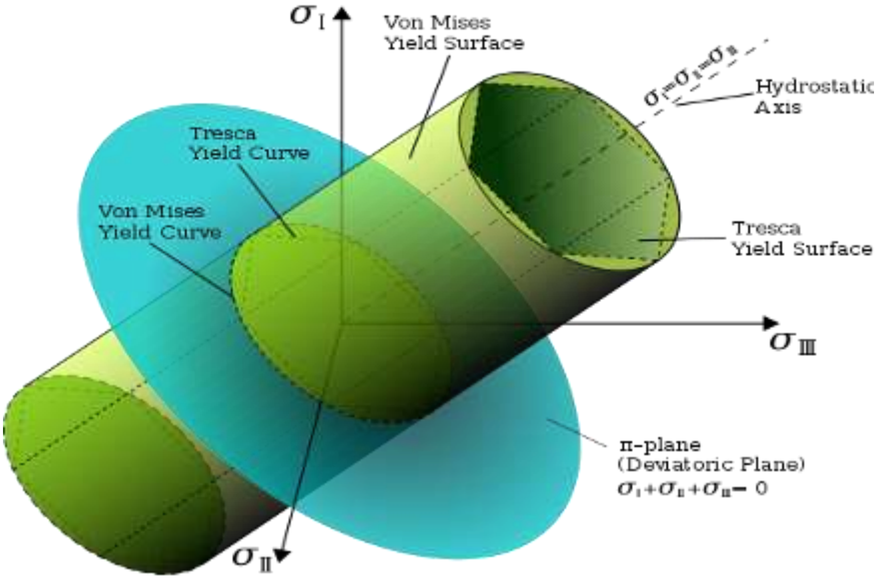

Fig. 13 -The von Mises yield surfaces in principal stress coordinates circumscribes a cylinder with radius $\sqrt{\frac{2}{3}}\tau_y$ [15]

CONCLUSIONS

Finite element method (FEM) is simple and faster for complex geometrics as compared to other methods. By using FEM as analysis tool, results achieved were within small range deviations from actual measured value. Hence by using FEM , it's easy to predict the pressure vessel limit load closer to actual measurement and it can be done at different preferred locations as per requirements.

The Von-Mises yield criterion has been used to determine the distribution of stress intensity. A new numeric-analytical method for calculation of transient temperature, stress and displacement of the vessel's wall is introduced.The variation of the wall temperature with time is calculated by numerical method to estimate the stress and displacement variations. The static equations are applied as functions of the temperature and radius of the wall.

The static structural analysis of the tank was performed by modelled 3D and the displacement plots and von Mises stress plots served for comparision of results.

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APPLICATION OF SYSTEMIC ANALYSIS METHOD OVER SOIL-TOOL INTERACTION /
CERCETARI ASUPRA INTERACTIUNII SCULA-SOL PRIN APLICAREA METODEI DE ANALIZA SISTEMICA

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Keywords: *soil-tool interaction, tillage tool, systemic analysis, tool draft, operation parameters .*

ABSTRACT

In the paper it is proposed to apply the method of systemic analysis on the interaction between the agricultural tool and the soil. This aims to obtain an analytical mathematical relationship describing the soil-tool interaction and its optimization in order to obtain the desired final soil state with the minimum energy consumed. Thus, starting from a simple functional equation through the decomposition of the system, a series of equations have been obtained that explain to a greater extent the complexity of the tool-soil interaction. As a direct application, a physical model is proposed which allows the quantification of the interaction between the operating parameters of the tool / agricultural aggregate and the tool advancement.

REZUMAT

În lucrare se propune aplicarea metodei de analiza sistemică asupra interacţiunii dintre scula agricola si sol. Prin aceasta se urmăreşte obţinerea unei relaţii matematice analitice care să descrie interacţiunea sculă-sol şi optimizarea acesteia în scopul obţinerii unei stări finale dorite a solului cu minim de energie consumată. Astfel, pornind de la o ecuaţie funcţională simplă prin descompunerea sistemului urmărit s-au obţinut o serie de ecuaţii ce explică într-o mai mare măsură complexitatea interacţiunii sculă-sol. Ca aplicaţie directă se propune un model fizic ce permite cuantificarea interacţiunii între parametrii de exploatare a sculei/agregatului agricol şi rezistenţa la înaintare a sculei.

INTRODUCTION

In the paper, it is proposed to apply the method of systemic analysis on the interaction between the agricultural tool and the soil. This aims to obtain an analytical mathematical relationship describing the soil-tool interaction and its optimization in order to obtain the desired final soil state with the minimum energy consumed. Thus, starting from a simple functional equation through the decomposition of the system, a series of equations have been obtained that explain to a greater extent the complexity of the tool-soil interaction. As a direct application, a physical model is proposed which allows the quantification of the interaction between the operating parameters of the tool/agricultural aggregate and the tool advancement.

Most studies are based on theoretical breakout mechanisms, empirical cutting relationships, or based on the theory of passive soil pressure extensively used in civil engineering. Experiments on agricultural soils have shown that soil rupture can be achieved by cutting, chopping, chipping or flowing and that it can not be generalized for all soil types and for all conditions. It has also been shown that current theoretical considerations are inappropriate in generalizing the problem since the effect of the value of the humidity, the influence of the stress-induced stresses, the cyclic breaking mechanism rather than the instantaneous breakage can not be taken into account by the current soil breaking theories. Rajaram and Erbach, 1997 highlight the importance of better understanding of breakdown mechanisms and the use of soil properties in situ in the development of theoretical models for applications in mechanical soil processing.

In accordance with soil characteristics or classifications defined in different standards, it is difficult to draw clear boundaries for the most important properties of typical soils, for example, there are currently no well defined methods for separating soils into homogeneous, isotropic, anisotropic by quantifiable features. For example, there are clay soils that behave differently depending on their composition and the moisture value. Some soils possess special properties that have not been considered in any model so far. Thixotropy, colloidal activity, dilatation and sensitivity to previously induced tensions are just a few difficult factors to introduce in the approaches to existing theoretical models (Terzaghi, 1959; Braja. 2013; Armin, 2014; Blednykh, 2015).

Considering the above and extrapolating the sculpture-soil interaction, it is more than difficult to define a generally valid model without understanding the general principles of the soil breaking mechanism and corresponding theoretical considerations which led to the presentation of the existing breaking patterns soil and soil-to-soil interaction, developed to date. Thus, the present paper aims to theoretically investigate the tool-soil interaction through the systemic analysis method and to propose a quantitative variant of the investigated elements.

MATERIAL AND METHOD

Soil processing through the interaction between the tool and the soil for the introduction of a certain amount of energy can be considered as a mechanical system (Gill and Vanden Berg, 1968; Ros, 1993; Gheres, 2014) for the transformation of the soil in order to achieve agro technical requirements. This schematically presented mechanical system (fig. 1) illustrates the complexity of the interdependencies between the influence factors of the quality of the soil work and the energy requirement.

The entry into the system (I) is represented by the initial properties and characteristics of the soil S_i and the energy W applied to the system to obtain at the output (O), the properties and the final characteristics of the S_f. soil, which can be represented by an equation of the form:

$$S_f = f\ (S_i, W) \tag{1}$$

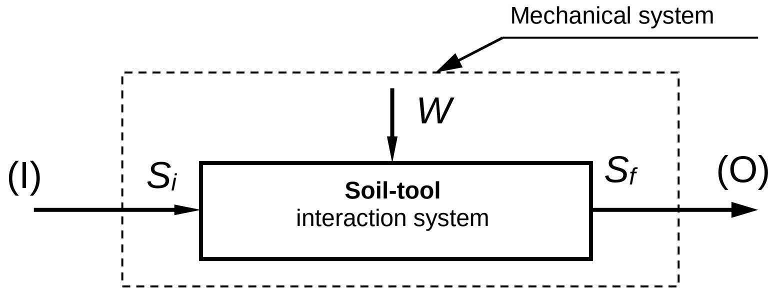

Fig. 1 - System representation of soil tilling process (adapted after Ros, 1993)

Expression (1) is called the functional relationship of the tool-to-ground system or the **behavioral equation** of the system. If the elements of the relationship above can be expressed and correlated in a quantitative manner, this will lead to an explicit mathematical equation that defines the soil processing. For this purpose it is necessary to decompose the functional relationship into a series of other relations, respectively the division of the system into a series of subsystems that allow quantification of the parameters involved in the process.

RESULTS

W energy can be expressed through relation:

$$W = \varphi\left(G_t, M, S_i\right) \tag{2}$$

Where, G_t characterizes the tool geometry and M movement module of this. As consequence, relation (2) may be represented like in figure 2 and written in the following way:

$$S_f = f\ (G_t, M, S_i\ ) \tag{3}$$

Every element of the equation (3) may be considered as a subsystem which can be described by own equations, respectively:

$$G_t = f_1(\alpha, \beta, \gamma, \theta, a, b, h, ...) \tag{4}$$

$$M = f_2(v_m, \omega, v, v', ...) \tag{5}$$

$$S_i = f_3(\rho, \rho_s, w, \tau_a, \tau_c, \mu, \mu', E, \sigma, \tau, ...) \tag{6}$$

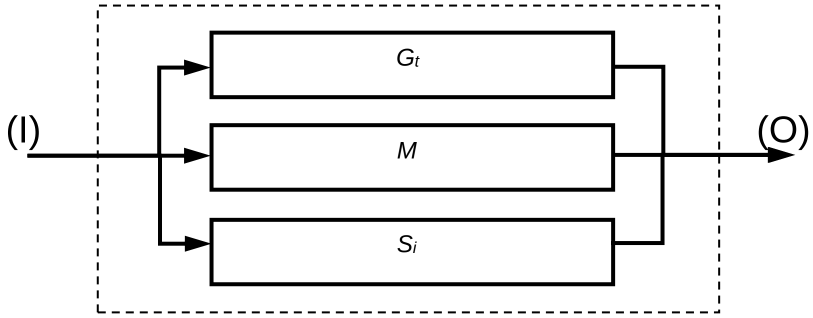

Fig. 2 - Decomposition of soil-tool interaction system into subsystems: G_t – tool geometric parameters subsystem; M – operation parameters subsystem; S_i – soil initial state system

Partial developments of the energy subsystem are achieved until subsystems can be described by a proper equation that expresses the process in quantitative sense.

The tool geometry sub-system can be further decomposed into subsystems that characterize: tool macro-geometry G_1, micro-geometry of work surfaces G_2 and geometry of their contour G_3.

$$G_1 = f_4\ (\alpha, \beta, \gamma, \theta, a, b, h, ...) \tag{7}$$

$$G_2 = f_5\ (R, R(\tau), S(\tau), A_r, \psi, ...) \tag{8}$$

$$G_3 = f_6\ (h, h_1, h_2, \chi, \chi_1, \chi_2, \varepsilon, \varepsilon_1, ...) \tag{9}$$

On the other hand, the energy required for the soil process W can be determined by summing its components, namely the amount of energy transmitted to the WU soil and the non-recoverable WP energy losses, both components being influenced by the initial state of the soil, the operating parameters of the aggregate and the working parameters of the working parts.

The energy subsystem represented by the block diagram of the system in figure 2.2 can be described quantitatively, mathematically, by means of:

$$W = W_U + W_P \tag{10}$$

$$W_U = W_t + W_m + W_d \tag{11}$$

$$W_P = W_{pi} + W_r \tag{12}$$

The amount of energy required to displace the soil Wt, respectively the horizontal and vertical plane cutting can be determined analytically depending on the soil resistance specific kt, the ground blade dimensions a·b, the geometry of the tool Gt. etc.. with a relationship of this kind:

$$W_t = \varphi_1\ (\ k_t\ ,\ a\ ,\ B\ ,\ ...\ ) \tag{13}$$

The energy component W_m is transmitted to the soil to overcome tensile forces, compression, shearing, bending and twisting forces opposed by the soil in the disintegration process.

The amount of energy needed to displace the soil Wd is given by the energy required to accelerate the soil particles on the work surface of the tools:

$$W_d = \varphi_2\ (\ m_s\ ,\ v\ ,\ a\ ,\ G_t\ ) \tag{14}$$

The energy losses due to the Wpi-soil interaction are determined by the friction forces between the soil and the tool F_f and by the F_{ca} soil adhesion forces acting on the tool while moving the soil on its surface:

$$W_{pi} = \varphi_3\ (F_{ca}\ , F_f\ ,\ M\ , G_t\ ) \tag{15}$$

Energy losses determined by aggregate displacement W_r. are due to tractor running resistance, namely:

$$W_r = \varphi_4\ (\ G_t\ ,\ F_t\ ,\ f\ ,\ i\ ,\ v_m\ ,\ ...\ ) \tag{16}$$

Continuing this reasoning, it is possible to describe physically any physical link between the factors that fall into the structure of the abstract terms.

In this way a system of equations can be developed and the system solutions can be determined according to the soil and tool parameters. Through such a generalized solution we can determine the interdependences between the system parameters and ensure their optimal setting.

In order to develop a mathematical relationship to quantitatively reuse energy consumption in soil processing, it is necessary to analyze and express the interdependencies between the parameters that intervene in the system: the parameters of the soil initial state, the geometric parameters of the tools and the operating parameters of the aggregate.

Thus, in order to optimize the soil working tool, the relation (1) showing the mode of soil-soil interaction in accordance with figure 3 (Kushwaha and Zhang, 1998) can also be written as:

$$R_t = \{F_H. \Omega\} = R(T_s. T_m. S_d. I_{st}) \quad (17)$$

$$S_f = S(T_s. T_m. S_d. I_{st}) \quad (18)$$

where R_t represent the tool response
F_H – the strength of the tool in the soil
Ω – tool wear
$R(\ )$ – tool function responce
T_s – tool shape
T_m – tool movement mode
S_d –soil dynamic responce
I_{st} – tool-soil interaction

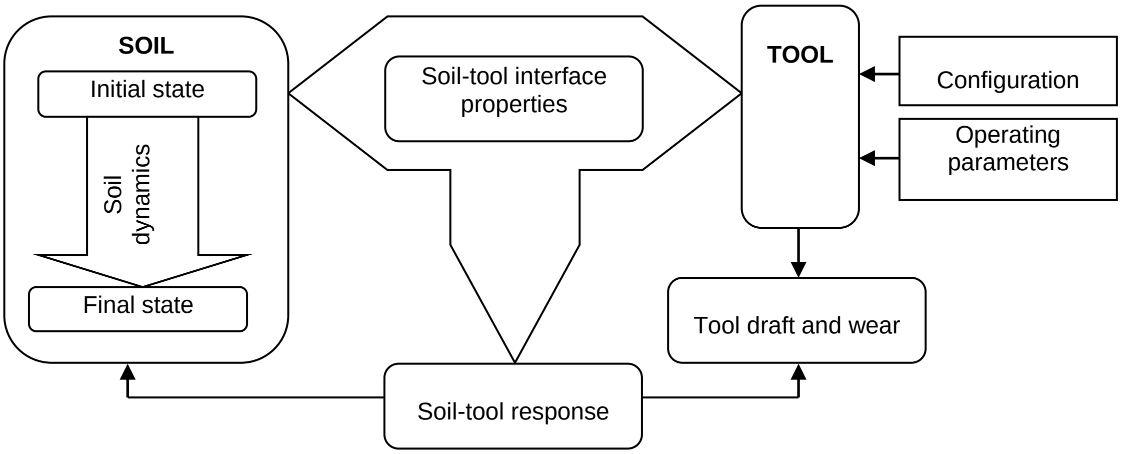

Fig. 3 - Soil-tool interaction schematics (adapted after Kushwaha and Zhang, 1998)

The design optimization function for the soil tool can be expressed as:

The objective function: Rt = {F. Ω} → min (19)

Restrictions: **Sf ≥ So** (20)

T (x. y. z) = 0 (21)

where T (x, y, z) represents the equation of the tool surface.

Obviously, this optimization feature is a multi-objective and multi-criterion. In order to be expressed in practice, equations (17) - (21) must be specified. Taking as an example a simple flat tool, the quasi-static cutting force is associated with the factors (Hettiaratchi. 1966) specified below:

$$F = f(\gamma . \varphi \, . \, c_c. \, \delta. \, c_a. \, a. \, b) \quad (22)$$

In accordance with the above relations and with the scheme presented in figure 3 during the future researches, part of the relations that will lead to the obtaining of a quantifiable mathematical model of the sculpture-soil interaction will be traced as it is shown in the figure below.

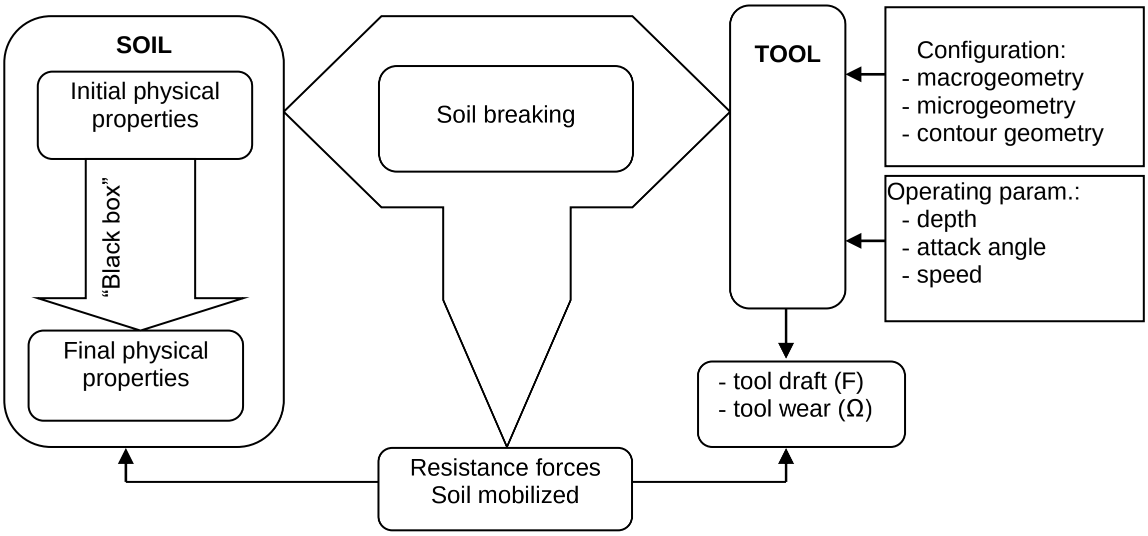

Fig. 4 - Layout of soil-tool interaction - an application

In order to be able to investigate the above, a test stand was designed and made in laboratory conditions, allowing the above mentioned indicators to be obtained. For this, a portable loading tool delivery system has been considered, as schematically shown in figure 4. Also, the realization of a frame assembly as shown in figure 5 allows the adjustment of a set (A ... D) of tool position adjustment parameters.

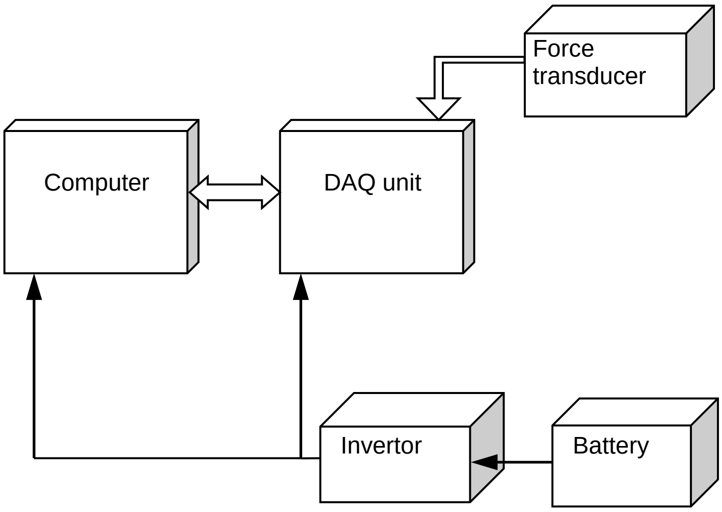

Fig. 5 - DAQ system schematics

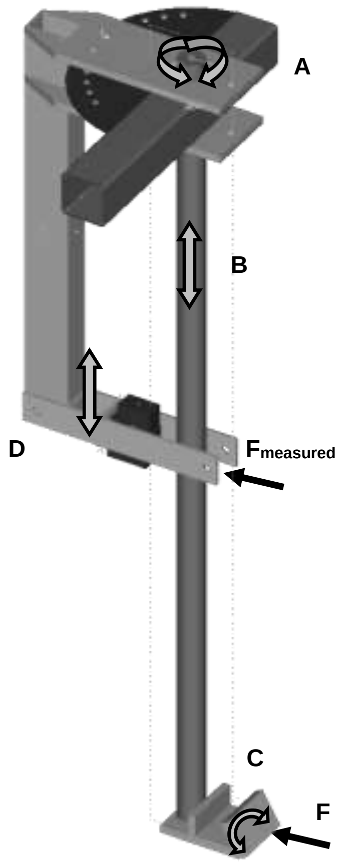

Fig. 6 - Tool assembly

CONCLUSIONS

The method of systemic analysis is a powerful method of investigating the difficult quantifiable phenomena that allow the mathematical bases to establish a functional relationship of the observed phenomenon.

By applying this method, in the case of the scula-sol interaction, the decomposition of the land breaking phenomenon was accomplished as a "black box" system in a series of subsystems that can be easily quantified by analytical relations. Thus, functionally, there were defined the elements that competed to achieve the scula-soil interaction. Also, a model was presented that allows the quantification of the interaction between the operating parameters of the soil working tool and the resistance to its advancement.

Continuing the investigation through this method can lead to the establishment of a series of analytical relations that will lead to the understanding of the interaction between the agricultural tools and the soil processed by them, respectively, to obtain a desired final state of the soil with minimal energy.

ACKNOWLEDGEMENT

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MODERN TECHNOLOGIES OF ALGAE BIOMASS USED FOR OBTAINING ALTERNATIVE FUELS /
TEHNOLOGII MODERNE DE UTILIZARE A BIOMASEI ALGALE PENTRU OBTINEREA DE COMBUSTIBILI ALTERNATIVI

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Keywords: *algae, biodiesel, biogas, technological equipment.*

ABSTRACT

Since classical fuel reserves are exhaustible, mankind is moving towards finding new sources of energy based on renewable, inexhaustible and environmentally friendly resources. Biogas and biodiesel are unconventional energy sources resulting from a natural controlled conversion process of biomass. In recent years, major research has been carried out on algal biomass conversion technologies in biogas and biodiesel. New types of digesters, power systems, storage facilities and a whole range of other equipment have been introduced and adapted.

REZUMAT

Deoarece rezervele clasice de combustibili sunt epuizabile. omenirea se îndreaptă spre găsirea de noi surse de energie bazate pe resurse regenerabile, inepuizabile şi ecologice. Biogazul si biodiesel-ul sunt surse de energie neconvenţionale care rezultă în urma unui proces de conversie naturală controlată a biomasei.În ultimii ani, au fost efectuate importante cercetări cu privire la tehnologiile de conversie a biomasei algale în biogaz si biodiesel. Au fost introduse şi adaptate noi tipuri de digestoare, de sisteme de alimentare, de facilităţi pentru depozitare, precum şi o serie întreagă de alte echipamente.

INTRODUCTION

Implementation, development and scale-up of technologies for energy production are currently a challenge for scientists and a priority for energy system operators. Biomass of different origins is believed to be one of the main sources of renewable energy (McKendry P.. 2002, Goyal HB et al. 2008. Börjesson P. and Berglund M., 2006), some reports undermine this common opinion. Fargione et al. (2008) and Searchinger (Searchinger T. et al. 2008) have argued that irrational management of typical energy crops could in practice lead to increased greenhouse gas emissions, being emitted into the atmosphere. Some works also suggest that the intensive exploitation of arable land for growing crops for the production of biofuels can have a negative impact on global supply and food prices (Johansson D. and Azar CA. 2007).

Having in view the above issues, an urgent need arises for alternative sources of biomass for energy purposes that are both economical and environmentally friendly. Considering a very high photosynthetic efficacy, a rapid growth rate of biomass, resistance to various types of contamination and the ability to manage land that can not be used for other purposes, algae appear as a competition on typical energy crops (Mandal S et al . 2009; Smith V. et al., 2010).

Green algae produce lipid substances - vegetable oils after the photosynthesis process. These oils can be used to produce biogas and diesel fuel.

MATERIAL AND METHODS

Alternative fuels (Table 1) are chemical substances (alcohols, ethers, esters. etc.) obtained through the use of various physicochemical and biological processes for the transformation of plant biomass represented by woody and herbaceous plants, forestry and agricultural waste of industrial and municipal waste, in products that can release by combustion a large amount of energy without generating major polluting effects.

Biomass represents the entire plant material or vegetation, either in the raw or processed state, from wild or cultivated plants, trees, shrubs or fast growing herbs, agricultural residues, wood residues, methane from the basins of city treatment plants (Naghiu et al. al.. 2005).

Table 1

Types of alternative fuels and their characteristics

Biofuel	Characteristics	Advantages
Farming biomass ethanol	- alcohol obtained by fermentation of grain crops and other plant sources	- high octane fuel and reduced emissions of greenhouse gases
Lignocellulosic biomass ethanol	- lignocellulosic biomass alcohol obtained by converting the fermentable sugars followed by fermentation to ethanol their	- high octane fuel and reduced emissions of greenhouse gases -do not use food or feed commodity
Biogas	- gas mixture of the predominant methane produced by anaerobic fermentation of manure or other waste or agricultural products. domestic and industrial	- raw material is unworthy - Important role in waste management -can be a source of energy in rural communities or poor areas of the globe
Biodiesel	- a diesel-like fuel obtained from vegetable oils	-reduce the emissions -engine is lubricated
Renewable diesel	- a diesel-like fuel obtained from vegetable fat and oil	- meet the standards for diesel with very low sulfur and animal fats added
Biobutanol	- alcohol fuel, like ethanol	- easier to carry, less corrosive than ethanol in pipelines

Biodiesel appears to be one of the fuels of the future, mainly due to the abundance of natural raw materials from which it can be produced. In this context, we do not wonder that biodiesel can also be produced fresh from marine algae.

The greatest advantage of algae is that it can get 30 times more biodiesel per hectare than corn or soy. Since algae grow in salt water (the most abundant substance on Earth), it is understandable why marine algae can become an alternative to oil. The discussion must begin with the source of raw material. It is not yet known what plant species we will rely on in the future as a source of fuel, so the big companies in the field are considering more options.

The future will show which of the experienced plants will prove to be the most appropriate. The selected algae species are those able to synthesize large amounts of lipids (fatty substances). But why? Because it is precisely these substances that can be obtained through a chemical process called transesterification, the precious fuel that we will feed tomorrow cars, motorcycles, scooters, chainsaws that work today with diesel. In theory, it's pretty simple.

Green algae produce lipid substances - vegetable oils after the photosynthesis process. These oils can be used to produce biodiesel fuel for the supply of any diesel engine. At the current level of consumption, oil reserves may end soon enough; as the reserves will drop, the price will grow alarmingly and anyway, the oil industry is extremely polluting, contributing to global warming.

The oil crisis is near and new sources of raw materials need to be found to get fuel. Researchers look for algae more than other terrestrial plants! This is explained by the fact that they have some great advantages. First of all, their vital needs are smaller and easier to satisfy. They only need water, sun and carbon dioxide and they are easier to buy and create fewer problems than the pesticides and pesticides that are growing today in terrestrial plants (Vadineanu A.).

The process of algae transformation in biofuels which are growing today in the terrestrial plants (Vadineanu A.), is shown in figure 1..

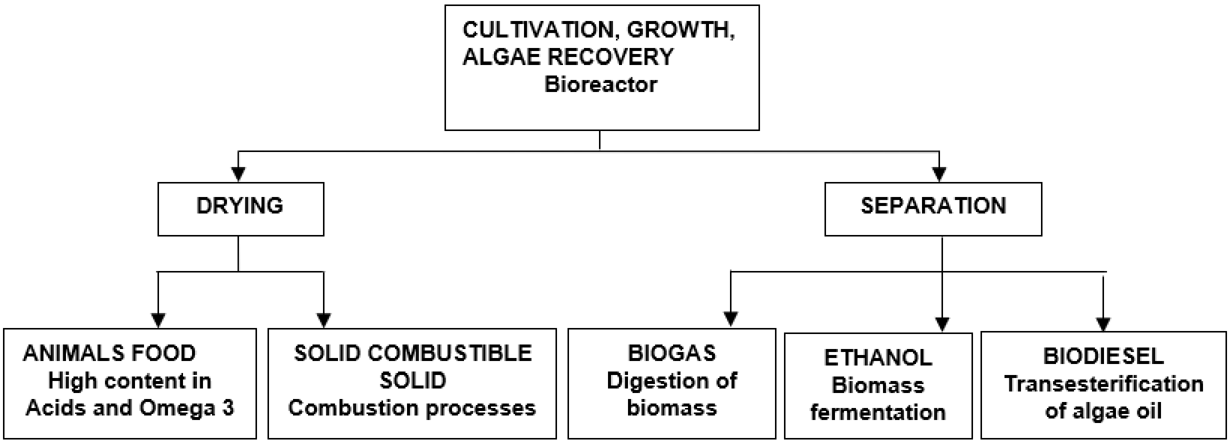

Fig.1 – The process of transforming algae into biofuels

Biogas is a gas composed mainly of methane and carbon dioxide in varying proportions, resulting from anaerobic fermentation (without air, without oxygen) of organic matter. Biogas emanates from the substrate, from waste, organic, vegetal, animal, household waste, under the action of methanogenic bacteria.

Biogas production technology is one of the oldest and most known natural processes of "swamp gas" emission. It allows the creation of alternative energy sources and is the object of study of many scientific schools in the world. As a result, biogas technology is widely applied in a number of industrial countries in Europe and America.

The Southeast Asian example shows that thousands and thousands of different capacity biogas plants are already operating using standard technology. However, the biomethane content of the biogas does not exceed 60 ± 5% and the process is characterized by the long duration of fermentation - from 3 to 10 days, the degree of transformation of organic substances from biomass being only 40-60%. The resulting waste water contains high concentrations of pollutants, making it necessary to treat them under aerobic conditions (Cleseri LS., 1992).

The production of biogas by anaerobic digestion (AD) is considered to be the optimal treatment for animal manure as well as for a wide variety of organic waste suitable for this purpose, as such substrates are converted into recoverable energy and organic fertilizer for agriculture. At the same time, the elimination of the organic fraction from the total amount of waste increases both the energy conversion efficiency by incinerating the remaining waste and the stability of the waste dumps.

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Anaerobic Digestion (AD) is a microbiological process of decomposition of organic matter, in the absence of oxygen, encountered in many natural environments and nowadays widely applied for the production of biogas in air-tight tank-type reactors, commonly called digesters.

A wide variety of microrganisms are involved in the anaerobic process, resulting in two final products: biogas and digestate. The process of producing biogas and the two phases of the anaerobic digestion system are presented below in Figure 2 (Olguin EJ.).

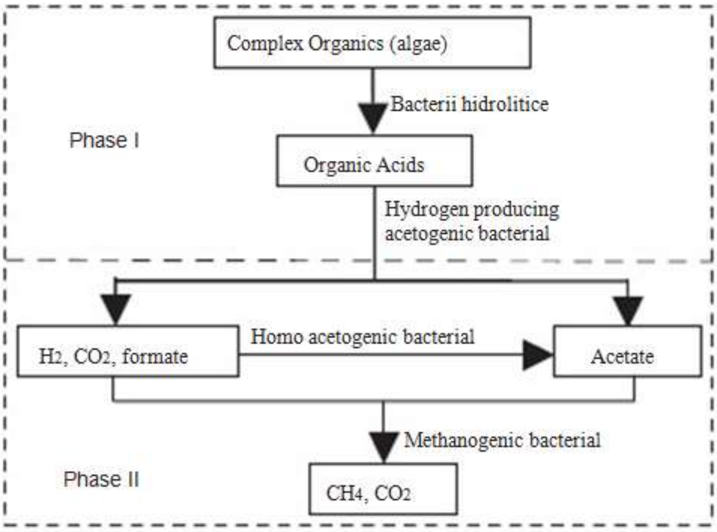

Fig.2 - Biogas production process

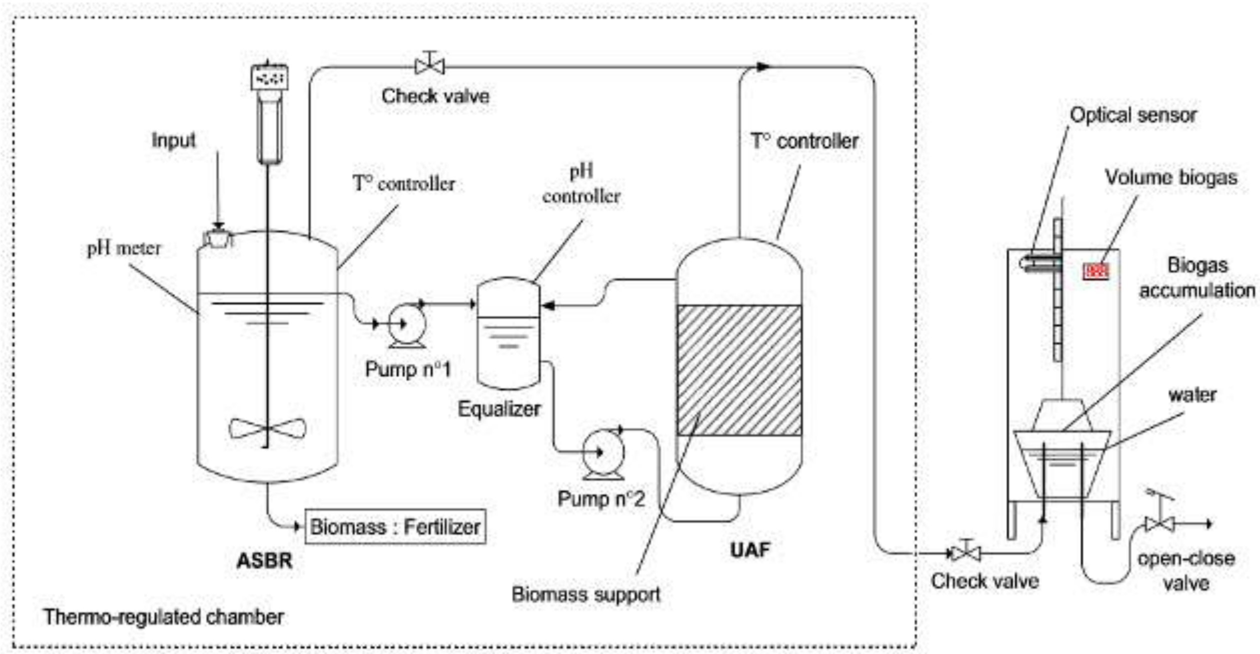

Fig.3 - Schematic design of a two-phase anaerobic digestion system

▪ Technologies and equipment for biogas production

Biogas technology has its own traditions in India, China, USA, Canada, Japan, and has become interesting in Europe, namely Denmark, UK and in Romania since 1975. The raw material, biomass can also be obtained by growing fast-growing plants in the so called energy plantations that can be: land plantations, plantations at sea, algae and other marine plants.

From the point of view of the fermenter's feed (loading), the technical equipment within the technologies can be classified as follows:

- with discontinuous power supply (characteristic of small capacity equipment for household use and medium capacity of farms);

- with continuous feed for industrial installations (Vintila M.. 1989).

Examples of biogas plants used in Romania

A. Low capacity plants

The installation shown in FIG. has a capacity of 14 m3. And was designed by a team from the faculty of Hydrotechnics of Iasi Polytechnic Institute and it was made in rural households from the counties of Iasi, Botosani and Suceava.

The plant is composed of a feed chamber, a fermentation tank, a gas meter and an exhaust chamber.

From the base of the outer wall of the supply chamber to the base of the evacuation chamber, a 1.1 m level difference is made which allows the gravitational displacement of the fermentation material (the floor of the feed chamber and the fermenter are formed in a tilted plane). The supply and evacuation chambers are in the form of openings with wooden caps and access to metallic steps.

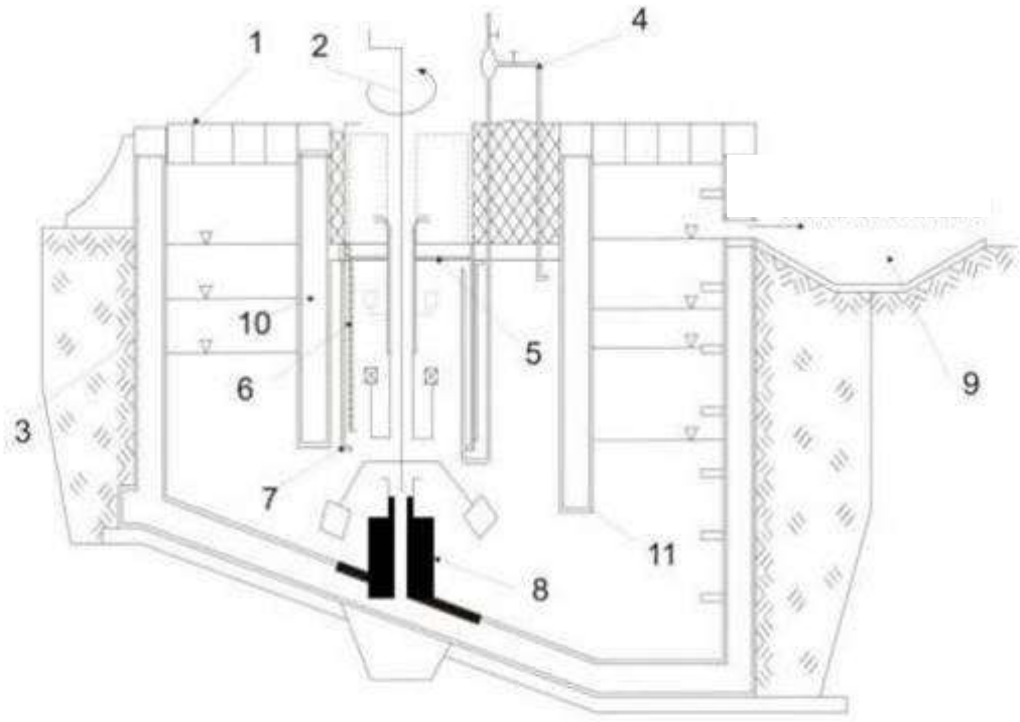

Fig.4 – Small capacity biogas installation

1 – wooden floor; 2 – stirrer; 3 – outer wall; 4 – gas outlet pipe; 5 – ballast on the wooden floor; 6 – plate bell (gas meter); 7 – exhaust pipe; 8 – bronze nut; 9 – exhaust duct; 10 – the inner wall of the feed chamber; 11 – the inner wall of the evacuation chamber

The plant operates at ambient temperature and the insulation is done with a layer of straw and manure. Biogas production stagnates if the temperature in the fermenter drops below 8 - 10 ° C.

To accelerate the fermentation process, a blade shaker is provided which acts on the bottom of the fermenter. The shaker is manually operated by a crank.

Fuel gas capture is done through two wells, one under the bell and the other in the fermenter's shelter where the gases from the biomass flowing to the exhaust pipe are stored. Under normal operating conditions, the plant can supply about 3 cubic meters of gas per day.

In this field, the researchers from INMA Bucharest designed and built a biogas pilot plant, fig.5 (for experimenting with biogas technologies from animal manure, agricultural biomass, algal biomass).

The pilot plant for biogas production consists of two bioreactors for fermentation, stirring system, agitator drive motor - frequency inverter system. 4 pH sensors, 6 temperature sensors, heating system, photovoltaic panel system, solar panels, pH correction solution, storage tank, biogas flowmeters, low pressure transducers, biogas-powered generator, portable gas analyzer. The total capacity of the pilot plant is 5 m3.

With the help of the pilot station you can experiment with different biogas-producing innovative recipes, as well as conducting the fermentation process either mesophilic or thermophilic.

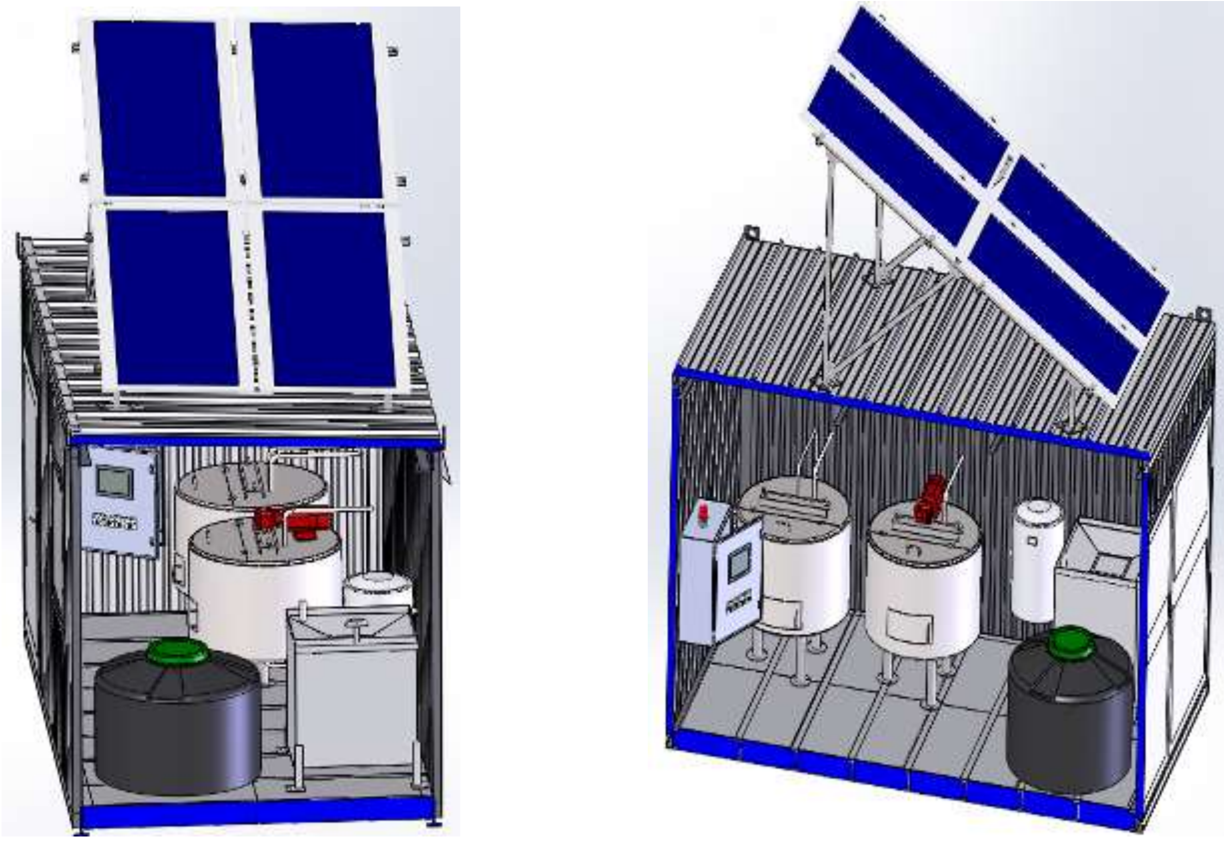

Fig. 5 - MGA- Pilot plant for obtaining bioenergy through dry and wet advanced methanogenesis

Within the INMA research is being carried out on an innovative technology for obtaining algal biomass as a source of raw material for the production of alternative biofuels. In this biogas technology, the MGA pilot station will be used.

B. Medium capacity facility

Such a facility was designed by a team of the Institute of Food Chemistry in Bucharest. The scheme of the installation is shown in Figure 6.

The capacity of the fermenter is 25-50 m3., the plant having two main components: the fermentation tank, the cylindrical vertical shaft, thermally insulated and a multifunctional bell,. which can be slid vertically into the fermentation tank. The fermentation cuvette is semi-planted, so that at least 1.5 m of its height is above the ground. There are four metal stops inside the bowl, which limit the lower position of the bell.

The installation works in mesophilic mode, with the possibility of mounting an internal heat exchanger. Dilution of the material is done with warm water. Organic feed is through a tube that penetrates through the bell shaft and the exhaust of the fermented material is made with an exhaust pipe.

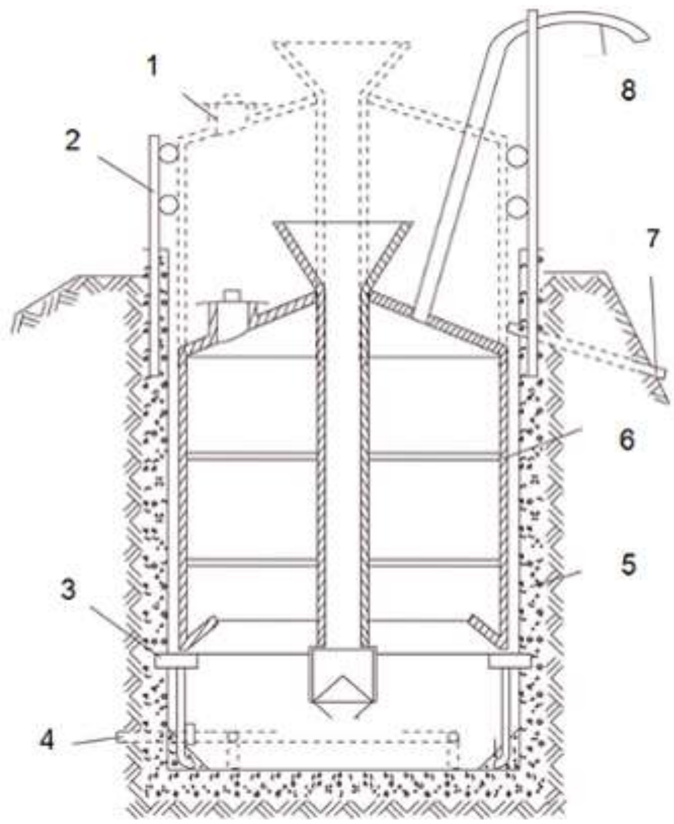

Fig.6 - Medium capacity biogas plant (25 – 50 m^3)

1– manhole; 2- bell guide support; 3- stopper bell; 4- connect hot water; 5- concrete wall; 6- metal bell; 7- exhaust pipe; 8- biogas hose

C. High capacity installation

High-capacity biogas plants have been designed by the Institute of Studies and Design of Construction for Agriculture and Food Industry (ISPCAIA) based on the technology established by a research team from the Institute of Food Chemistry (IAA).

Many companies have been established in the country to assemble high-capacity biogas plants such as pulg-flow and superflow (http://biogaz-instalatii.ro/imari.html).

CONCLUSIONS

- The biogas and biodiesel production technology are ones of the oldest and most known natural processes. It allows the creation of alternative energy sources and is the object of study of many scientific papers in the world.

- Despite some limitations on the use of algal biomass for biofuel production processes, studies have led to their recognition as an alternative source of organic substrate. These organisms have many advantages in the production of biofuels compared to typical crops used as energy sources: they contain large quantities of polysaccharides and lipid substances and are devoid of lignocellulosic compounds that are hardly degradable; are characterized by an increased biomass rate; eliminate a small amount of carbon dioxide; are biodegradable, so they do not affect the environment.

- Biogas is obtained through the anaerobic digestion process (AD) in special plants, which, depending on the production capacity, can be classified in small, medium and large plants- by using the alternative biofuels obtained from reducing the consumption of fossil fuels.

ACKNOWLEDGEMENT

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THEORETICAL CONSIDERATIONS ON FLATTENING PROCESS OF CEREAL GRAINS WITH HIGH HUMIDITY FOR USING AS FODDERS / *CONSIDERAŢII TEORETICE ASUPRA PROCESULUI DE APLATIZARE A CEREALELOR BOABE CU UMIDITATE RIDICATĂ ÎN VEDEREA UTILIZĂRII CA FURAJE*

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Keywords: *cereal grains, moisture, flattening process, fodder, mixing rolls.*

ABSTRACT

Intensive animal breeding in livestock farms and providing high-quality feed for a rational diet result in a high production of animal products.

This paper addresses the theoretical aspects of the process of flattening grain cereals with high moisture content for preservation by ensilage. The research investigated the process of flattening the cereal between two rollers, the forces that appear in the working process, the rolling parameters of the rollers, the working capacity and the energetic energy balance of the system were identified and calculated.

REZUMAT

Creşterea intensivă a animalelor din fermele zootehnice şi asigurarea unor nutreţuri de calitate superioară pentru o alimentaţie raţională determină obţinerea unei producţii ridicate de produse animaliere.

Lucrarea de faţă abordează aspecte teoretice ale procesului de aplatizare a cerealelor boabe cu umiditate ridicata în vederea conservării prin insilozare. În cadrul cercetarilor s-a analizat procesul de aplatizare a cerealelor între două valţuri, s-au identificat şi calculat forţele care apar în procesul de lucru, parametrii constructivi ai valţurilor. capacitatea de lucru şi bilaţul energetic al sistemului.

INTRODUCTION

The importance of cereals is important for human food, directly for human consumption and indirectly as a factor in animal production, accounting for about 45% of the world's population's energy source (the amount of calories), which makes that half of the arable land of the planet of 710 ... 740 million hectares is cultivated with cereals. (*Mănişor P.. 1994*). The world cereal production is approx. 2000 million tons, the world's main cereals being wheat, corn and rice. In the last years, world grain production has risen gradually from 1.9 to 2.5 billion tons, stocks have risen between 2.2 and 2.4 billion tons, and annual use has increased linearly to 1.95 to 2.51 billion tons. [*7. 10*].

Directly, animal husbandry is involved in making foods of particular biological value: milk, meat, eggs, etc., which cannot be obtained from plant cultivation, also providing a range of products such as wool, skins, furs, which is the raw material for the light industry: garments and footwear.

Nutrition and nourishment have a direct and obvious effect not only on the level of animal production but also on reproduction, growth and development processes, animal health and, last but not least, the economic efficiency - a decisive factor in the development of livestock farming. (*Pop M.. 2014*).

For intensive animal husbandry and for high animal production, adequate high quality feed and rational nutrition must be ensured, especially as the latter represent the most significant share of the production costs that may reach value over 50%.

Fodder is any product or by-product of vegetable, animal, mineral and synthetic origin, which, used in animal feed, ensure vital functions and exploits their productive potential. (*Samuil C.. 2009*).

The transformation of vegetable mass production into livestock products depends mainly on the quantity and quality of the feed obtained, factors that are largely influenced by the mechanized execution of the works, especially those of harvesting, transport and processing.

MATERIAL AND METHOD

The best known and used methods (technologies) for harvesting and preserving fodder, both in the world and in our country, which fully meet the requirements of the zoo technical sector, are presented in Fig.1.

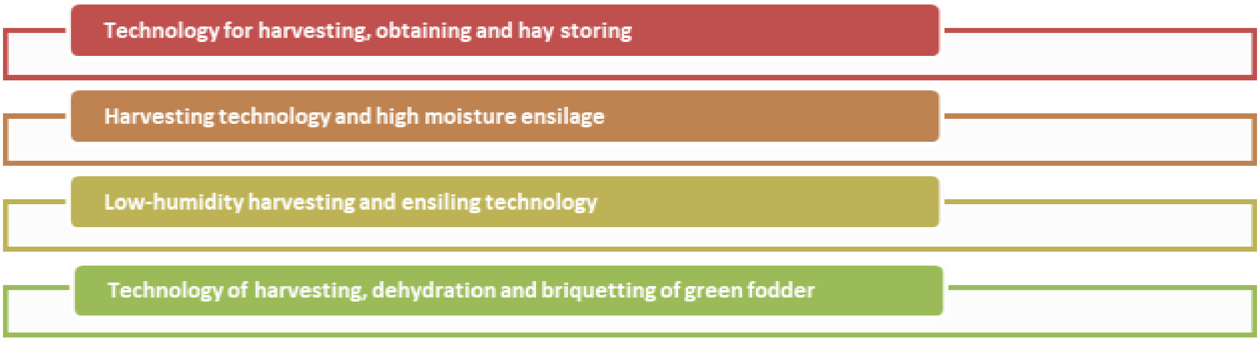

Fig. 1 - Methods of harvesting and preserving different types of feed

Regarding to the preference criteria or the selection of one or other of these technologies, production experiments have shown that it cannot be considered to be one or two of these technologies as being the most technically and economically efficient, but the simultaneous use of more technologies is envisaged, applying in a differentiated way, depending on a number of factors, among which the most important are the following:

- Type of farm and animal species;
- Climatic conditions in the region during harvesting;
- The possibilities of preserving and administering fodder in animal feed;
- Endowment with machines and equipment used in the respective technology.

Ensilage is one of three methods of using fodder plants in animal nutrition, the other two being grazing and hay production. Grazing is the cheapest of them, but it has a pronounced seasonality.

The opportunity to study technologies for the superior utilization of grain cereals by wet preservation and the machine system for their application are determined by some aspects related to keeping the nutrient content and the good qualities of the feed in preparation and the losses of nutrients 5 ... 10%.

The technology is especially important in insulating barley with high moisture content, which is used in feeding cattle to fat. In addition to barley, corn, sorghum or other crops are also used with moisture content of between 25 and 35%. (*Mănişor P.. 1994*).

Conservation of forage by silage is usually done for one year, but storage can be up to two years, and administration for consumption in winter, but also in summer when periods of inadequate green feed (for example during droughts periods).

Silo preparation works are less dependent on weather conditions, are entirely mechanized and land is released shortly. The storage spaces being smaller, in one cubic meter can be preserved 450 ... 600 kg of silo.

For the superior exploitation by natural preservation, by silage of cereal grains of the type of barley,sorghum and apple quantities of grain obtained from late varieties or from double cultures, which do not reach the autumn harvest maturity, the utilization of the stocks of wet corn in agricultural units, a technology is needed for the processing of the grains by flattening, flushing and also for the production of high-digestibility quality silos. (*Ciobanu V. G. et al. 2016; Mănişor P.. 1981*)

The results of some researches have shown that whole grain cereal starch is digested by animals in the case of flaky grains- about 68% and 98%.

The technological process of mechanization to obtain flattened concentrated feed for silage is represented by the following works: harvesting, loading, transport, if necessary hydro-thermal treatment of grain cereals, crushing / flattening without grinding and placing the material in the silo, Fig. 2.

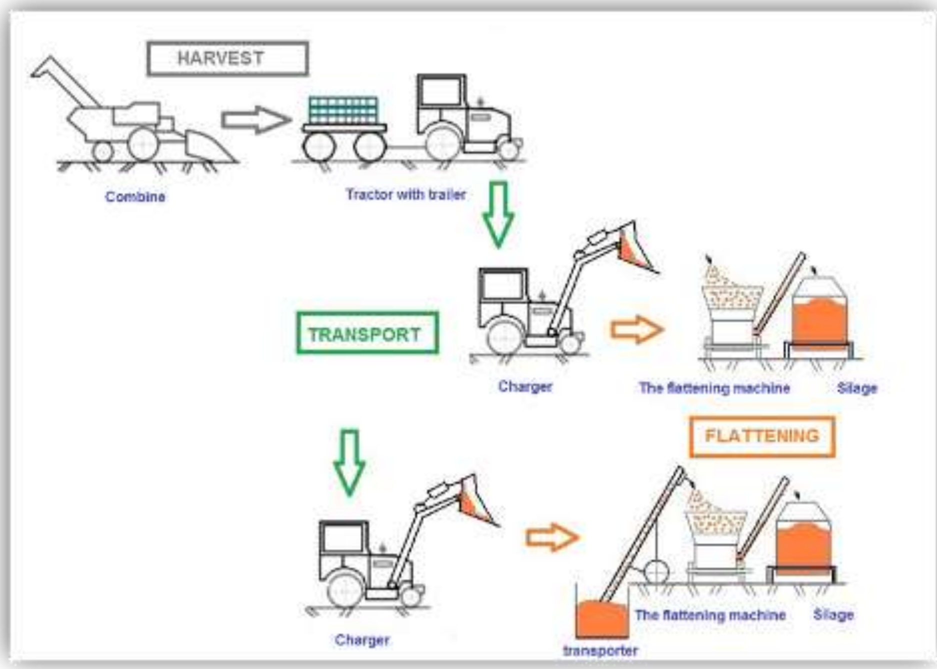

Fig. 2 - Technological scheme for mechanization and ensilage of grain harvesting works

Conservation of this type is a natural preservation process that takes place in the absence of air (in the anaerobic environment). Harvesting must be done when the humidity is between 24 ... 32%.

The wet grains are stored immediately in a sealed silo. At a low humidity, the beans naturally are in a durable inert environment, but at higher humidity, the disappearance of oxygen is accompanied by a more intense fermentation process that favors the growth of the lactic flora. In all cases, the silo must remain sealed.

The choice of storage media shall be based on the type of livestock holding, its size and the percentage of moisture content at harvest.

Storage in large bags (Fig. 3), the "*big bag*". allows the storage of approx. 800 kg of wet corn. Adapted to small-scale livestock farms, the system is made up of a double outer shell where the grains are stored, which ensures a tight environment (*Ciobanu V. G. et al. 2016) and* [*9*].

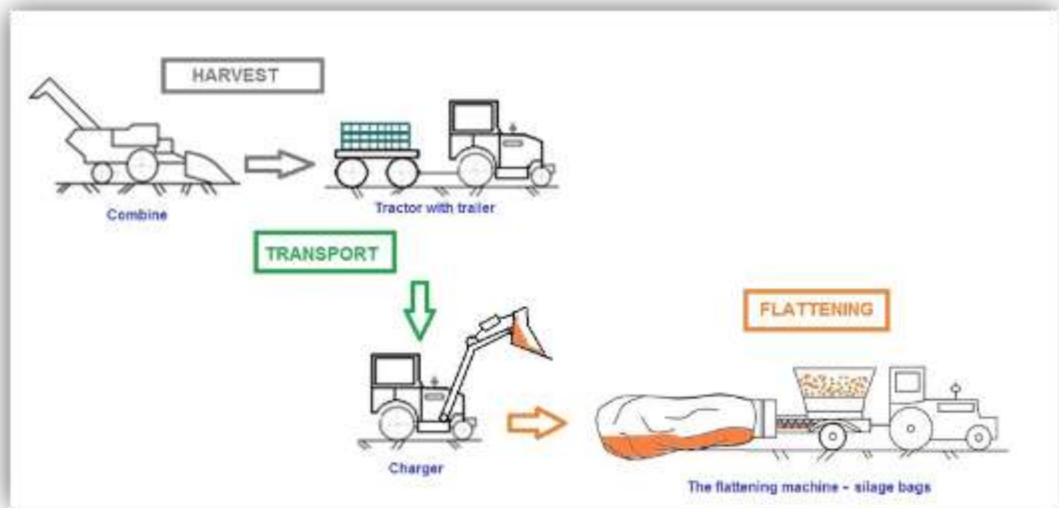

Fig. 3 - Technological scheme for mechanization of the grain harvesting and ensilage works in "bags"

Preserved in a wet state (in silos or "sacks"), flaking cereal grains retain all their nutritive properties (energy, proteins, minerals, vitamins, pigments). Acidification induced by preservation and favored by the flattening of the grains is beneficial to the digestion of the animals, so it is noticed that the nutritional value of maize and sorghum used for fattening cattle is higher by approx.10% in the case of silting of grains, with a moisture content of 28 ... 33% of the nutritional value is due to the increased digestibility of protein and starch from crushed wet grains. (*Mănişor P.. 1994*)

The silage technology comprises a succession of operations that lead to the production of a good quality pickled fodder: preparation of the storage facilities; establishing the harvesting age; harvesting and transport; silage itself. (*Vintu V.. 2004*).

The process of the flattening machine is as follows: grain cereals are loaded into the feed basket by means of a hopper / belt conveyor are taken over by the feed roller and inserted between the rollers where the flattening process takes place. Grain fills are collected and transported to the silo.

RESULTS

The classic process of flaking production is based on crushing grain cereals between two crushing rollers of a special machine.

The action of the rollers on the processed materials is influenced by the following basic factors: the value of the ratio between the peripheral speeds of the rollers (λ), the radius of the rollers, the width of the working slit of the rollers, the shape and dimensions of the rollers. (*Mănişor P.. 1981 and Mănişor P.. 1994)*.

Two smooth rollers with the same peripheral speed will crush the material; if the rollers will have different peripheral speeds, the traction material will be crushed, split and ground by rubbing. The phenomenon also occurs in the case of ribbed rollers, with the exception that in this case friction milling is replaced by cutting or splitting the particles into a rough grind.

Either: $$\lambda = \frac{V_{PR}}{V_{PL}} \qquad (1)$$

Where it is noted: V_{PR} - the peripheral speed of the fast roll and V_{PL} - the peripheral speed of the slow roll.

For: $\lambda =$ 1.5 ... 3. the cereal grinding is achieved with the lower limit for the fine grind and with the upper limit for the large grind (in the case of roller mills); for λ = 1, it is obtained the flushing and the flattening of the cereals is achieved.

The forces that act in the process of flattening cereal grains

In the process of grinding or flattening cereal grains, there are a number of forces between the rollers and the undergoing processing material (Fig. 4 a. b).

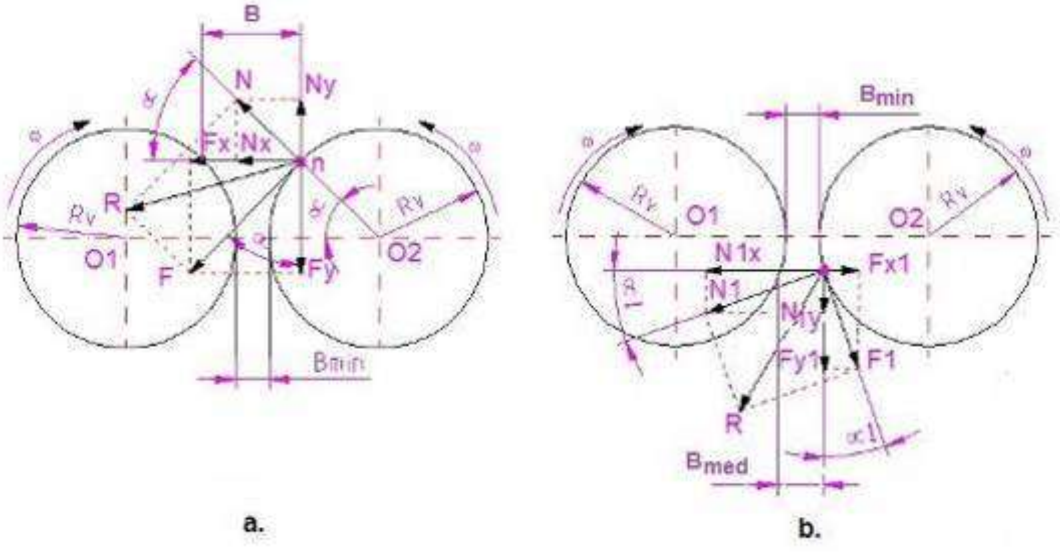

Fig. 4 - Functional scheme of wet grain rolls. (*Mănişor P.. 1981*)

a. The forces occurring at the material input between rollers; b. The forces that occur at the material exit between the rollers

It is noted: B - the initial thickness of the material to be flattened;

B_{min} - the distance between the rolls, the minimum thickness of the processed material;

B_{med} - the final thickness of the processed material;

B_{med} - Bmin is thickness variation due to the elastic properties of the material;

α - the angle of attachment of the material.

α_1 - the contact angle of the roll with the material at the exit.

When the material enters the work slot, the rollers are pressed in the contact points "n" with a force N in the direction of the radius. The friction force that is born in this case is:

$F = f \cdot N$, after the tangent direction (2)

f - the coefficient of friction between the material and the rolls

R - the result of the forces

$$\overline{R} = \overline{N} + \overline{F} \tag{3}$$

The analyzed forces are only valid for one half of the grain B. for the other half, the forces are the same. Thus, the horizontal forces with the symbol, acting on the right and left sides of the particle, cancel each other - B_1.

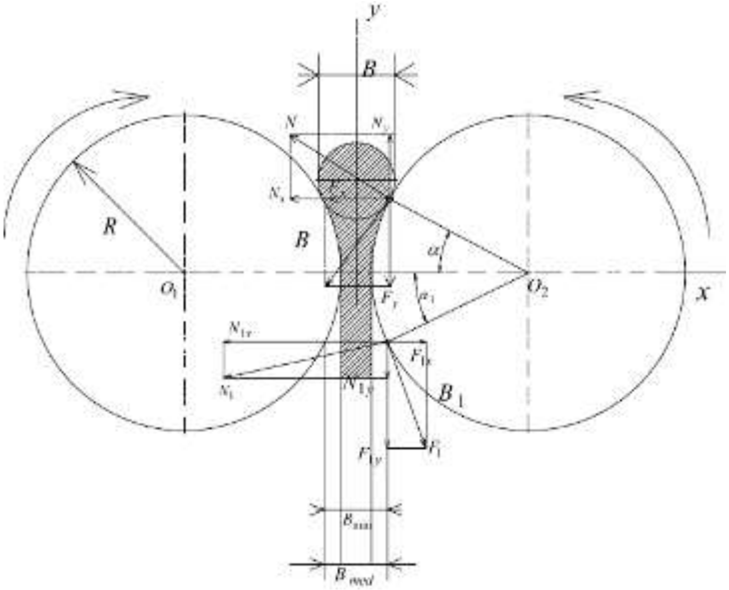

Fig. 5 - Scheme of forces acting in the flattening / flushing. (*Mănişor P..1994*)

The vertical components with the y symbol are in the same direction, but with different directions

- Fy forces - trying to pull the beans into the workspace
- Ny forces - pulls the material between the rollers

The condition that the material be rooted between the two rollers in the working space is:

$Fy > Ny$ sau $f N \cos \alpha > N \sin \alpha$ (4)

$f \cos \alpha > \sin \alpha$

for φ – friction angle

$$f = tg\ \varphi \tag{5}$$

$$tg\ \varphi > tg\ \alpha \tag{6}$$

It follows that, in order to ensure that the material is driven by the surfaces of the rolls, it is necessary that the angle of grip of the material α be smaller than the angle of friction between the material and the roll. φ. At the time of material exit from the workspace, the same forces will work on it. In this case both components will have the same directions and the particles will be helped to leave the space between the rollers with a force equal to their sum, Fig. 5. It results that:

$$\overline{R_1} = \overline{N_1} + \overline{F_1} \qquad F_1y = f \cdot N_1 \cos\alpha_1 \qquad N_1y = N_1 \sin\alpha_1 \tag{7}$$

which is the force impressed by the flakes at the exit between the crushing rollers.

Table 1 presents orientation values for the frictional angle φ and the friction coefficient f. (*P. Manisor. 1981*). Indicative values of the friction angle and the coefficient of friction of the grain with flattening rollers are: 12 ... 15 ° and respectively 0.194 ... 0.268.

Table 1

The values for the friction angle φ and the coefficient of friction f. (*Mănişor P..1994*)

Roller material	Values	
	φ	***f***
Smooth cast iron (sanded)	12^0	0.194
Matte cast iron (not sanded)	15^0	0.268
Cast iron used in the work	17^0	0.300

The relationship between the radius of the rollers, the dimensions of the grains and the angle of friction is expressed as it follows:

$$R = \frac{B - B_{\min}}{4\sin^2\frac{\alpha}{2}} \qquad (8)$$

Where $\alpha = \varphi$. Thus, the radius of the rollers is directly proportional to the initial and final thickness of the crushed material and inversely proportional to the contact angle between the material particles and the rollers. (*P. Manisor. 1981* and*P. Manisor. 1994*)

The distance between rollers is influenced by the radius and initial and final thickness of the material.

Construction of the flattening roller ribs

The most widespread structural variants of the high moisture grain flattening rollers are those with the working angle $\tau = 70 - 75°$. Fig. 6, where the ribbon CB edges are the tangential planes on a helper circle with radius R_c that is calculated with the relationship 9.

$$R_c = \left(\frac{2}{f} + 1/3\right)R \qquad (9)$$

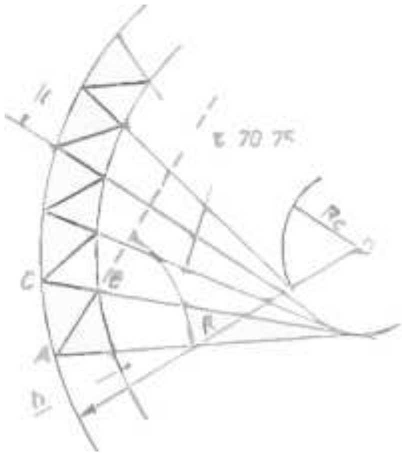

Fig. 6 - Scheme of rolled flat ribs. (*Mănişor P..1994*)
t - the pitch of the ribs; h - the height of the ribs

The valleys of the flattened valves may be arranged in the direction of the roller generator in Fig. 7 or inclined at an angle to the roller generator in Fig. 8.

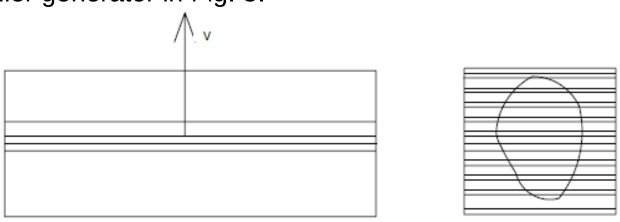

Fig. 7 - The ribs arranged in the direction of the roller generator. (*Mănişor P.. 1981*)

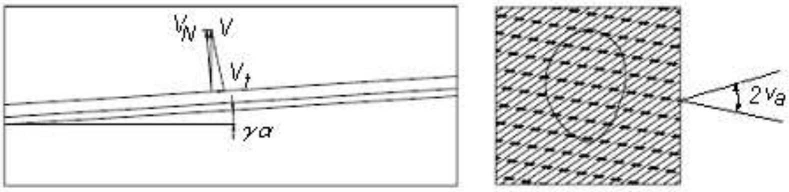

Fig. 8 - The ribs inclined at an angle to the roller generator. (*Mănişor P.. 1981*)

In the modern construction of flattening rollers the variant of the arrangement is adopted at an angle γ_a which imparts the tangential velocity V_t to the beads to produce a uniform dispersion of the material over the entire working width. Thus, the flattened material has a uniform thickness and greater tear resistance. (*Mănişor P..1994*)

To improve the flattening process, the ribs are arranged inclined on the rollers in two variants:

a - ribbons with different tilting meanings, in this case a larger grain crush is obtained, but there is the disadvantage that different inclination leads to material agglomeration and sluggish rolls.

b - inclined ribs in the same direction prevents agglomeration with the material at one end and besides crushing there is also a uniformity of the layer of material between the rollers.

Research done indicates the angle of inclination of the ribs γ_a = 5…10°. The functional parameters for the ribs commonly used in the flattening process are: pitch of the ribs t = 2 ... 4 mm; rib height h = 0.5 ... 1.5 mm; number of ribs n = 5 ... 7 cm circumference of the roll.

The working process of flattening machines is influenced by the width of the working slot, which is determined by the radius of the rollers and the initial and final size of the material.

Working capacity of flattening rollers

The capacity of the flattened grain rolls is the amount of material passing through the space between rollers in the unit of time. This depends on a number of factors. the main ones being: the work slot width. the length of the rollers. the peripheral speed of the rollers. the properties of the work piece and the fill volume of the working slit. (*Mănişor P.. 1994*). If: Q - Theoretical working capacity [kg/s]; B_{min} - Distance between rolls [m]; L_v - Roll width [m]; V_m - The average peripheral speed of the rollers (equal to the speed of the material at the outlet of the working slot which is:

$$V_m = \frac{V_{PR} + V_{PL}}{2} \tag{10}$$

Where: V_{PR} - the peripheral speed of the fast roller. V_{PL} - the slow speed peripheral speed. [m / s]; γ - The bulk density of the material in the working area [t/m³]; k - Coefficient of filling of the slit in the working area; k = 0.1 ... 0.3.

The working capacity of the rollers is expressed in relation 11.

$$Q = B_{\min} \cdot L_v \cdot V_m \cdot \gamma \cdot k. \qquad \text{[kg/s]} \tag{11}$$

The value of B_{min} in the crushing rollers may be within the range of 0.2 ... 0.5 mm. and in practice is measured by passing a roller plunger along with the grains while rotating.

When determining the width of the working slit, the initial and final dimensions of the particulate material are taken as the basis.

Power required for operating the flatbed machines

The power required to drive the flatbed machines equipped with rollers results from the sum of the power consumed for crushing the material ,the friction of the beads between them and the rollers and for the friction in the bearings and in the transmission mechanism. (*Mănişor P.. 1994*). Studies have found that for every 100 mm roll length are required 1.5 ... 2 HP. (*Mănişor P.. 1981*)

The power required to drive the rollers can be calculated [*8*]. with: $P = P_s + L_v$. [kW] (12)

Where: P_s - specific power per unit length; P_s = 10…15 [kW/m].

The power balance equation of the tractor in aggregate with a tractor-driven and tractor-driven cereal flattening machine has the expression in relation:

$$P_e = P_{tr} + P_f + P_t + P_p. \qquad \text{[kW]} \tag{13}$$

Where: P_e - effective engine power; P_{tr} - power lost in transmission; P_f - power consumed for rolling resistance; P_t - traction power, the useful power used to tow the machine; P_p - the power required to drive the wet grain dryer machine.

CONCLUSIONS

In the economic life of humans an important role is played by animal husbandry, because it provides indispensable food for man, and by the way it combines with the vegetal production, it contributes to the development of the whole sector of agriculture, to the increase of labor productivity and economic efficiency.

Animal husbandry is a basic sector of modern agriculture, occupying an important place in agricultural structures; it is an important factor of social stability and of maintaining the ecological balance, while being the main productive branch providing food for the population and important quantities of materials raw materials for food and non-food industries.

The technological process of producing cereal flakes is based on a grain cereal treatment by crushing them between two rollers of a machine, an operation called flattening. The economic effect of flattening technology and machines is related to increased production in animal husbandry and reduction of feed ration with concentrates. Grain cereal flattening machines with high humidity have in construction two crushing rollers, which by rotating motion around their own axis produce the flattening of the material penetrated into the space between them.

The article briefly presented, on the basis of a specialized documentation, an analysis of the flattening process at cereal grains in a wet condition, with a special importance in order to improve the work performance and at the same time to obtain useful information in the design and efficient activity under various working conditions.

ACKNOWLEDGEMENT

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THE EFFECT OF VIBRATION ON AGRICULTURAL WORKERS AT SOIL PROCESSING IN A GREENHOUSE
/
EFECTUL VIBRAȚIEI ASUPRA OPERATORILOR LA PRELUCRAREA SOLULUI IN SERE

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Keywords: *vibration exposure, greenhouse, Arduino, soil processing.*

ABSTRACT

Agricultural machines produce vibrations that act on the operator causing discomfort or more or less serious effects on his health. Our study presents a system for determining the vibration exposure of agricultural workers during soil cultivation operations in a greenhouse with a cultivator Husqvarna T85HX. The vibration measurement system was developed using the Arduino development platform, an MPU9250 inertial motion sensor (IMU) and open source programs. MATLAB Advanced Programming Language was used to process and analyse measurement data. Experimental tests have shown that the proposed vibration monitoring system is fully functional and that the level of exposure to vibration in soil processing with the mentioned equipment is not at high risk.

REZUMAT

Masinile agricole produc vibraţii care acţionează asupra operatorului producand disconfort sau efecte mai mult sau mai puţin grave asupra sănătăţii acestuia. Studiul nostru prezintă un sistem pentru determinarea expunerii la vibratii la care sunt supusi lucratorii agricoli in timpul operatiilor de prelucrare a solului într-o seră cu o motoprășitoare Husqvarna T85HX. Sistemul de masurare a vibratiilor a fost realizat cu ajutorul platformei de dezvoltare Arduino. a unui sensor inertial de miscare (IMU) tip MPU9250 si a unor programe "open source". Pentru prelucrarea și analiza datelor din masuratori a fost utilizat limbajul de programare avansat MATLAB. Testele experimentale au arătat că sistemul de monitorizare a vibratiilor propus este deplin functional. precum si faptul ca nivelul de expunere la vibratii in prelucrarea solului cu echipamentul mentionat nu prezinta un risc crescut.

INTRODUCTION

In our country, horticultural crops in greenhouses represent an important sector of the economy, generating approximately 2% of total crop production. Machines for soil tillage are widely used by workers in greenhouses and the main health hazards while maintaining the lawn using gasoline powered machines are noise and vibration [9]. Both present risks to health and safety and it is reported to worsen or even cause back injuries. International legislation on potential health hazards produced by case of vibration transmitted to the hand-arm system, ISO 5349-1, defines the main factors that determine the level of exposure to vibrations that may be acceptable and provides guidance on the possible effects on health or comfort. A thorough knowledge of the undesirable effects of vibration on the human body is essential for achieving appropriate administrative, technical and medical prevention measures [2].

According to several papers from the specialty literature [3.4.6.11], long-term exposure to vibration accelerates onset of lumbar spine disorders and possibly adversely affects the gastro-intestinal and cardiovascular systems.

As described in the paper [10], is underlined the need for rice farmers to utilize health management strategies suited to the farming seasons and measures to reduce exposure to WBV for each farm task. Monarca et. all [8] study transmission of vibrations from portable agricultural machinery to the Hand-Arm System (HAV). They conclude that vibrations can cause some professional diseases whose symptoms can appear after many years too.

This paper has as main objective the design and use of instrumental and computer systems designed to evaluate the influence of vibrations on the human body and/or its component parts following the carrying out of soil processing activities. Field testing conducted in our campus verified the functionalities of the mini portable system and its practical application in the proposed environment, and the manner in which they meet international standards. Results show that proposed solution can collect and present data in a mobile environment.

MATERIAL AND METHOD

The vibration transmitted to the hand shall be measured and reported for three directions of an orthogonal coordinate system such as defined in Figure 1.

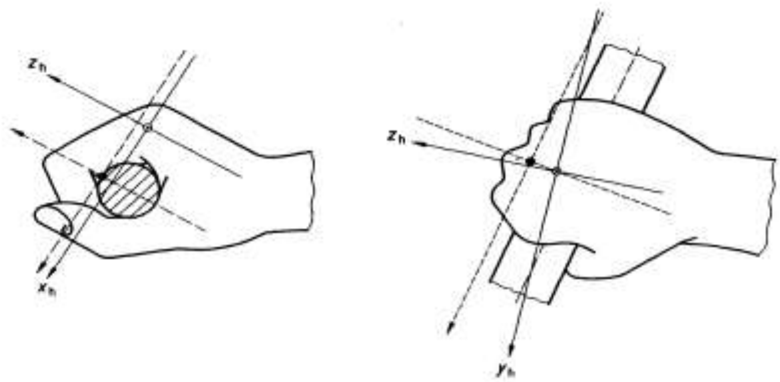

Fig. 1 - Triaxial vibration transmitted to the hand

The primary quantity used to describe the magnitude of the vibration shall be the root-mean-square (rms) frequency-weighted acceleration expressed in meters per second squared (m/s²). Vibration exposure is dependent on the magnitude of the vibration and on the duration of the exposure. In order to apply the guidance on health effects, the vibration magnitude is represented by the vibration total value a_{hv}:

$$a_{hv} = \sqrt[2]{a_{hwx}^2 + a_{hwy}^2 + a_{hwz}^2} \qquad (1)$$

Where, subscripts. ***w*** - refers to frequency-weighted acceleration values and ***x,y,z*** – refer to the direction of translational or rectilinear vibration.

The weighted ***rms*** acceleration shall be calculated in accordance whit the following equation or its equivalents in the frequency domain:

$$a_w = \left[\frac{1}{T}\int_0^T a_w^2(t)\,dt\right]^{1/2} \qquad (2)$$

Where, $a_w(t)$ [m/s²] is the weighted acceleration as function of time (time history), respectively, T [s] is the duration of the measurement.

Daily vibration exposure is derived from the magnitude of the vibration (vibration total value) and the daily exposure duration and can be expressed:

$$A(8) = a_{hv}\sqrt{\frac{T}{T_0}} \qquad (3)$$

Where, T is total daily duration of exposure to the vibration a_{hv}. respectively. T_0 is the reference duration of 8h (28.800 s).

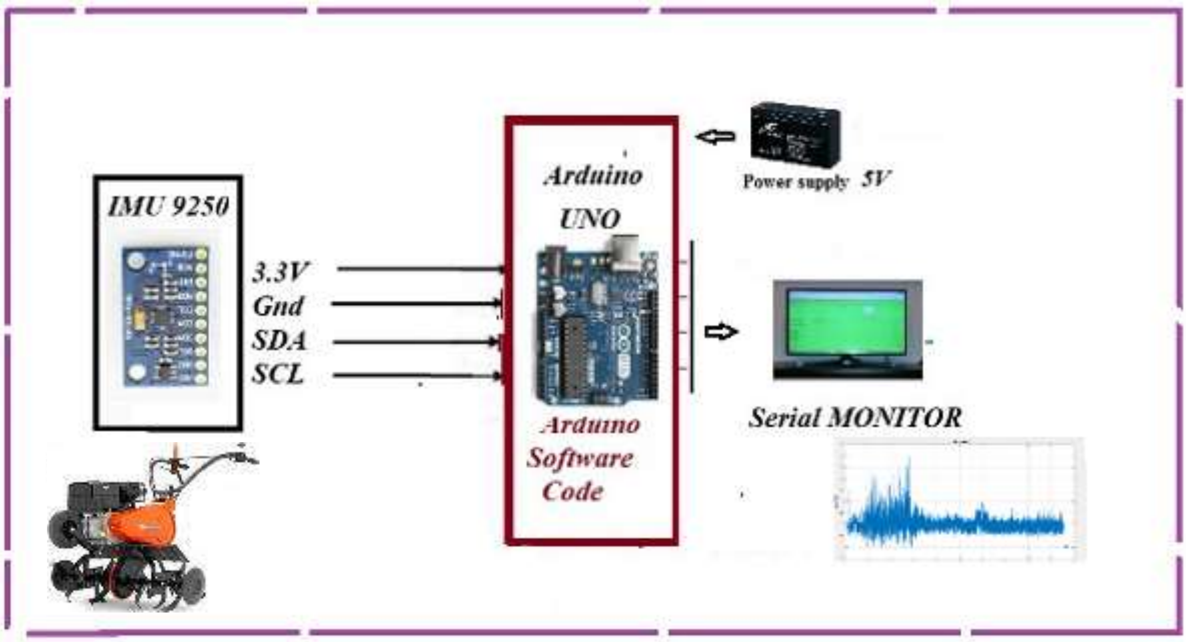

Fig. 2 - Block diagram of vibration monitoring system

The proposed monitoring system is presented in Figure 2. The main component of hardware section is the **Arduino UNO**, a microcontroller board based on the ATmega368. on miniature computers in a single integrated circuit. The main board can be programmed flexibly to provide specific features regarding requirement function in the intelligent system, such as data handling. In general, Arduino boards have proven to be robust enough to be accurate, simple tasks are not affected by the programming style even at beginner level. Software implementation of our vibration monitoring system uses Arduino software. Data were exported in ASCII format and were loaded in MATLAB for further analyses.

Inertial motion sensors (IMU) are a booming industry, mainly because they are autonomous. require a low power supply and are miniaturized. IMU sensors typically contain three orthogonal accelerometers and three orthogonal gyroscopes and sometimes three orthogonal magnetometers, measuring angular velocity, acceleration and magnetic field respectively. MPU 9250 developed by InvenSense Inc.. a full 9DoF inertial sensor is used as the motion sensor in our research. It has accelerometer, gyroscope and compass on all three axes.

Micro-Electro-Mechanical Systems or MEMS. is a technology that in its most general form can be defined as miniaturized mechanical and electro-mechanical elements that are made using the techniques of microfabrication. The MEMS accelerometer can be considered as a mass-spring system. Figure 3 shows an illustration of a typical MEMS accelerometer on one axis. It is composed of movable proof mass with plates that is attached through a mechanical suspension system to a reference frame (Ipate. 2016). Therefore, the measurement of an accelerometer can be modeled as [12]:

$$R(t) = \hat{v} - g + s_a(t) + n_a(t) \tag{4}$$

where $\hat{v}$ represents the instantaneous linear acceleration, **g** represents gravitational acceleration, $s_a(t)$ and $n_a(t)$ stand for accelerometer bias and noise respectively.

MPU 9250 is integrated into the GY-9250 module which converts the analogue output from MPU 9250 to digital (Fig.4).

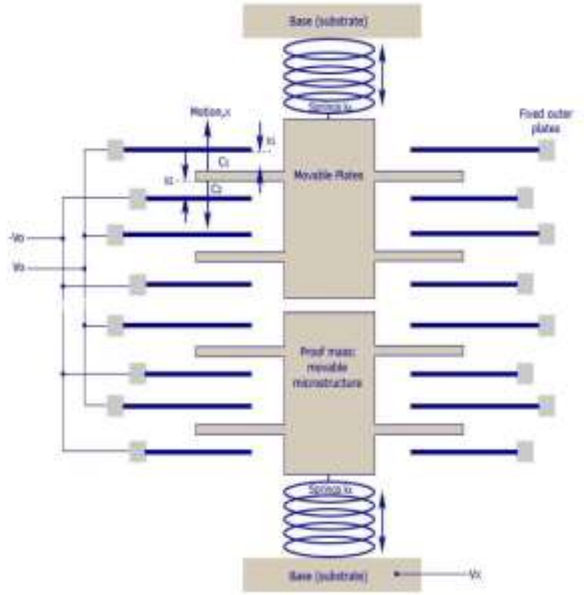

Fig. 3 - Functional Block Diagram of MEMS Accelerometer

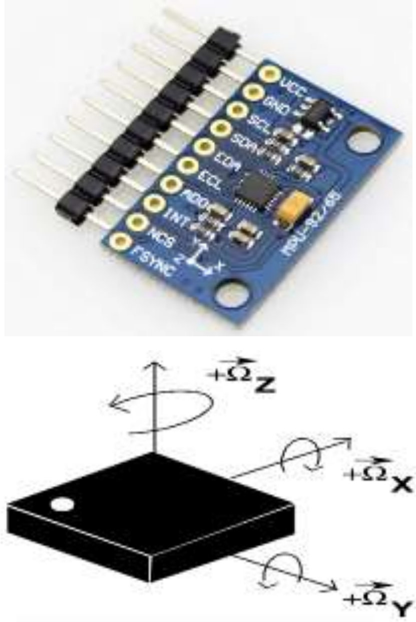

Fig. 4 - Block Diagram of IMU 9250 module

Gyroscopes sense orientation through angular velocity changes and therefore find orientation, but they tend to drift over time because they only sense changes and have no fixed frame of reference [7]. The measurement of a MEMS gyroscope can be modelled as:

$$\Omega_g^b(t) = \Omega(t) + s_g(t) + n_g(t) \tag{5}$$

where $\boldsymbol{\Omega_g^b}$ **(t)** is the gyroscope reading in sensor frame, $\boldsymbol{\Omega(t)}$ is the actual angular velocity in global frame, $\boldsymbol{s_g(t)}$ and $\boldsymbol{n_g(t)}$ represents gyroscope bias and high-frequency noise in gyroscope respectively.

RESULTS AND DISCUSSION

The experimental work has deployed in the greenhouse with polyethylene film roof, available in UPB campus, Depart. of Biotechnical Systems. To classify the vibrations according to their degree of discomfort and the risk of injury they produce to workers, measurements were made for hand-arm vibrations in the soil-processing activity with a cultivator Husqvarna T85HX.

Fig. 5 - The system used for experimental measurement of hand-arm vibrations in the soil-processing activity

To test the use of sensors, we have conducted several series of measurements to check the system and data accuracy. Accelerometers are extremely sensitive to attitude changing and impact forces while gyroscopes are sensitive to temperature changes and suffer from a slow-changing bias. The gyroscopes measurement error is a fixed value and is only a function of the change in sensor temperature.

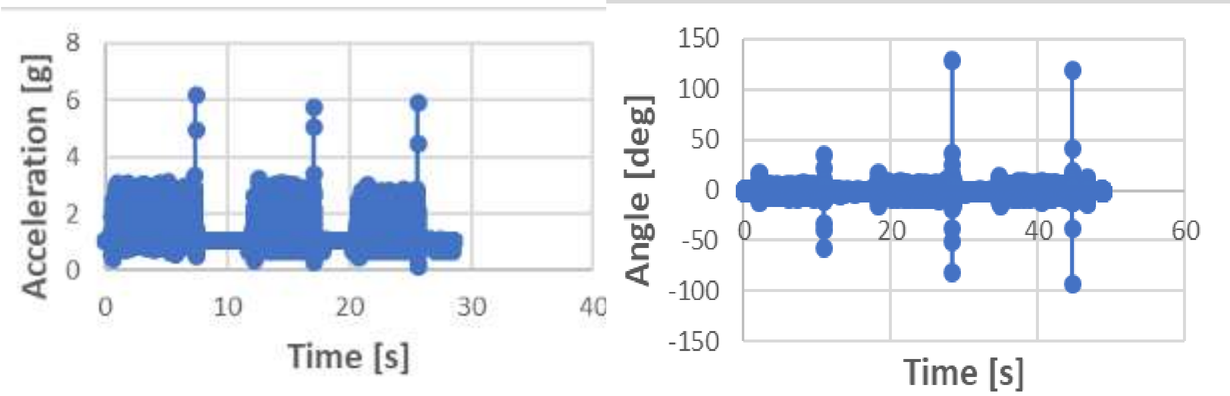

Fig. 6 - The measurement accuracy and repeatability of IMU 9250 device

Fig. 6 depicts the IMU 9250 device acceleration and angular displacement test measurements with respect to time. Gyroscope drift is also presented in the same figure. For this example, accuracy and short-term repeatability will be determined. This type of gyroscope sensor has a typical thermal drift value of 0.01 dps/Hz$^{1/2}$.

Total acceleration scaled data are illustrated in Figure 7. Data come in 16 bits with the range of (±4g). A translational orientation is given to the system and quantification of fluctuations is observed as a response. The sample rate of the system is 10 Hz corresponding to 10 data per second or with another means. 0.1 seconds between every sequent data. When the machine system is stationary as the top of the sensor faces upward. Z axis stays on 1g while X and Y axes give the value of 0g.

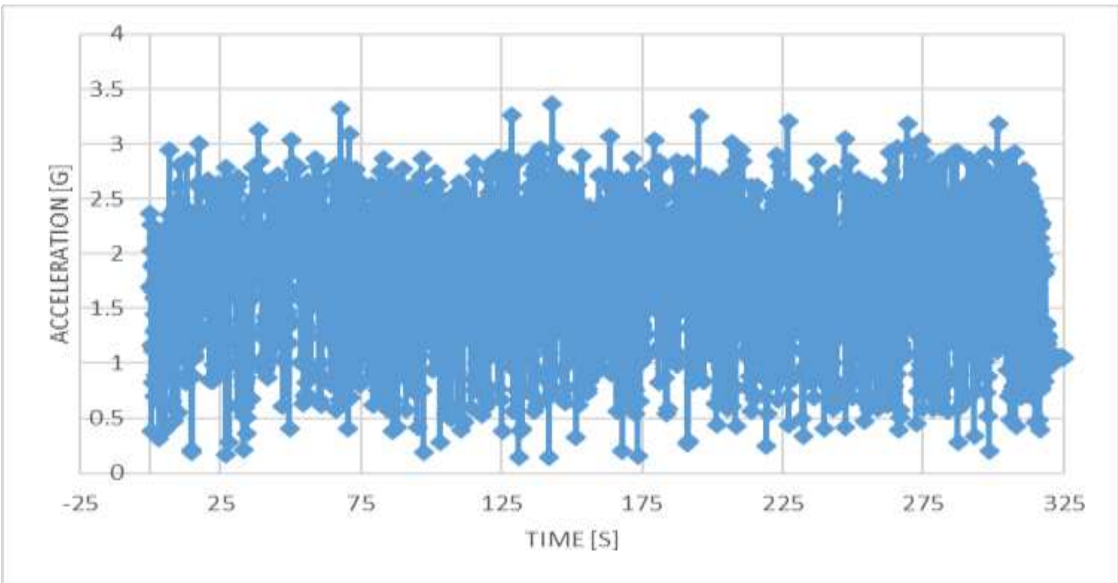

Fig. 7 - The scaled triaxial data averaged illustration

In the case of vibration transmitted to the hand-arm system, the European Union (Directive 2002/44/EC) established the requirements of the minimum health and safety exposure to vibration. They are two reference values: Exposure Action Value (EAV) of 2.5 m/s^2 and Exposure Limit Value (ELV) of 5.0 m/s^2 [5].

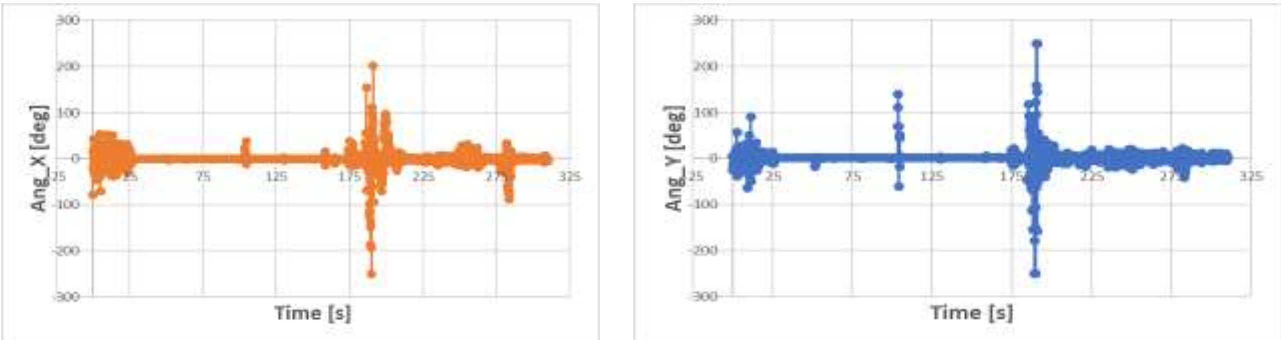

Fig. 8 - Gyroscope scaled data illustration

For a daily exposure duration of T = 0.17h. the evaluations for experiment presented showed the lowest A (8) values (0.338 m/s^2) below the vibration exposure action (EAV. Directive 2002/44/EC). According to ISO 5349-1 it would take over 52.5 years of exposure to vibration in the soil processing, so 10% of a population of exposed workers to develop Vibration induced White-Fingers.

Angular orientation scaled data is illustrated in Figure 8 (OX on the left graph. respectively. OY on the right graph). Data comes in 16 bits and subsequently it is converted into scaled data by using the scale constant quantity stated in the MPU 9250 datasheet [1]. The scaling is simply performed by dividing the raw data into the sensitivity constant which is 131.

CONCLUSIONS

A novel architecture for an economic smart vibration monitoring system is proposed and implemented in this paper. It gives a basic idea of how to estimate level risk of vibration exposure and provide a guidance of agricultural workers' security using Arduino UNO and MATLAB.

Identifying the symptoms of certain illnesses caused by exposure to vibration is not at all simple, requiring complex knowledge, both from the medical point of view and from that of vibration specialists.

Results of experimental tests have shown that the proposed system ensure optimal working conditions. However, in its current state, this prototype system is already prepared for deployment in real-world test beds and is an adequate low-cost alternative for much expensive vibrational measurement instrument.

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CONSIDERATIONS REGARDING THE IMPACT OF HEAVY METALS FROM SOIL ACCUMULATED IN FRUITS AND VEGETABLES, ON THE HUMAN HEALTH
/
CONSIDERATII PRIVIND IMPACTUL METALELOR GRELE DIN SOL ACUMULATE IN FRUCTE SI LEGUME ASUPRA SANATATII OMULUI

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Keywords: *heavy metal, soil, fruits, vegetables, human health.*

ABSTRACT

This paper presents considerations regarding the accumulation of heavy metals from soil in fruits and vegetables and the assessment of the impact of contamination produced by their consumption on human health. There are sites from different countries, such as: Italy, Serbia, China, Brasil, Romania, Spain, India, etc, contaminated with heavy metals (iron, copper, nickel, cadmium, manganese, zinc etc.), the bioaccumulation of metals in fruit and vegetables grown in the vicinity of the sites and the assessment of the health risk caused by their ingestion.

REZUMAT

Prezenta lucrare prezinta consideratii cu privire la acumularea metalelor grele din sol in fructe si legume si evaluarea impactului contaminarii produs de consumul acestora asupra sanatatii omului. Se prezinta situri din diferite tari, cum ar fi: Italia, Serbia, China, Brazilia, Romania, Spania, India, etc.. contaminate cu metale grele (fier, cupru, nichel, cadmiu, mangan, crom, plumb, zinc, etc), bioacumularea metalelor in fructe si legume cultivate in vecinatatea siturilor si evaluarea riscului de sanatate cauzat de ingestia lor.

INTRODUCTION

Vegetables are widely used for culinary purpose and are very important in human diet because of presence of vitamins and minerals salts. They contain water, calcium, iron, sulphur and potash. They also act as neutralizing agents for acidic substances forming during digestion. Therefore, fruits and vegetables are very useful for the maintenance of health as a preventive treatment of various diseases (Smriti P.R. et al., 2017).

Potentially, harmful metal contents in soils may come not only from the bedrock itself, but also from anthropogenic sources like solid or liquid waste deposit, agricultural inputs and fallout of industrial and urban emissions. Excessive accumulation in agricultural soils may result not only in soil contamination, but has also consequences for food quality and safety. Therefore, it is essential to monitor food quality, given that plant uptake is one of the main pathways through which heavy metals enter the food chain (Guerra et al. 2012). Water irrigation is among the major sources of soil contamination with heavy metals and an increased metal uptake by food crops grown on such contaminated soils is often observed (Ferré-Huguet N. et al.. 2008).

Ingestion of vegetables and fruits contaminated with heavy metals is one of the main ways in which these elements enter the human body. The consumption of foodstuff contaminated with heavy metals may lead to accumulation of these contaminants in different tissues causing both chronic and acute health outcomes, including kidney disfunction, polycythemia, bone fracture, respiratory illness, memory deterioration, asthma, heart problems, and various kinds of cancers . The control of heavy metals in foods including fruits and vegetables is of increasing importance (Roba C. et al.. 2016).

The study aim was to investigate the concentrations of potentially toxic elements (Pb, Cd, Cu, Ni, Cr, Mn, Zn, etc.) in soil, vegetables and fruits grown on polluted soils in many countries and to assess the health risk associated with exposure to these elements.

MATERIAL AND METHOD

The presence of heavy metals may have a negative influence on the quality of vegetables and fruits causing changes to their taste and smell. The term heavy metals applies to any metallic elements that has a relative density greater than 4 g/cm^{-3}. In the group of heavy metals one can distinguish both the element necessary for living organism and elements whose physiological role is unknown and those that are neutral for plants, animals and humans. Accumulation of heavy metals by vegetables may depend on plant species as well as temperature, moisture, organic matter, pH, nutrient availability and concentration of heavy metals. The total concentration of heavy metals in soil and water however varies from local to regional and further to continental level. The uptake and accumulation of Cd, Cr, Fe were higher during the summer due to high transpiration rate as compared to winters whereas Cu, Ni, Pb accumulated more in winter. Heavy metals exert toxic effect on soil. Metals are industrious natural contaminants, that have long biological half-lives and potential for accumulation in different body organs leading to unwanted side effect. Metal toxicity in plants is aggravated at higher temperature and low ph as it facilitates the mobility from roots to shoots hence results in the change of the diversity population size and over all activity of soil microbial communities (Smriti P.R. et al.. 2017).

Soil and vegetables sampling points were located in different parts of world. Samples came from 7 countries. The materials in the studies presented consisted of soil samples from arable fields, gardens located in polluted areas, mining areas and frequently consumed edible vegetables (carrot, parsley root, tomato, potato, green bean, cabbage lettuce, cucumber, onion, etc) and fruits (banana, lemon, papaya, strawberry, grape, apple, coco, etc) cultivated on sampling sites.

The analysis of vegetables and fruits proved they have different capacity of bioaccumulation, depending on plant species, type of metal, type of soil, etc (Roba C. et al.. 2016).

Analytical methods A sample of 0.5 g of soil was placed in a polytetrafluoroethylene (PTFE) vessel and a solution of concentrated nitric acid and concentrated hydrochloric acid (1:3. aqua regia) was added. The vessel was sealed and heated in a microwave digester for a specific period of time. After cooling, the vessel was allowed to settle and then diluted to a specific volume (100 mL).

As regards fruits and vegetables, approximately 1–2 g sample (wet weight) was digested with 5 mL of nitric acid and 2 mL of hydrogen peroxide in a PTFE vessel. The resultant digestate was diluted to a final volume of 50 mL. For all the matrices, Cd, Pb and Zn contents were measured by inductively coupled-mass spectrometry (ICP-MS), using a quadrupole inductively coupled plasma mass spectrometer Agilent 7500a (Agilent Technologies. USA) equipped with a Babington nebulizer, a Peltier-cooled quartz spray chamber and a standard torch (2.5 mm i.d.). The As content was measured by an inductively coupled plasma optical emission spectrometry (ICP-OES) using a spectrometer with an axially viewed configuration (VISTA PRO. Varian. Australia), equipped with a solid-state detector, Stumar-master mist chamber and V-groove nebulizer (Beccaloni E. et al. 2013).

Samples were analysed by atomic absorption spectrophotometry (AAS) and instrumental neutron activation analysis (INAA). (Antoine J.M.R. et al.. 2017).

The concentrations of arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni) and lead (Pb) were determined by inductively coupled plasma-mass spectrometry (ICP-MS, Perkin-Elmer Elan 6000), using rhodium as an internal standard. Manganese (Mn) levels were determined by inductively coupled plasma-optical emission spectroscopy (ICP-OES, Perkin Elmer Optima 3200 RL). In brief, approximately 0.5 g of sample was predigested with 5 ml of nitric acid (65% Suprapur. E. Merck. Darmstadt, Germany) in hermetic Teflon vessels for 8 h at room temperature. Solutions were heated at 80°C for 8 h. On completion of the digestion and after adequate cooling, solutions were filtered and made up to 25 ml with ultrapure water. Two aliquots were separated and kept frozen at −20°C until analysis. The analytical procedure has been reported in the paper (Ferré-Huguet N. et al.. 2008).

RESULTS

In many papers, heavy metal concentrations varied among different vegetables and fruit species due to their different absorption capacity and the regional soil and atmospheric degree of pollution.

The concentrations of heavy metals were determined in soil and in vegetable food samples, the results being presented in the table 1.

Table 1

The Mean concentrations of the soil and food categories

Food categories	**Median concentration of element [mg/kg fresh weight]**											**Study area/ Concentrations in soil [mg/kg]**	**Reference**
	Al	**As**	**Cd**	**Pb**	**Zn**	**Cr**	**Ni**	**Cu**	**Fe**	**Mn**	**Co**		
Leafy vegetables	-	0.065	0.353	0.374	12.783	-	-	-	-	-	-	***N-E Sardinia. Italy***. pH = 7.0; As (0.7-17); Cd (0.001-16); Pb (4.6-457); Zn (24-1075)	Beccaloni E. et al. 2013
Tomatoes	-	0.041	0.101	0.301	6.867	-	-	-	-	-	-		
Roots and onions	-	0.120	0.195	0.210	25.276	-	-	-	-	-	-		
Citrus fruit	-	0.119	0.009	0.152	5.829	-	-	-	-	-	-		
Other fruit	-	0.055	0.031	0.379	9.757	-	-	-	-	-	-		
Cabbage	8.49	0.001	0.041	0.003	-	-	-	-	-	-	-	***Jamaica***	Antoine J.M.R. et al.. 2017
Carrot	4.25	0.004	0.031	0.006	-	-	-	-	-	-	-		
Tomato	12.89	0.012	0.266	0.021	-	-	-	-	-	-	-		
Banana	93.12	0.104	0.057	0.010	-	-	-	-	-	-	-		
Coco	3.28	0.006	0.079	0.017	-	-	-	-	-	-	-		
Broccoli	-	-	0.065	0.083	2.172	0.095	0.291	0.560	-	-	-	***Pearl River Estuary. China***. pH = 6.3; Cd (0.858); Pb (48.7); Cr (112.4); Cu (57.3). Zn (210.8). Ni (40.0)	Li Q..S. et al.. 2012
Tomato	-	-	0.020	0.023	1.143	0.037	0.054	0.515	-	-	-		
Cucumber	-	-	0.009	0.023	1.615	0.008	0.074	0.516	-	-	-		
Cabbage	-	-	0.048	0.074	2.311	0.064	0.201	0.345	-	-	-		
Banana	-	-	0.006	0.114	3.725	0.518	0.577	1.016	-	-	-		
Papaya	-	-	0.002	0.051	1.955	0.109	0.240	0.340	-	-	-		
Root parsley	-	-	0.04	0.66	7.74	-	0.49	6.66	99.02	8.10	-	***mining areas of Romania***	Gergen I. Et al. 2012
Root carrot	-	-	0.03	0.09	3.18	-	0.08	1.54	31.89	2.22	-		
Onion	-	-	0.01	0.03	0.78	-	0.01	0.25	1.56	0.32	-		
Cabbage	-	-	0.06	0.25	8.51	-	0.33	2.77	31.53	9.15	-		
Lettuce	-	-	0.09	0.21	5.14	-	0.18	2.22	13.60	4.12	-		
Cucumber	-	-	0.15	0.37	1.39	-	0.54	2.42	2.38	6.01	-		
Green Bean	-	-	0.07	0.19	10.17	-	0.52	1.45	21.65	4.77	-		
Banana	-	-	0.06	0.68	-	0.34	0.27	-	-	-	0.10	***São Paulo State. Brasil***	Guerra et al.. 2012
Lemon	-	-	0.03	0.47	-	0.30	0.22	-	-	-	0.13		
Apple	-	-	0.02	-	-	-	0.05	-	-	-	0.08		
Papaya	-	-	0.01	0.58	-	0.09	0.40	-	-	-	0.15		
Strawberry	-	-	0.03	0.4	-	0.04	0.10	-	-	-	0.14		
Grape	-	-	0.07	0.39	-	-	0.03	-	-	-	0.12		
Iceberg Lettuce	-	-	0.03	0.41	-	0.20	0.13	-	-	-	0.07		
Cabbage	-	-	0.12	1.66	-	0.39	0.54	-	-	-	0.51		
Carrot	-	-	0.03	0.38	-	0.09	0.11	-	-	-	0.15		
Tomato	-	-	0.03	0.17	-	-	0.20	-	-	-	0.15		
Green Bean	-	-	0.07	0.75	-	0.15	0.19	-	-	-	0.30		
Mandarin	-	-	-	0.04	-	-	0.11	0.44	-	0.25	-	***Catalonia. Spain***	Ferré-Huguet N. et al.. 2008
Orange	-	-	-	0.02	-	0.13	0.20	1.00	-	2.14	-		
Pear	-	-	-	0.01	-	-	0.05	0.60	-	0.28	-		
Apple	-	0.05	-	-	-	-	-	0.40	-	0.30	-		
Artichoke	-	-	-	0.02	-	0.13	0.23	1.00	-	2.14	-		
Tomato	-	-	-	-	-	-	-	0.26	-	0.46	-		
Cauliflower	-	-	-	0.02	-	-	-	0.36	-	1.76	-		
Lettuce	-	-	-	-	-	-	0.05	0.29	-	0.91	-		

The translocation capability of heavy metals from the soil to the edible part of crops can be described using an accumulation factor (AF). The heavy metal concentrations in crops of dry weights were used in the calculations. The AFs of Cd, Zn, Pb, Cu, Cr and Ni were calculated as follows (Li Q..S. et al.. 2012):

$$AF = \frac{\text{Metal concentration in edible part of crop (dry weight)}}{\text{Metal concentration in root soil (dry weight)}}$$

The paper (Ličina V. et al. 2017) provides evidence for highly variable AF's within and between agricultural species, illustrating the mobility of Ni and Cr transfer from the root in aerial (aboveground) parts of agricultural plants. AF values for aboveground plant parts were below 1 (fig. 1), indicating that the tested agricultural species were also suitable for phytostabilisation of these metals by roots. Moreover, according to the obtained AF, the root was the preferential HM storage organ in the studied plant species. Chromium uptake by plants at the studied sites (mine topsoils) was lower than their Ni uptake (fig. 1). However, the present results of AF values for plant varieties which have edible roots/tubers (potato, carrot). do not support the elevated Cr content in plant tissues and could not be recommended as an evaluation factor of plant pollution.

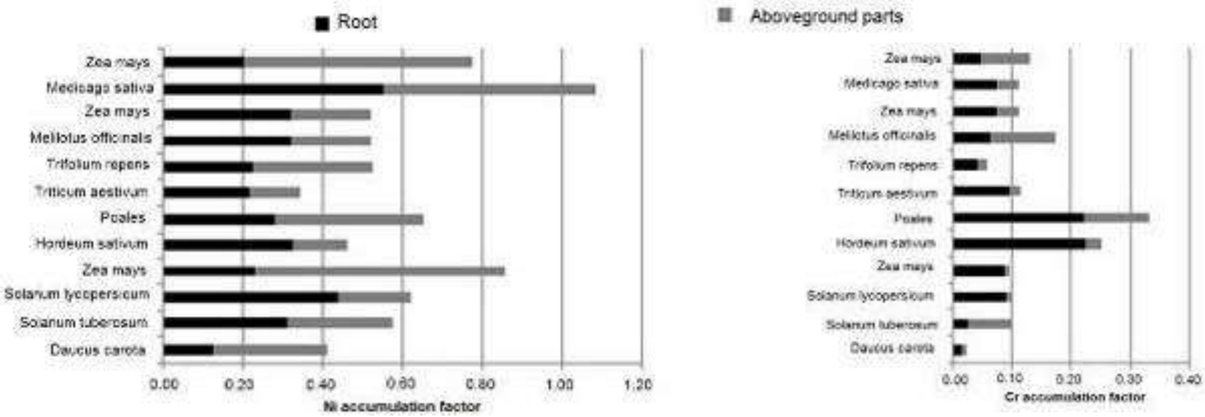

Fig. 1 - Accumulation factor (AF) of Ni and Cr in root and aboveground parts of different agricultural species grown on mine topsoil (Ličina V. et al. 2017)

The paper (Lacatusu et al.. 2008) presents some results concerning the relationships soil-plant and absorption of heavy metals in edible part of vegetables and fruits, in three areas (Copşa Mică - Sibiu County, Zlatna – Alba County and Baia Mare – Maramures County) from Romania, very strongly polluted with heavy metals caused by nonferrous ores extraction and metallurgical processing. In areas polluted, soils planted with vegetables are predominantly acidic, with small areas neutral or slight alkaline, oligo-mezo-basic. Investigated soils are diversely supplied with humus and total nitrogen, with content from low to medium phosphorus and potassium mobile.

Heavy metals contents in vegetables and fruits analytical data are presented as medium values in figure 2.

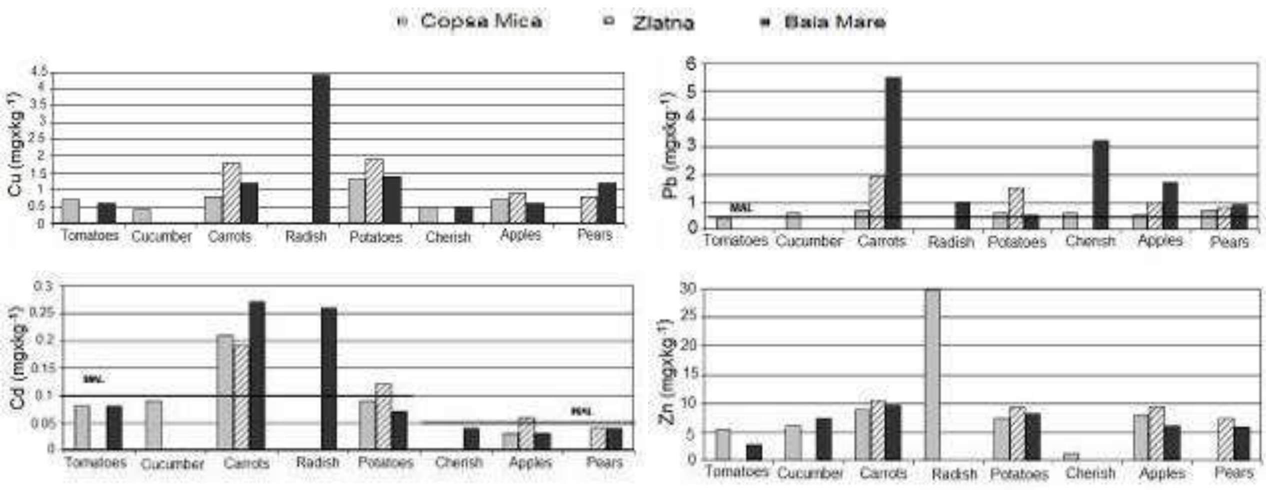

Fig. 2 - Medium copper, lead, cadmium and zinc content in edible parts of some fresh vegetables and fruits collected in areas polluted, as comparing with maximum allowable limits (MAL) (Lacatusu et al.. 2008)

In the paper (Nedelescu M. et al.. 2017) presented a study of daily intake by resident population in Copsa Mica 62 subjects and in Zlatna region 68 subjects. Food consumption in the studied areas showed an average consumption of 0.95 kg potatoes per person per week. 0.36 kg carrots/week. 0.42 kg yellow onion/week in Copşa Mica. and respectively 1.12 kg potatoes per person per week. 0.30 kg carrots/week and 0.48 kg onion/week in Zlatna. these three vegetable types being the most consumed local products among the vegetables and fruits included in the food frequency questionnaire. The corresponding estimates for daily intake values ofmetals were compared with the provisional tolerable daily intakes (PTDIs) recommended by the Joint FAO/WHO Expert Committee on Food Additives (JECFA. 2014) (Table 2). The results for total daily intake of metals exceeded such values for Pb and Cd both in Copşa Mica and Zlatna (JECFA. 2014). Daily intake rate of Pb was found 2.4 times higher in Copşa Mică. and 1.2 higher in Zlatna than the international norms. Daily intake of Cd was exceeded 9.1 times in Copşa Mică. and 5.5 times in Zlatna area (Table 2).

Table 2

Daily intake rates of metals through the local vegetable consumption calculated in the study regions (Nedelescu M. et al.. 2017)

Metal	Daily intake rates of metals						PTDI* (mg/kg bw)	Equivalent per day (mg/day)**
	Copsa Mica			Zlatna				
	Potato	Carrot	Onion	Potato	Carrot	Onion		
Pb	0.16	0.32	0.03	0.15	0.086	0.017	0.0035	0.21
Cd	0.13	0.25	0.17	0.187	0.063	0.081	0.001	0.06
Cu	4.9	0.75	0.51	5.9	0.53	0.8	0.5	30
Zn	15.23	3.74	8.39	19	2.2	5.4	1	60

* JECFA.2014

** For an adult with 60 kg body weight

Heavy metal content in vegetables and fruits cultivated in Baia Mare mining area (Romania) and health risk assessment are presented in the paper (Roba C. et al.. 2016). The estimated daily intake rates (DIR) (µg/day kg body weight) of heavy metals caused by vegetables and fruits ingestion are presented in fig. 3. The contribution of heavy metals to total DIR followed the order of Zn>Cu>Pb>Cd. The higher levels of DIR were caused by consumption of root vegetables. while the lower DIR were caused by the ingestion of fruits.

The DIR for Zn and Cu were higher in rural areas. while for Pb and Cd. the DIR were higher in urban areas. close to the nonferrous metallurgical plants SC Romplumb SA and SC Cuprom SA. Due to the lower body weight. the daily intake rates (µg/day kg body weight) were generally higher for females and children than those recorded for males (fig. 3). High concentrations of Cu and Zn are toxic to the ecosystem and human health. although they are essential microelements for plants. animals. and humans Continuous intake of high levels of Cu and Zn over an extended period can cause anemia. damage of the pancreas. liver. and kidney. and decrease in the levels of high-density lipoprotein cholesterol.

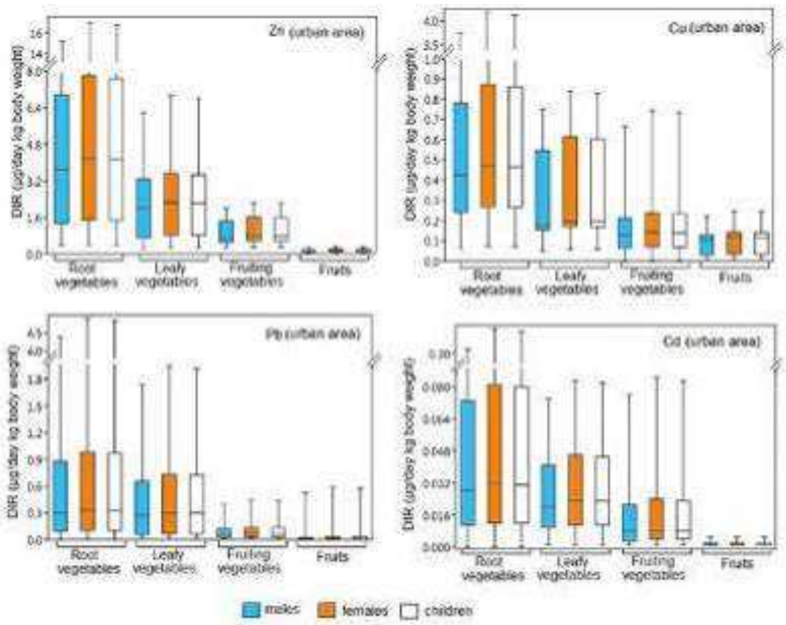

Fig. 3 - The estimated daily intake rate (DIR) (µg/day kg body weight) of heavy metals caused by vegetables and fruits ingestion (fresh weight) (Roba C. et al.. 2016)

CONCLUSIONS

This research can represent a useful tool for the risk managers in order to apply the appropriate prevention measures and to give key recommendations in order to protect the health of the population in the specific study areas.

Consumption of fruits or vegetables contaminated with heavy metals by humans could lead to changes in health of the inhabitants of polluted areas and can contribute to the emergence of various chronic diseases. The phenomenon has become alarming for people who systematically eating such vegetables and fruits produced in their own gardens located in polluted areas.

This legacy of heavy metals pollution generated by industrial society put pressure on human health all over the world. Finding a solution for this situation is a permanent task of researchers, which involves not only finding new and advanced analytical methods to identify quality and quantity of contaminants, but also applying complex statistical methods that allow an overall assessment of the interaction of these contaminants in the food chain and the health risk associated with their consumption by humans.

Overall, findings suggest the need for a careful assessment of vegetable metal content as well as soil quality monitoring in contaminated areas, to reduce health risks to consumers of these foodstuffs and of the local population.

ACKNOWLEDGEMENT

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THE EFFECT OF MOISTURE CONTENT ON SOME PHYSICAL PROPERTIES OF CORN GRAIN
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INFLUENȚA CONȚINUTULUI DE UMIDITATE ASUPRA UNOR PROPRIETĂȚI FIZICE ALE PORUMBULUI

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ABSTRACT

Cunoașterea proprietăților fizice ale cerealelor este fundamentală în optimizarea proiectării echipamentelor fluxului tehnologic de prelucrare. Lucrarea prezintă evaluarea unor proprietăți fizice ale semințelor de porumb mărunțite cu o moară cu cilindri riflați (soiul Bărăgan 48). care influențează operațiunile de transport, depozitare și procesare a acestora. în funcție de variația conținutului de umiditate de la 11 la 15%. A fost pus în corelație conținutul de umiditate cu diametrul mediu al particulelor mărunțite, prin analiza granulometrică a acestora, precum și cu gradul de mărunțire. Corelația a fost testată cu legi de distribuție de tip linear, putere și exponențială, coeficienții de corelație având valori relativ ridicate ($R^2 > 0.89$). Pentru masa volumică și unghiul de taluz natural a fost testată corelația cu legea de distribuție de tip linear, coeficientul de corelație fiind $R^2 = 0.9447$ și respectiv $R^2 = 0.9244$. Distribuția granulometrică a măcinișului a fost descrisă cu rezultate bune de legea de distribuție de tip Rosin-Rammler, coeficientul de corelație având valori $R^2 \geq 0.996$.

REZUMAT

The knowledge of physical properties of grains are fundamentals in order to optimize the design of equipment of the processing technological flow. A study was conducted to evaluate some physical properties that affect transportation, storage, processing of grist corn (Bărăgan 48) as a function of moisture content varying from 11 to 15%. It was correlated the moisture content of the initial material with the mean diameter of the particles, by its granulometric analysis and the grinding index. This correlation is expressed by linear, power and exponential type distribution functions, the correlation coefficients having relatively high values ($R^2 > 0.89$). For bulk density and natural slope angle, the correlation was tested by linear distribution function and the correlation coefficient having values of $R^2 = 0.9447$ and $R^2 = 0.9244$, respectively. The granulometric distribution of corn grist (particle size distribution) has been described with good results by the Rosin-Rammler function, which the correlation coefficient values have been $R^2 \geq 0.996$.

INTRODUCTION

Corn (*Zea Mays L.*) is a cereal of high productivity ranking the second place in the global hierarchy, after wheat. Due to its complex chemical composition, corn is a valuable product for both humans and animals. The physical characteristics of corn seeds vary according to variety, climate, harvesting, transport and storage conditions (humidity and temperature of drying air, drying time) [12].

Knowing and studying the physical properties of cereals is fundamental in the management and optimization of handling, transport, conditioning (storage, sorting, drying), storage and optimization of processing technologies. The shape and main dimensions of corn seeds influence the cleaning and sorting process with a particular importance in the correct choice of the shapes and sizes of the separation holes. Density, bulk density and porosity are of practical importance in the cleaning and sorting, drying and aeration processes of seeds, as well as in the efficient handling of storage areas or transport. The specific surface affect drying process or occurs in the problems of appreciation of the grinding energy consumption. Also, the coefficient of friction on surfaces of different materials occurs in transport, separation, flow and bulk storage of the grain [4.7.9.10.21]. Physical properties are important parameters according to which the quality of cereals is determined.

Moisture is the amount of water contained in the mass of the seeds expressed as a percentage, based on the wet weight of the substance (100%) [2.11]. Moisture is a quality parameter that exerts a profound influence on the physical and mechanical properties of grain seeds as well as on processing technology. The grain seed dimensions increase as the moisture content increase. Thus, in the paper [7] it was shown that for wheat seeds with a moisture content of 8%, the mean values for length, width and thickness were 6.78 mm, 3.45 mm and 2.84 mm, respectively and at increasing the moisture content to 18%. the mean values of the dimensions increased to 6.86 mm, 3.47 mm and 2.74 mm, respectively. For corn grains with a moisture content variation of 5.15% to 22%, mean values of length, width and thickness increased from 11.33 mm, 7.93 mm to 4.69 mm, respectively at 12.06 mm, 8.11 mm and 4.77 mm. [16]. The same has been shown in many other papers in the literature [1.8.13.15]. The variation in the moisture content from 8.7% to 21.7% resulted in an increase of 1000 kernel weight and volume from 287.25 to 347.25 g and 296.27 mm^3 to 351.28 mm^3, respectively) [13]. Increasing cereal moisture content results in increased density and porosity [10]. This is demonstrated in many specialized papers regarding the corn seeds. In the paper [14] was shown that for corn seeds moisture content values ranged from 4.73 to 22%, the density and porosity increased from 1250 to 1325 kg/m^3 and from 43.2% to 51.02%, respectively; on the other hand, the density decreased of 710 to 649 kg/m^3.

The knowledge of grist granulometric characteristics is important for establishing and adapting the constructional characteristics of roller mills and equipment of sorting from the milling unit.

The paper shows the results of some experimental researches regarding the variation of some physical properties of the corn grist, Bărăgan 48 variety (mean diameter, grinding index, bulk density, natural slope angle) in relation to the moisture content (between 11 and 15%).

MATERIAL AND METHOD

In the present paper, experimental researches have been carried out on corn seeds of the Bărăgan 48 variety from the 2014 production. Researches had the purpose of determining the *influence of the seed moisture on grinding index, the mean diameter of the grinding particles, the bulk density and the natural slope angle.*

In order to modify the moisture content, which initially was 11%, three samples of Bărăgan 48 corn seeds were subjected to a wetting process. The amount of water required to bring the moisture content to the values 13%. 14% and 15% was determined and the three samples with an initial seed mass of 500 g each, were sprinkled, homogenized, placed in sealed vessels and left to rest for about 30 hours. The samples were grinded with the help of the laboratory mill (figure 1) with two rollers with rifled surface and the revolution ratio of about 2.5: 2. Other features of laboratory mill: the length of the milling cylinders is 345 mm, the grinding roller diameter is 110 mm; the flutes have a zero inclination to the horizontal, their number on the cylinder circumference is 310 flutes/cm. During functioning, the speed of the fast roller was about 550 rpm and the distance between the cylinders was, for all three samples, at e = 1 mm.

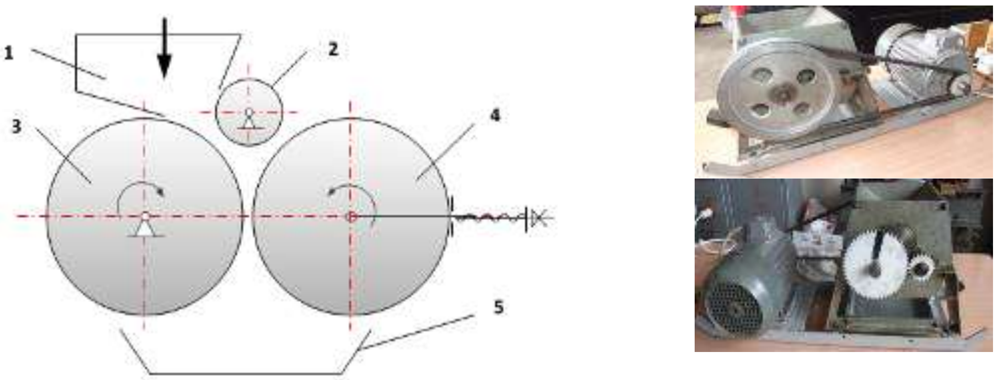

Fig.1 - Scheme of laboratory mill with fluted rolls [19]

1.feed vat; 2. feed roller; 3. fast grinding roller; 4. slow grinding roller; 5. collector tray; 6. electric drive motor

Grinding index (appreciated by λ index) and the mean diameter (d_m). of the grist were determined by granulometric analysis with the help of the classifier. Analysette 3 Spartan model provided with 5 overlapping sites, placed in descending order of mesh size (from up to down), fixed in a block with oscillating motion at an amplitude of 2 mm. The grinding degree represents the ratio of the average equivalent dimensions of the material particles before and after grinding (D_e/d_m) or the ratio between the specific surface area of particles results after grinding and the initial specific surface area of the particle subjected to grinding. (S_f/S_i). [17.18]:

$$\lambda = \frac{D_e}{d_m} \quad \text{or} \quad \lambda = \frac{S_f}{S_i} \tag{1}$$

The methodology of the experimental measurements was the one presented in the paper [17] and the processing of the obtained data was done using Excell program. There were calculated, for the grinding material, cumulative weights (%) of material that passed through the mesh sites T(x) and those left on the sites R(x).

Mean diameter was determined with the following equation:

$$d_m = \frac{\sum_{i=0}^{n} p_i d_i}{\sum_{i=0}^{n} p_i} \tag{2}$$

where: p_i represents percentage of material on the sieve of the sieve shaker (i = 0. 1. 2..... 5); $\Sigma p_i = 100$ – sum of the percentages of material on sieves; d_i – average particle size of each intermediate fractions, considered as an arithmetic mean of sieves size apertures surrounding the respective fraction $d_i = (l_i+l_{i+1})/2$. Classifier sieves were chosen to meet the estimated relationship from the topper to the lower sieve.

For *particle size distribution* was used MS EXCEL and were drawn the real curves for cumulative distribution of material percentages sifted by sieve T(x). the percentage of material refused by sieve R(x) and the percentage of material remained on each sieve p(%). Real curves of cumulate distribution for particles size of wheat millings are characterized by Rosin-Rammler law, given by the relationships [5.6]:

$$T(x) = 100 \cdot \left(1 - e^{-b \cdot x^n}\right) \tag{3}$$

$$R(x) = 100 \cdot e^{-b \cdot x^n} \tag{4}$$

where T(x) – represents mass percentage share of the fraction with particles smaller than x (passed through the sieve with size x); and R(x) – mass percentage share of the fraction with particles bigger than x (don't pass through the sieve with size x); x - apertures size sieve by which particles have passed; b and n – coefficients of the grounded material.

The natural slope angle represents the angle which makes the free surface of a poured seed mass, on a surface, with the horizontal plane. In order to determine the natural slope angle, the material cone method with the cylinder device was used, shown in [3].

The bulk density of a granular mixture is the mass of the material reported to the total volume they occupy in the natural state. Thus, the bulk density was determined using a 200 cm^3 laboratory flask and an electronic balance with precision of 10^{-1} g. The bulk density (ρ_v) was calculated with the equation:

$$\rho_v = \frac{m}{V_t} \tag{5}$$

where: *m* represents the mass of the sample of the total volume $V_t = 200\ cm^3$.

They have been correlated the moisture content of the material with the degree of grinding and with the mean diameter of grinded particles through the functions: linear distribution function (eq. 6), power function (eq. 7), exponential function (eq. 8).

The distribution functions used for correlations are as follows:

- Linear distribution function:

$$y=a+bx \tag{6}$$

- Power distribution function:

$$y = ax^b \tag{7}$$

- Exponential distribution function:

$$y = ae^{-bx} \tag{8}$$

where: *a* and *b* are experimentally determined coefficients, which take into account the physical characteristics of the material and the constructive characteristics of the mill.

RESULTS AND DISCUSSION

Figure 2 shows the appearance of the grinded material for the four samples of corn seeds at different moisture contents.

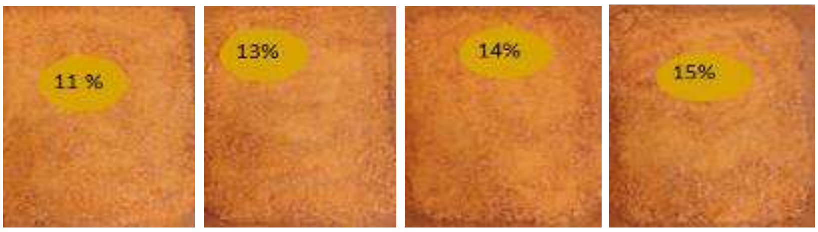

Fig. 2 - The appearance of the four samples of grinded material

The results obtained from the conducted experiments are shown in the table 1.

Table1

Experimental research results on grinded indices of corn seeds

Material sample	Moisture content. *u* (%)	Mean diameter of grist. d_m (mm)	Grinding index. λ	Bulk density. ρ_v (kg/m^3)	Natural slope angle Φ
Sample 1	11	1.52	5.19	1006	51
Sample 2	13	1.58	5.00	825	51.56
Sample 3	14	1.66	4.75	771	52.43
Sample 4	15	1.77	4.46	749	53.27

In the graphs from fig. 3 is presented the mean diameter variation of the grist particles obtained by grinding with the mill with fluted cylinders, depending on the moisture content. The variation curves were plotted by regression analysis of experimental data with linear, power and exponential distribution laws. It can be observed that the mean particle diameter increases as the moisture content of the seeds increases. Thus, the mean diameter ranges from 1.52 mm for seeds with a moisture content of 11% to 1.77 mm for seeds with a moisture content of 15%. As the moisture content increases, the mean diameter of the grinded particles is increasingly higher. This is explained by the fact that with increasing moisture content the seed coat is softer, the endosperm is no longer fragile, no longer broken into small particles, the seeds being compressed (flattened).

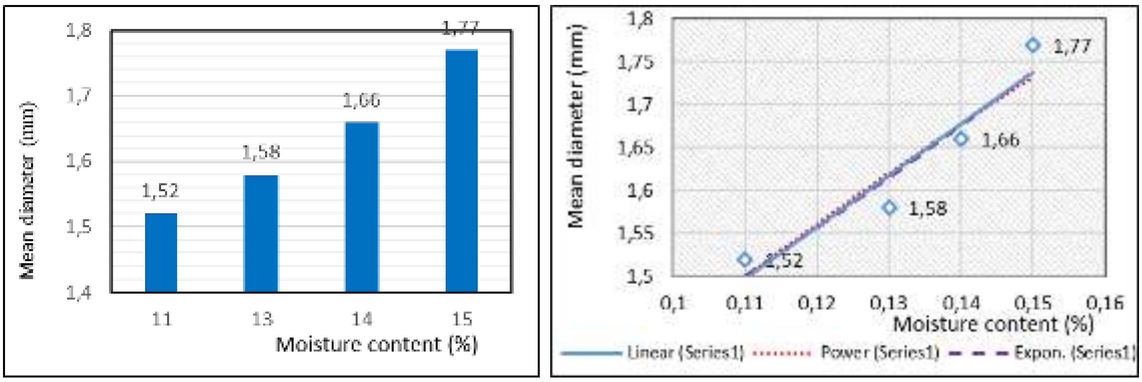

Fig. 3 – Mean diameter variation of the grist particles with the moisture content

Figure 4 shows the variation of the grinding index of corn seeds with the moisture content, the curves being obtained by regression analysis of the experimental data with linear, power and exponential distribution laws. There was a good correlation of the three laws with experimental data, the correlation coefficient R^2 having values above 0.89 in all cases. Table 2 presents the values of the correlation coefficients R^2.

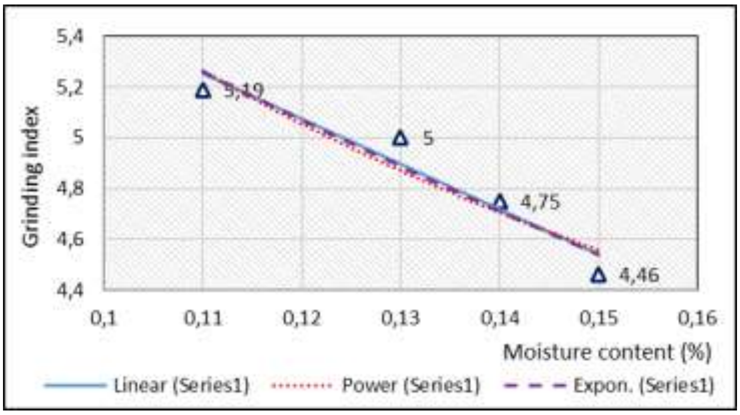

Fig.4 – Variation curves of the grinding index depending on the material moisture content

From the analysis of the grinding material and the graph of Figure 4 it is found that the grinding index depends very much on the moisture content of the material. Grinding index decreases with increasing of the moisture content**.** If at 11% moisture content, the grinding index is about 5.19%, at 15% moisture content it decreases to about 4.46.

Table 2

Correlation coefficient values

Function	Mean diameter			Grinding index		
	Parameter			Parameter		
	a	b	R^2	a	b	R^2
Linear function	0.833	6.028	0.907	7.212	-17.829	0.927
Power function	4.194	0.466	0.892	1.885	-0.465	0.889
Exponential function	0.999	3.690	0.918	7.890	-3.684	0.916

Table 3 presents the results obtained from the granulometric analysis and the sieves of classifier used for analysis grinded corn products at different moisture content.

Table 3

The ponder values (%) p_i of the fractions from the sieving machine classifier sieves and of the cumulative weights R_i (%) for the grist corn

l_i (x) (mm)	u=11%		l_i (x) (mm)	u=13%		u=14%		u=15%	
	p_i (%)	R_i (%)		p_i (%)	R_i (%)	p_i (%)	R_i (%)	p_i (%)	R_i (%)
0.00	11.30	0.00	0.00	19.00	0.00	15.90	0.00	20.10	0.00
0.50	15.00	11.30	0.50	17.10	19.00	14.70	15.90	17.60	20.10
1.00	19.90	26.30	1.00	25.30	36.10	23.70	30.60	24.90	37.70
1.40	22.00	46.20	1.60	20.70	61.40	20.30	54.30	15.70	62.60
2.00	17.50	68.20	2.50	7.00	82.10	8.30	74.60	7.20	78.30
2.80	14.30	85.70	3.15	10.30	89.10	17.40	82.90	14.60	85.50
d_{m1} = 1.66 mm			d_{m2} = 1.53 mm			d_{m3} = 1.77 mm		d_{m4} = 1.58 mm	

The cumulative distribution curves for sifting and sieve refusal (R(x). T(x)) for the Rosin-Rammler distribution relationship (4) are shown in Figure 5.

The values of b and n coefficients form Rosin-Rammler cumulative distribution (4), as well as the values of correlation coefficient R^2, are presented in Table 4.

The profile of the regression curves is correlated with the experimental data obtained, showing inflection points depending on the weight of the material collected ob each of the sieves.

Table 4

The coefficient b and n and of the R_2 correlation coefficient for the Rosin-Rammler distribution function, for the grist products

Grist fractions	Coeff.	u=11%	u=13%	u=14%	u=15%
R(x). T(x)	b	0.337	0.498	0.395	0.509
	n	1.730	1.350	1.328	1.204
	R^2	0.998	0.998	0.997	0.996

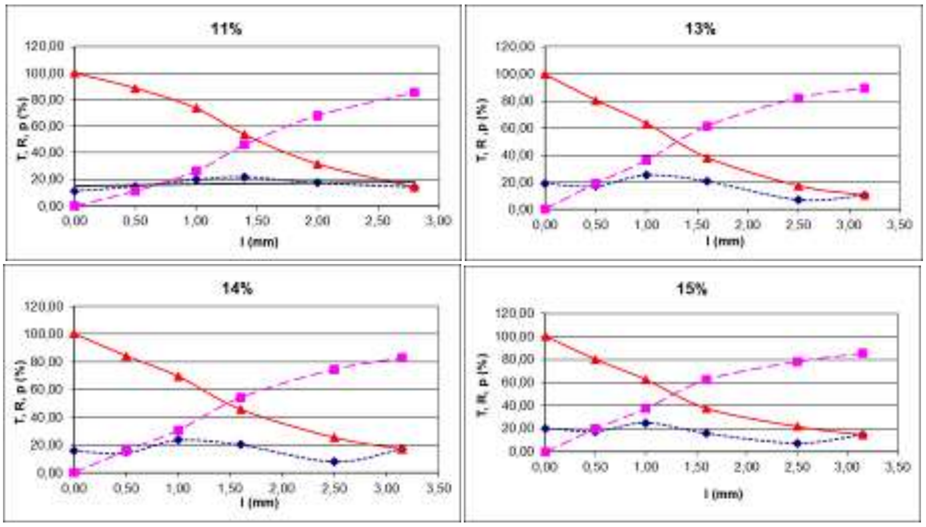

Fig. 5 - The variation curves of sifting percentages, refusal rates and the the distribution of material on sives depending on size of the sieve holes

■ – T – cumulative percentages of material that passed through of the sieve; ▲ – R – cumulative percentages of material remaining on sieve; ♦ - p – percentage of material remaining on eah sieve.

It is observed that the granulometric distribution of grist corn with different moisture level is very well described for Rosin-Rammler distribution. The same results were also obtained in the granulometric analysis of the intermediate products of grist from a wheat mill [17. 20], when multiple distribution laws were tested of which the Rosin-Rammler function the best-described granulometric distribution. The variation of bulk density of corn grist with moisture levels are shown in figure 6. The bulk densities were observed to decrease linearly from 1006 to 749 kg/m^3 as moisture level increased from 11 to 15%.

The linear relationship between bulk density and moisture content level can be expressed by equation (9):

$$\rho_v = -66.371 \cdot u + 1717.2 \quad (R^2 = 0.9447) \tag{9}$$

The decrease of bulk density of ground corn as the moisture content increases is due to the higher rate of increase in volume relative to the increase in weight [15].

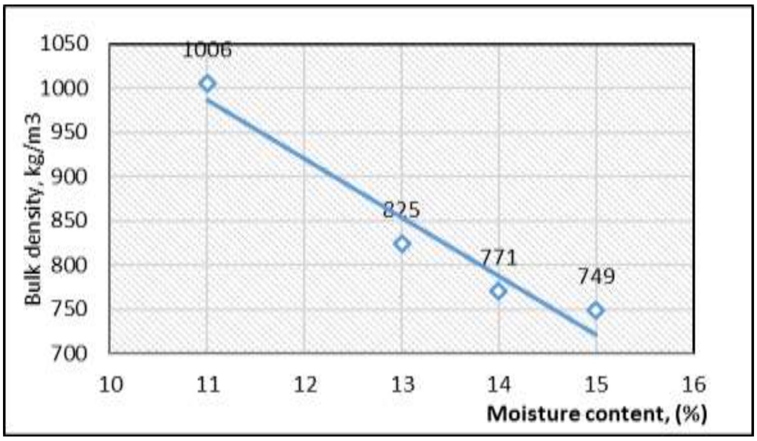

Fig.6 - Effect of variation in moisture content on bulk density of corn grist

Figure 7 showed the natural slope angle of corn grist increased linearly from 51 to 53.27° with increase in moisture content from 11 to 15%. The linear relationship between natural slope angle (φ) and moisture content can be expressed by equation (10):

$$\varphi = 0{,}5606 \cdot u + 44{,}637 \qquad (R^2 = 0.9244) \qquad (10)$$

The increasing trend of natural slope angle with moisture content occurs because the grain particles with high moisture content tend to adhere (to stick) together, which results in greater slope stability and less flowability [15].

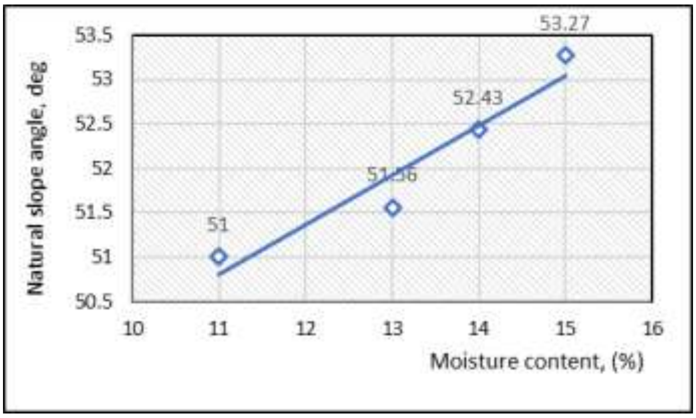

Fig.7 - Effect of variation in moisture content on natural slope angle of corn grist

CONCLUSIONS

In this study. some physical properties of grist corn were determined as a function of moisture content in the range of 11% to 15%. The results showed that the mean diameter of grist particles increased from 1.52 mm to 1.77 mm and the natural slope angle from 51.56° to 53.27°. The grinding index decreased from 5.19 to 4.46 and the bulk density from 1006 kg/m³ to 749 kg/m³.

The variation in corn seed moisture significantly influences the grain size characteristics of the grist. The results from this paper show that in case of corn seed grinding in a roller mill, at different moisture level, the granulometric distribution of grist (particle size distribution) can be described with the best results by the Rosin-Rammler function, which the correlation coefficient values have been $R^2 \geq 0.996$.

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ELECTROCHEMICAL REMEDIATION OF SOILS IN CASE OF A COMPLEX POLLUTANT MIXTURE
/
TRATAREA ELECTROCHIMICĂ A SOLURILOR ÎN CAZUL UNUI AMESTC COMPLEX DE POLUANȚI

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Keywords: *electrochemical treatment, PCBs, PAHs, heavy metals.*

ABSTRACT
This paper investigates the electrochemical remediation of polychlorinated biphenyl (PCB), heavy metals, PAHs and pesticides from contaminated soils. The research was performed by using industrial contaminated soil with heavy metals and artificially contaminated with PCBs and PAHs. The experimental work was developed in two phases: at laboratory and real scales in order to validate the results. At laboratory scale, the experiments were performed on three different installations (with three different dimensions). Specific voltage, current density, redox potential, time and pH values were monitored. The treatment efficiency was proven to work on organic pollutants, while for inorganic contaminants a very important factor that influenced the results was pH.

REZUMAT
Această lucrare investighează remedierea electrochimică a bifenililor policlorurați (PCB), metalelor grele, HAP-urilor și pesticidelor din solurilor contaminate. Cercetarea a fost realizată utilizând sol contaminat industrial cu metale grele și artificial cu PCB-uri și HAP-uri. Partea experimentală a fost realizată în două faze: la scară de laborator și la scară reală, în scopul validării rezultatelor obţinute. La scară de laborator, experimentele au fost efectuate pe trei instalații diferite (scări diferite ale instalaţiilor). În timpul testelor au fost luate în considerare tensiunile specifice, densitatea curentului, potențialul redox, timpul și valorile pH-ului. Eficiența tratamentului s-a dovedit a fi foarte bună pentru contaminanții organici, în timp ce, pentru contaminanții anorganici, un factor foarte important, care a influienţat rezultatele obţinute a fost pH-ul.

INTRODUCTION
Contaminated soils problem has become one of increasing importance from a practical, scientific and political point of view, both nationally and internationally, as one of the key themes within the European Union. Historic contamination has been a critical category of land pollution in recent years, partly because of the persistent nature of the contaminant in soil or groundwater, and, on the other hand, because it is more difficult to manage and solve compared with an accidentally pollution (Istrate et al. 2013; Lacatusu et al. 2013). The magnitude of the polluting phenomenon at global level does not take into account borders, the type of economic activity, climatic factors and extreme weather phenomena. Instead, pollution is dependent on the degree of civilization and best available techniques (BAT) applied to areas where this phenomenon has major implications for the environment and the human factor (Baciocchi et al. 2013).

MATERIAL AND METHOD

Method description
The principle of electrochemical remediation is based on the application of a low-intensity current to the polluted soil using electrodes that are introduced into the polluted environment and which can be made of different materials (stainless steel, graphite, precious metals, etc.). Current charged species are immobilized, causing movement of ions and water by electrodes. Current charged species are fixed, causing movement of ions and water by electrodes (Istrate et al. 2013; Cocarta et al. 2016b).

This method uses electrochemical and electro-kinetic processes for extracting and then removing pollutants, such as metals (Zheng et al. 2007).

The main part of the present experimental work was developed in the framework of a more complex research within a European project called RECOLAND. The electrochemical technologies tested across the cited project have been applied to both organic and inorganic pollution of soil.

Experimental activity

There have been made a number of tests on three experimental installations (Figure 1. Figure 2) at laboratory scale using on the one hand, historically polluted soil with heavy metals and, on the other hand, controlled contaminated soil with a series of organic compounds. The considered pollutants are characterized by a high degree of toxicity.

Besides the experimental part conducted at laboratory scale, the obtained results were validated by applying the electrochemical technology on a polluted soil with PCBs and HAPs at a real scale (in field remediation of the contaminated soil). One of the main objective of the experimental work was to test the electrochemical technology for various types of pollution: heavy metal pollution, PCBs, crude oil and complex pollution (the mixture of the above mentioned pollutants).

Through the activities proposed in the RECOLAND project, for the electrochemical treatment, it was wanted to investigate the applied treatment efficiency on different types of soil contamination.

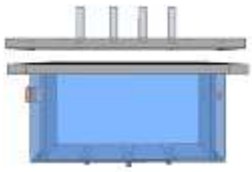

Fig.1 - IPER 1 experimental setup (dimensions: 200 mm x 100 mm x 100 mm)


Fig. 1 - IPER 2 experimental setup (dimensions 600 mm x 300 mm x 300 mm)

Table 1 shows the soil types, the class of pollutants with which the soil was contaminated and the experimental setup used to apply the electrochemical treatment to each type of soil.

Table 1

Soil groups used during experimental campaigns

Initial contamination of soil	Artificially contaminated soil	Experimental setup
Historically contaminated soil with heavy metals: Pb. Cd. Be. Cr. Ni. As. Hg	Controlled contaminated soil with PAHs (crude oil)	IPER 2
Historically contaminated soil with heavy metals: Pb. Cd. Be. Cr. Ni. As. Hg	Controlled contaminated soil with PCBs (transformer oil / condenser)	IPER 2
Historically contaminated soil with heavy metals: Pb. Cd. Be. Cr. Ni. As. Hg	Controlled contaminated soil with: PCBs and HAPs (mixture of transformer / condenser oil and crude oil)	IPER 1. IPER 2. IPER 3
Historically contaminated soil with heavy metals: Pb. Cd. Be. Cr. Ni. As. Hg	Not supplementary contaminated	IPER 1. IPER 2

Laboratory tests were performed varying the amount of treated soil (3 kg. 50 kg and 550 kg) by applying a constant voltage of 1 V/cm and using a treatment period of approximately 21 days (a 42-day test was also performed). Parameters that were monitored throughout the experiments were: current value, pH, ORP, temperature, humidity, conductivity and pollutant concentrations. In order to observe how the positioning at different electrode distances may affect the electrochemical process, it has been decided to establish three areas of interest: the area near the anode. the middle zone and the area near the cathode.

The specific objectives pursued were: testing the integrity of the three setups, with different dimensions; establishing parameters that influence the application and efficiency of electrochemical technology; identifying the key parameters that decisively influence the efficiency of electrochemical treatment; monitoring the variation of the main parameters characterizing the electrochemical process in order to observe the differences that may occur from one type of contamination to another; observing an eventual scale effect that could occur by changing the experimental setup.

In order to validate the results obtained on IPER 3, the electrochemical technology was applied in field, on a surface of 10 m^2 and a depth of 33 cm, for a period of 21 days. The experiment was performed on 5 active and 3 inactive cells (Figure 3).

At the end, the samples were taken as follows: 1 mixed sample from superior active cells (identified as cell 1, cell 2 and cell 3). 1 mixed sample from superior inactive cells (identified as cell 12 and cell 23), 1 mixed sample from lower active cells (identified as cell 4 and cell 5) and 1 mixed sample on the inactive cell (identified as cell 45). The cell positioning scheme is shown in the figure below.

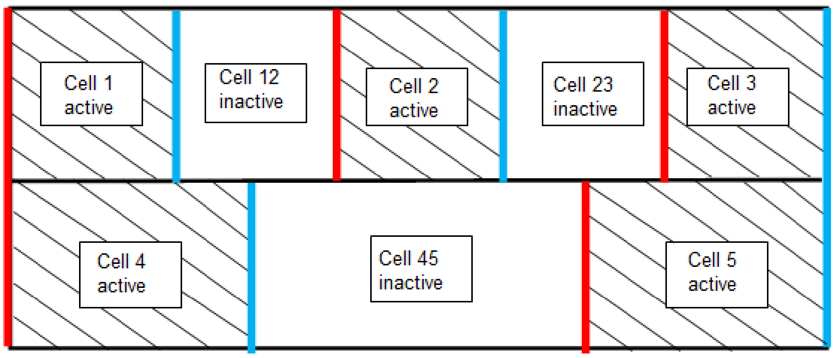

Fig.3 - Scheme of applying in field electrochemical treatment

RESULTS

For laboratory tests. good results were obtained especially for organic pollutants. Concerning the inorganic contaminants, good results were observed with regard to elements such as Pb, Cd, As and Hg (Figure 4).

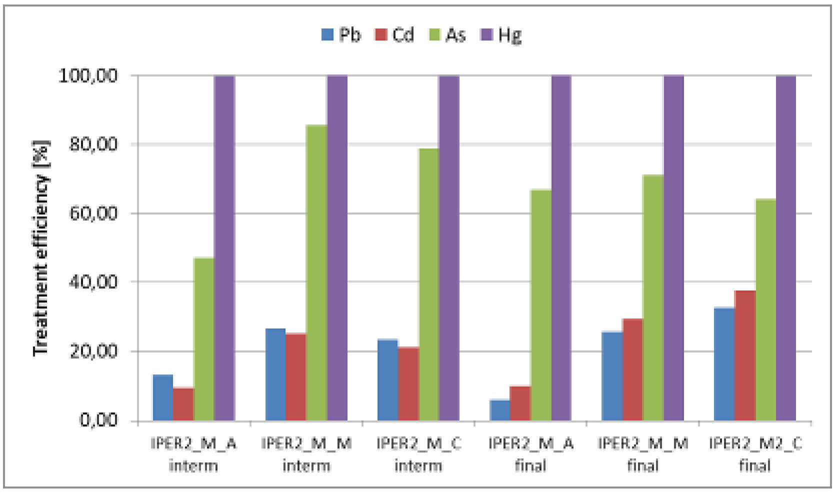

Fig.4 - Variation of electrochemical treatment efficiency for Pb, Cd, As and Hg

For Cd, treatment efficiency was positive but not satisfactory, reaching a maximum of 37.67% remediation percent. Improving this value would mean using another chemical substance to ensure a lower pH value that can be maintained throughout the treated soil sample.

Arsenic behaviour in the test is in accordance with the data retrieved in the literature. Consequently, it has a higher mobility in an alkaline medium (the fact observed in the intermediate sampling when it was a higher percentage of remediation in the middle and cathode areas and the pH did not reach the values present at the anode each time), in the present case especially for the middle and cathode, it can be said that there were periods of poor alkaline environment.

Pb has a good evolution, not satisfactory, but compared to the previous test on IPER 1 where the values at the end of the test are well above baseline; there are now efficiencies reaching 26%.

Treatment efficiency can be increased by increasing the period of treatment and by maintaining the acidic environment. Regarding the results obtained for organic pollutants (treated separately), it can state the following:

- By applying electrochemical treatment where the specific voltage is 1 V/cm and the treatment period of 21 days, an efficiency ranging from 60% to 85% for the ΣPCBs and from 46% to 100% for individual compounds of PCBs is obtained (Figure 5).

From a legislative point of view. the compounds also found in Order 756/1997 had the following average efficiencies: PCB 28 of 72%, PCB 52 of 19%, PCB 101 of 83%, PCB 118 of 86%, PCB 138 of 96 %, PCB 153 of 90%, PCB 180 by 87% and ΣPCB of about 75%.

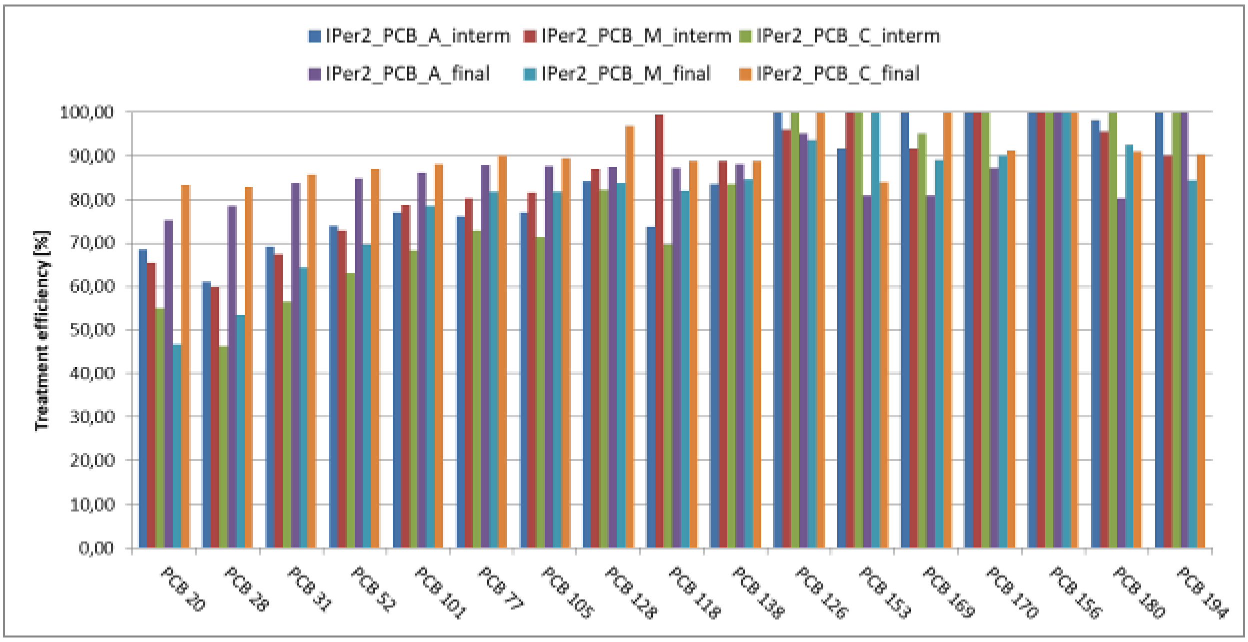

Fig.5 - Treatment efficiency for individually determined PCB types

In the framework of the present work, the attention was mainly focused on pollutants known as carcinogenic: namely benzo(a)pyrene, pyrene and the sum of PAHs and which were identified in the analysed soil. All three components have remediation rates higher than 90% and the mean final concentrations of 0.110 mg/kg for pyrene, 0.010 mg/kg for benzo(a)pyrene and 0.600 mg/kg for the sum of PAHs do not exceed any legal limit mentioned in the Romanian Ministry Order 756 of 1997.

Moreover, the values obtained from the treatment of benzo(a)pyrene and pyrene from the contaminated soil are within the normal range, while the ΣPAH exceeds the maximum limit for normal values but does not exceed the alert or intervention thresholds for sensitive or less sensitive uses of soil (the smallest value is 7.5 mg/kg $_{d.w.}$ for alert threshold in case of sensitive soil use).

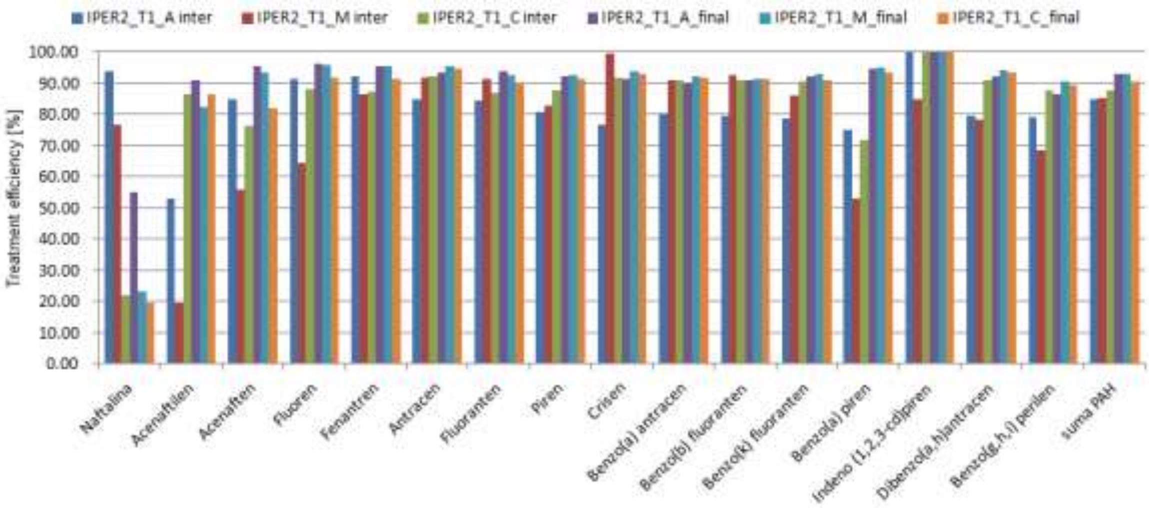

Fig.6 - Treatment efficiency for the 16 PAH compounds analysed, for 2 sampling times and three sampling areas

From the tests performed on the complex polluted soil by using IPER3 (PCBs and PAHs contamination), the following conclusions were drawn:

- Concerning the PAHs contamination, an efficiency ranging from 40% to 90% for individual compounds was achieved. but for the same compound and the same treatment time, but for a smaller volume treated, better efficiency has been obtained. So, in this case, the final concentrations dropped all in comparison with the initial concentrations (Figure 7).

- With regard to PCBs contamination, the level of concentrations in soil did not decrease significantly compared to the original soil as compared to the situation of PAHs; for some compounds the concentration level even increased: those with the lower molecule increased, probably generated from those with larger molecules by breaking the bonds. Also concerning PCBs soil pollution, the efficiency varies on average of around 50% on one hand, and on the other hand, small molecule PCBs show an increase in the final concentration compared to the initial concentration. This can be explained by the fact that PCBs with lower molecules can be formed from PCBs with larger molecules. Because the treatment time was not high enough, was not allowed the decomposition of PCBs with small molecule (Figure 8).

- Apart from δ-HCH and dieldrin, which showed quite low remediation efficiencies at the samples taken at the end of the tests, the other components had final efficiencies of over 75%. In case of some of pesticide group of contaminants, the situation was even better, because all three categories analysed had efficiencies that exceeded 85% (Figure 9).

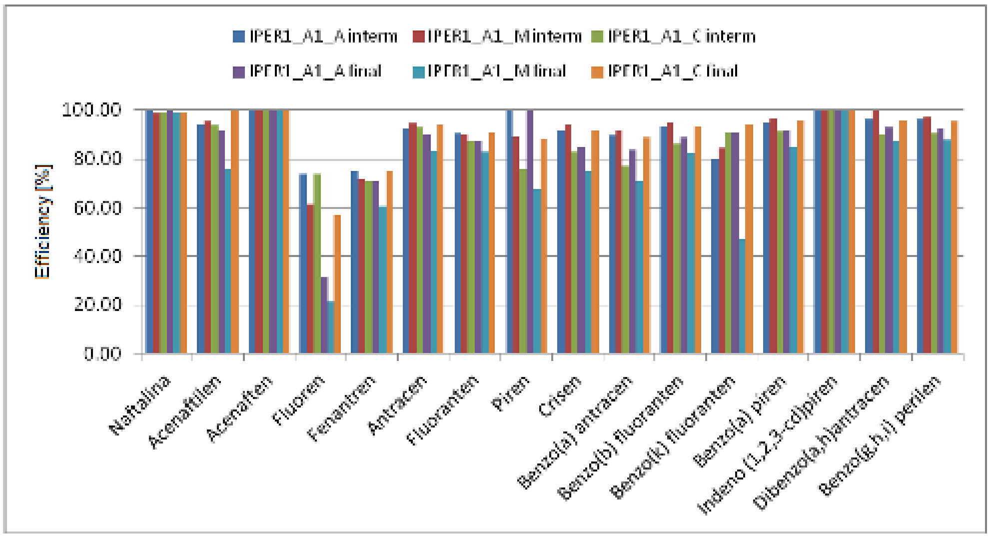

Fig.7 - Treatment efficiency evaluation for HAPs (for each component) that are found in the complex polluted soil

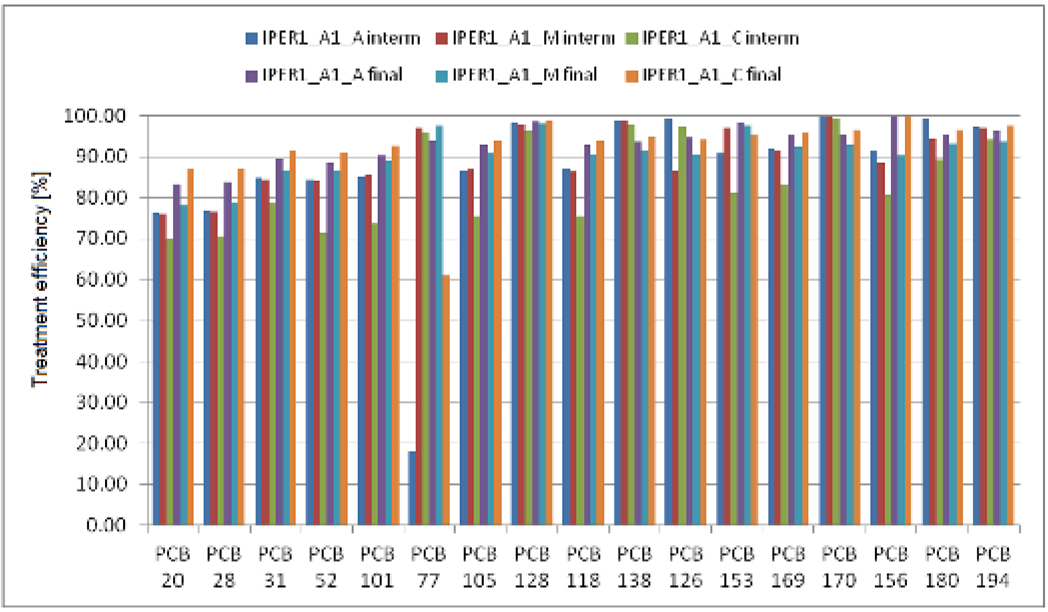

Fig.8 - Electrochemical treatment evaluation efficiency for the types of analysed PCBs

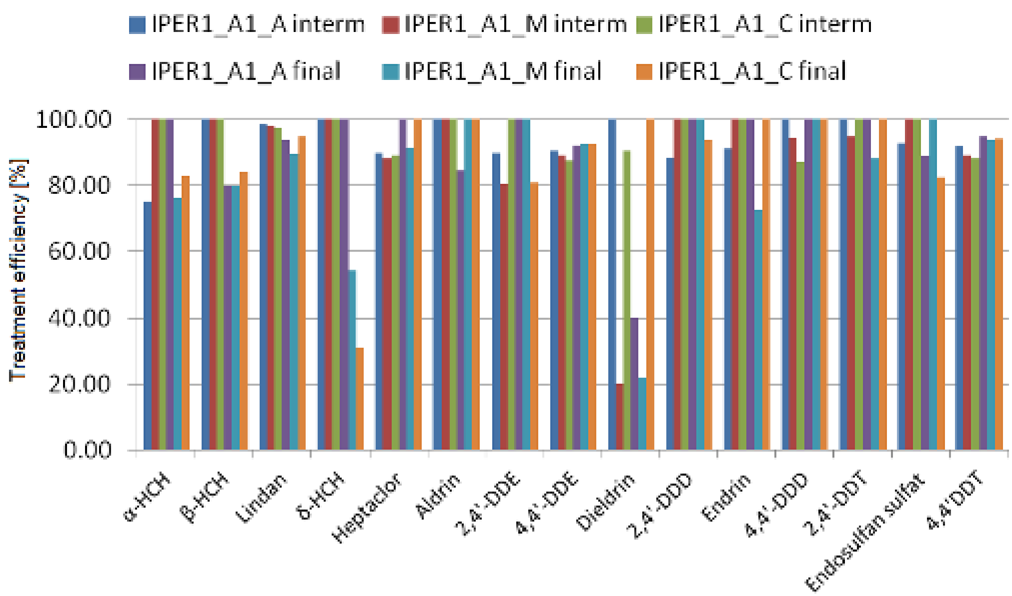

Fig.9 - Electrochemical treatment efficiency for each individual pesticide compound

Regarding ΣHAPs, it can be observed that for the analysed samples it was identified an efficiency ranging from 45% to 55%. The specialized literature (Oprea et al. 2008; Rada et al. 2013) had shown that the efficiency of electrochemical treatment increases with the increase in treatment time (Cocarta et al. 2017). This latest information helps us draw the following conclusion: the effectiveness of treatment could increase if electrochemical treatment had been applied for a period longer than 21 days.

It is interesting to note that we also have great efficiency for Mixt 2 (sample taken from the superior inactive cells) and Mixt 4 (sample taken from the lower inactive cell). This means that the influence of the electric field extends beyond the active cell. This is very important for in situ applications, because when it will be needed to apply the technology on a large surface, it will not be necessary to divide the entire surface into active areas only. The affected area can be divided into active and inactive areas, thus reducing the cost of materials and energy.

In the case of SRP (in field experiment), up to 40% efficiency was observed in PCBs remediation. In Mixed 2 sample case, the highest efficiencies were observed for each element of PCBs congeners as well as for the ΣPCBs. This sample refers to a mixture between the two higher inactive cells.

It has been observed that there is a lower efficiency for lower active cells where the distance between the electrodes is 1.5 m as opposed to 1 m in the case of the higher active cells. This means that in the present case, it is better to have a distance of 1 m between the electrodes even if in the literature, in some papers (Cocarta et al. 2016a; Herrada et al. 2016) it is stated that the two electrodes can be more than 1 m apart.

CONCLUSIONS

The electrochemical treatment as a remediation solution in case of complex organic pollution (HAPs and PCBs) came out from data and information provided by the specific literature, where, according to Huang et al. 1999; Andreottola et al.. 2008 and Krishna et Reddy. 2009, the degradation of organic compounds can be accomplished through chemical electro-oxidation, a method that has proven to be a promising tool for removing TPHs, HAPs and PCBs. These were demonstrated by different experimental studies which used hydrogen peroxide, permanganate, ozone and Fenton agent.

Electrochemical treatment has proven to be a viable solution for treating organically polluted soils. This type of treatment also works in the case of inorganic pollution, but only if the pH is better controlled with the help of different types of chemicals substances.

In PCBs case, all congeners on which attention was focused had initial concentrations exceeding the intervention threshold for sensitive uses, mentioned in Order 756 of 1997. After the considered treatment was applied for a period of 21 days, the concentrations obtained for most of the compounds were below thresholds. For the compounds that still had a slight excess of the limits, the treatment could be extended so as to ensure that after treatment, the concentration obtained is below the intervention threshold according to Order 756 of 1997.

For PAHs, baseline concentrations do not exceed the intervention threshold, but are still large enough to be considered a potential hazard to soil, and consequently on human health. Efficiencies of removing PAHs from the soil were relatively high, reaching almost 100% if the treatment period is increased.

Pesticides also had a satisfactory evolution both as individual components and as sums of pesticide categories. There was fear that in the case of HCHs we would have crossings from one compound to another. So, we could have a higher concentration after the treatment, compared to the initial contamination level, but the final results demonstrated that this was not the case.

The results obtained for IPER 3 have also been largely confirmed in real-time application.

ACKNOWLEDGEMENT

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ASPECTS REGARDING THE ENVIRONMENTAL IMPACT DUE TO THE USE OF ALTERNATIVE FUELS IN CEMENT MANUFACTURING PROCESS
/
ASPECTE PRIVIND IMPACTUL ASUPRA MEDIULUI DATORAT UTILIZĂRII COMBUSTIBILILOR ALTERNATIVI ÎN PROCESUL DE FABRICARE A CIMENTULUI

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Keywords: *greenhouse gasses, carbon dioxide, alternative fuels, cement.*

ABSTRACT
The cement production activity describes a negative environmental impact, which involves the contouring of policies and strategies to minimize it, which can be controlled by an appropriate legislative framework. The paper presents the results of a research on the possibility of minimizing emissions of greenhouse gases (carbon dioxide emissions) from the cement manufacturing process using alternative fuels , namely the opportunity to reduce the consumption of non-renewable resources (fossil fuel).

REZUMAT
Activitatea de producere a cimentului descrie un impact negativ asupra mediului, care implică conturarea unor politici şi strategii de minimizare a acestuia, controlabile printr-un cadru legislativ corespunzător. În lucrare sunt prezentate rezultate ale unei cercetări privind posibilitatea de minimizare a emisiilor de gaze cu efect de seră (emisii de dioxid de carbon) provenite din procesul de fabricare a cimentului, utilizând combustibili alternativi, respectiv oportunitatea de a reduce consumul de resurse neregenerabile (combustibili fosili).

INTRODUCTION
For each kilogram of cement, about 0.9 kilograms of CO_2 are emitted into the atmosphere. The production of one cubic meter of concrete (~ 2400 kg) is responsible for emitting ~ 540 kg of CO_2 in the atmosphere (Nisbet M. et al. 2003; Benhelal et al. 2013). In other words, the cement industry is responsible for 5% of global CO_2 emissions from human activities (1.5Gt CO_2) (INCDPM. 2017).

The situation is alarming and it is necessary to reduce greenhouse gas emissions through certain strategies, which can be correlated with the reduction of traditional fuel consumption and the production of clinker with a low limestone content. It is vital that the organizations to adopt an environmental policy that includes their commitment to meeting environmental standards in order to prevent pollution and to embark on a continuous improvement process with the intention of reducing environmental impact (Paraschiv G.. 2016). The legal basis for carrying out the CO_2 emissions monitoring activity is Regulation (EU) No. 601/2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87 / EC of the European Parliament and of the Council. The Regulation offers the possibility to choose from several CO_2 monitoring methodologies, namely: calculation-based approaches, measurement-based approaches, methodology which is not based on levels and combinations of approaches (EUR-LEX. 2017).

The preferred methodology for monitoring CO_2 emissions in cement plants is the standard methodology, which is based on calculations and distinguishes between combustion and process emissions.

$$\boxed{\text{Total CO2 Emission} = \text{Total Process Emission} + \text{Total Combustion Emissions}}$$

In 2015, data on waste generation and management in Romania in 2012, was published. Thus, 91.77% of the amount of waste generated in 2012 was stored, only 7.12% was recycled, 0.6% for energy recovery with co-incineration being less than 1%. Romania faces a serious problem with waste managemen,. especially as regards to the need to no longer store waste, the intervention of cement production, where the combustion temperature exceeds 2450°C being beneficial, the advantages being in both ways (Eurostat. 2017).

In a cement factory, the clinkering process is responsible of 60% CO_2 emissions, because the most important reaction in clinker formation is $CaCO_3 \rightarrow CaO + CO_2$. and 40% comes from the combustion process of fuels. Emissions from the process cannot undergo major changes, but there are types of cement in which the addition of secondary matter is higher, in this case, the clinker recipe is adapted, limestone content being a smaller proportion and thus reduced CO_2 emissions from the clinker process (Philip A. Alsop. 2007; Ali et al. 2011).

Conventional fossil fuels used in the cement industry are coal (lignite and anthracite), petroleum coke (the product of refining the fuel oil), heavy fuel oil and natural gas (for tempering the furnace). Alternative fuels, such as used tires, used oils, plastics, solvents, household waste and much more are used as substitutes for fossil fuels. The chemical components of solid fuel ash combine with the raw material and will be fully incorporated into the clinker produced. Therefore, according to the results of laboratory analyses for waste, the chemical composition of ash is taken into account when dosing raw materials.

In the same way as major elements, metals that can be introduced with liquid and solid fuels will be largely incorporated into the clinker structure. Exceptions are made by partly or fully volatile metals in the furnace, such as mercury, talc or cadmium. These elements will condense on the surface of the dust particles that are discharged from the furnace or can, to some extent, be discharged into the atmosphere (mercury) if they are not adequately controlled.

MATERIAL AND METHOD

The case study consists in calculating the CO_2 emission reduction, depending on the proportion of alternative fuels used and the fossil fuel substitution rate. Many factors are involved in this process, requiring the involvement of several departments within the factory. Most importantly, the raw material recipe is corrected depending on the input of chemical compounds from the co-incinerated waste. A second major aspect is the principles of combustion technology (Lei et al. 2011). Thus, for a good maintenance of temperatures and co-incineration principles, up to 30% of the total amount of fuels used can be introduced at the cold head of the furnace. In the factory where we conducted the study, it is a rotary clinker oven with a length of 97 m, diameter of 5.8 m and is described by 2 rpm with an injector as shown in Figure 1 (Silviu Opriş. 1999)

Fig.1 - Burner

The technical specifications of the furnace or the injector that were included in the study are presented in table 1:

Table 1

Technical data

Production [tons of clinker/year]	1 000,000
Energy consumption [MJ/tons of clinker]	3,300
Energy consumption/year [MJ/tons of clinker]	3 300,000,000
Energy consumption/year [GJ/tons of clinker]	3 300,000

Before using a new type of fuel, a representative sample is analyzed by a RENAR accredited laboratory and for the calculation of CO_2 emissions, the net calorific value, the CO_2 emission factor and the proportion of biomass contained are taken into account from the analysis bulletin. The higher the biomass is, the lower the CO2 emissions from the combustion. The calculation formula for CO2 emission is:

CO2 emission [t] = Fuel quantity * Emission factor * Lower calorific value * (100-biomass content)% / 1000

a. Net calorific value (NCV) = the specific amount of energy released as heat when a fuel or material undergoes a complete oxygen-firing process under standard conditions, without taking into account the heat of vaporization of the water formats;
b. Emission factor = average greenhouse gas emission rate relative to the activity data of a source stream assuming that oxidation is complete in the case of combustion and integral conversion for all other chemical reactions

Table 2

Properties of fuels used (*EU. 2012*)

Fossil fuels		
Coal		
Net calorific value	GJ / t	**25.80**
Emission factor	kg CO_2 / GJ	**94.60**
% Biomass	%	**0.00**
Petroleum coke		
Net calorific value	GJ / t	**32.50**
Emission factor	kg CO_2 / GJ	**97.50**
% Biomass	%	**0.00**
Natural gas		
Net calorific value	GJ / t	**48.00**
Emission factor	kg CO_2 / GJ	**56.10**
% Biomass	%	**0.00**
Alternative fuels		
Used tires and rubber		
Net calorific value	GJ / t	**27.00**
Factor Emisie	kg CO_2 / GJ	**85.00**
% Biomasa	%	**27.00**
Mixed solid waste		
Net calorific value	GJ / t	**15.00**
Emission factor	kg CO_2 / GJ	**95.00**
% Biomass	%	**44.00**
Agriculture products/waste (husks. shrubs. canes. stumps. etc)		
Net calorific value	GJ / t	**27.00**
Emission factor	kg CO_2 / GJ	**101.00**
% Biomass	%	**98.00**
Wood biomass waste		
Net calorific value	GJ / t	**15.600**
Emission factor	kg CO_2 / GJ	**101.000**
% Biomass	%	**100.00**
Impregnated wood (railway sleepers)		
Net calorific value	GJ / t	**20.000**
Emission factor	kg CO_2 / GJ	**98.000**
% Biomass	%	**97.00**

In this study, 5 scenarios are created, depending on the percentage of alternative fuels used, namely: 15%, 30%, 50%, 75%, 95%, taking into account that the cold head of the cement kiln can provide a maximum of 30% of the total mass of fuel and in all 5 cases is kept the percent of 5% for the natural gas. The natural gas is necessary for the tempering times, especially for the beginning of the cement kiln operation, where there must be a perfect climate, without temperature variations.

RESULTS

In order to reduce CO_2 emissions. the proportion of biomass existing in fuels should be as efficient as possible and as homogeneous as possible, for optimal furnace operation and complete control of pollutant emissions in atmosphere. The choice of alternative fuels considered in the co-incineration process was made according to their availability in the industrial market:

- case I: 15% used tires and rubber;
- case II: 20% used tires and rubber, 10% mixed solid waste;
- case III: 20% used tires and rubber. 20% mixed solid waste,10% impregnated wood;
- case IV: 20% used tires and rubber, 35% mixed solid waste, 10% impregnated wood, 10% agriculture products/waste;
- case V: 20% used tires and rubber, 35% mixed solid waste, 10% impregnated wood, 15% agriculture products/waste, 15% wood waste.

Table 3

Amount of tones of CO_2 emitted in the atmosphere (5 cases)

CO_2 emissions [t]	Alternative fuels ratio [%]
309.655.5	0
293.256	15
273.458	30
228.591	50
176.590	75
113.626	95

According to these results it can be noticed that the carbon dioxide emission resulting from the combustion process is significantly reduced as the rate of substitution of fossil fuels increases.

Based on these results, it is graphically plotted the carbon dioxide emission reduction trend, which is inversely proportional to the use of alternative fuels for the raw material combustion process.

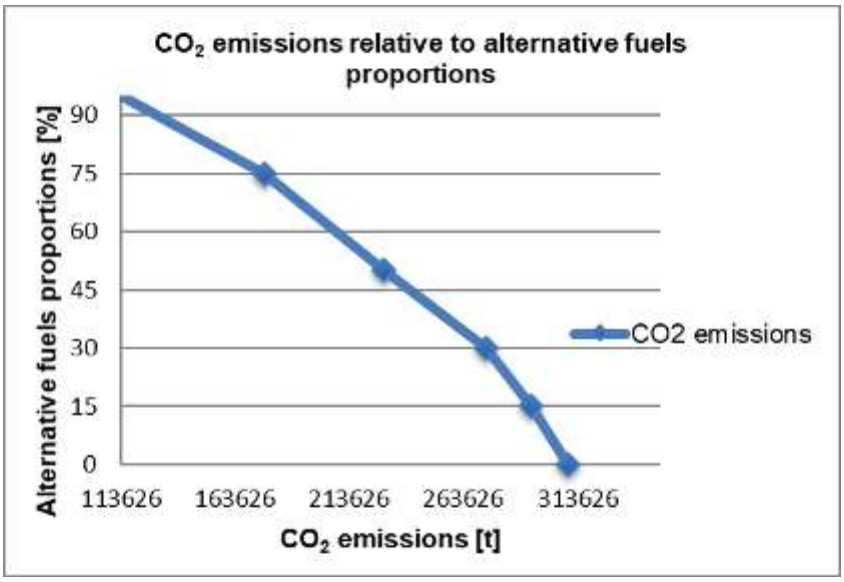

Fig. 2 – Graphic representation of carbon dioxide emissions at different proportions of alternative fuels

Figure 3 shows the CO_2 emissions avoided, reported with the original case, where 100% fossil fuels are used. It should be noted, that only carbon dioxide emissions from the combustion process involved in cement manufacture, are specified here and not the process carbon dioxide emissions, which depends on raw material.

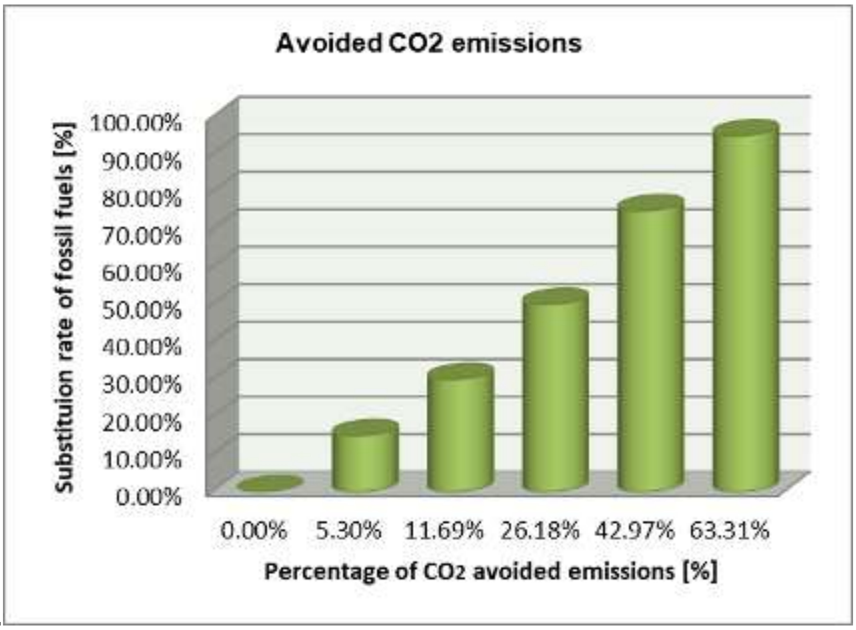

Fig. 3 – Carbon dioxide emissions avoided when using alternative fuels

CONCLUSIONS

In cement factories, greenhouse emissions, respectively carbon dioxide emissions come from the actual process of manufacturing the cement clinker and the combustion process. Process emissions are very difficult to minimize, because there are not many available alternative raw material resources. But in this study, it is figured that the CO_2 emissions that result from combustion can be reduced by 63% compared to an initial case where only fossil fuels are used. Thus, the notion of co-incineration of waste, substitution of alternative fossil fuels is involved in the process.

The alternative fuels used in this study. are: used tires and rubbe, mixed solid waste, agricultural products/waste (shells, tiles, wood, sapwood etc). waste wood, impregnated wood. The alternative fuels used in the case study were chosen on the basis of statistical data suggesting their optimal market presence. Used tires and rubber are introduced into the process at the cold head of the cement kiln up to a maximum of 30%. to maintain the thermal equilibrium necessary to create the optimal reaction conditions of the compounds. Mixed solid waste, called fluff, is municipal waste that is introduced through the burner, like the other fuels, but each in its own way (fig. 1).

It is also noted, according to the research in this paper that in the optimal achievable case with a 50% fossil fuel substitution rate, conservation of non-renewable materials, respectively fossil fuel consumption reductions are of 39.5% for coal and 48.5% for coke oil, having a positive impact on the environment.

In order to target the use of alternative fuels in the largest proportion in cement factories and to obtain the quantities and the qualities of waste that are desirable for co-incineration, it is important to raise public awareness of selective waste collection.

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MULTIFUNCTIONAL AGROTEXTILE FOR AGRICULTURE / HORTICULTURE /
AGROTEXTILE MULTIFUNCTIONALE DESTINATE DOMENIULUI AGRICOL/ HORTICOL

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Keywords*: knitted nets, warp knitting, technical textiles, agriculture, horticulture.*

ABSTRACT

Agrotextiles are textile materials used in agriculture, horticulture, floriculture, etc. and are part of technical textiles. Mostly produced as nets (knitted or woven), they are increasingly used for their functional benefits, improving the profitability and increasing the greening of the sector by improving the productivity and reducing the need for chemicals. In this paper are presented the results obtained regarding the development of a new type of knitted nets for agrotextiles made from polyester and polyamide yarns.

In order to confirm that the developed agrotextiles are suitable for the research purpose, the obtained variants were tested in the accredited laboratories of the INCDTP Bucharest. Thus, the main physical-mechanical features have been tested: weight, density, breaking force, elongation at break, thermal contraction, burst resistance, burst deformation etc.

The obtained nets have been experimented in the field to verify their multifunctionality for protection at pests, birds or bad weather (hail, solar radiation, strong wind etc.).

Rezumat

Agrotextilele sunt materiale textile folosite in domeniul domeniul agricol/ horticol, floricol etc. si fac parte din categoria textilelor tehnice, realizate mai ales sub forma de plase (tricotate sau tesute) sunt din ce în ce mai utilizate pentru beneficiile lor funcţionale în domeniul agricol, îmbunătăţind profitabilitatea și crescând gradul de ecologizare al sectorului prin îmbunătăţirea productivităţii și reducerea nevoii de produse chimice. În cadrul prezentei lucrări se prezintă rezultatele obţinute privind realizarea de plase tricotate destinate agrotextilelor având ca materie primă fire de poliester și poliamidă.

Pentru a confirma că aceste tipuri de fire sunt adecvate scopului cercetării, variantele obținute au fost testate în laboratoarele acreditate ale INCDTP Bucuresti. Astfel, au fost testate principalele prtoprietati fizico-mecanice: masa, desimea, forța de rupere, alungirea la rupere, contracția termică, rezistența la strapungere, deformarea la strapungere etc.

Plasele obținute au fost experimentate in conditii reale de utilizare pentru a verifica multifuncționalitatea lor pentru protecția împotriva dăunătorilor, a păsărilor sau a intemperiilor (grindina. radiatii solare. vânt puternic etc.).

INTRODUCTION

The agrotextiles comprise all textiles that are used in growing, harvesting. protection and storage of either crops or animals. They include diverse items such as fishing nets and fish-lines, ropes, shade fabrics,mulch mats, woven and non-woven covers for crops, bird protection nests etc. The agrotextiles are used for their functional benefits in the agricultural field and are driving the sector profitably by improving the productivity and reducing the need for chemicals.

Some of the purposes for which these textiles are being increasingly used are as follows: preventing erosion and paving way for afforestation; in greenhouse cover and fishing nets; for layer separation in fields; in nets for plants, rootless plants & protecting grassy areas; as sun screens (since they have adjustable screening) and wind shields; as packing material and in bags for storing grass (that has been mowed); controlling stretch in knitted nets; shade for basins; anti-birds nets; fabrics for sifting and separation, for the phases of enlargement of the larvae; materials for ground and plant water management at the time of scarcity and abundance of water.

In the present era of globalization, the importance of agriculture as a prime mover particularly in developing countries has become unequivocal.

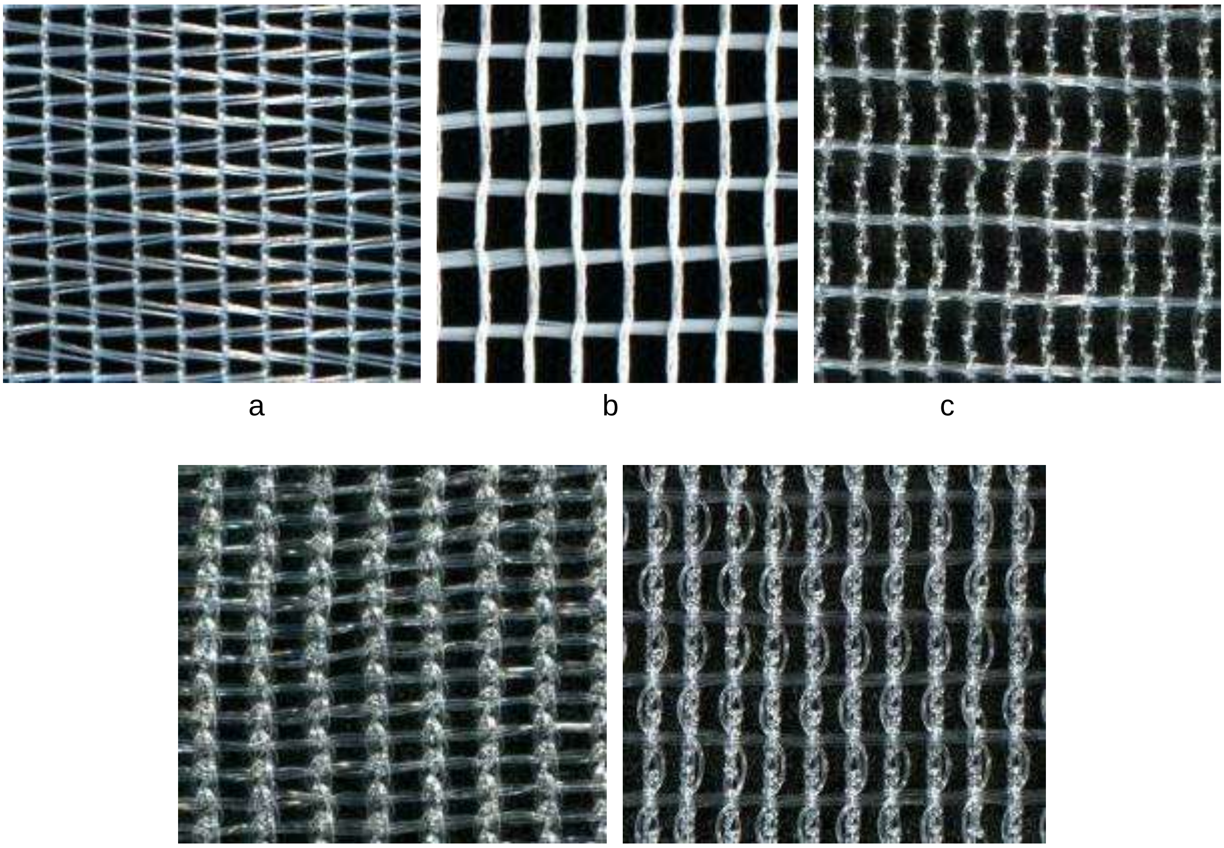
Everyone is interested in the ability to improve the quantity and quality of food production to feed the population and to have a substantial reserve. This objective can be reached through factors that influence plant growth, together with the application of improved techniques and the use of textiles in agriculture is the most important.

The main types of agrotextiles are:

- shade nets;
- anti-hail nets;
- anti-insect nets and pollination nets;
- windshield nets;
- bird and animal protection nets;
- harvesting nets;
- crop covers/ anti-frost covers.

MATERIAL AND METHOD

In this stage of research, for the development of the knitted nets it was chosen 2 types of yarns: polyamide monofilament 1298dtex and multifilament polyester 83dtex. These yarns were knitted on a Karl Mayer knitting machine RJSC 4F-NE E18 at NGM Leonard SRL Pascani. Thus, were obtained 5 knitted variants with pillar stitch structure with weft yarn inserted at 1...4 rows and 2...5 wMd.Azmeri Latif Begales (fig.1 a-d and table 1).



a b c

d e

Fig. 1 – Knitted net variants

Table 1

Characteristics of net variants

Characteristics			V1	V2	V3	V3A	V4
Weight		g/m^2	53	52	86	106	94
Density, horizontal		rows/ 10cm	80	75.5	80	80	80
Density, vertical		wales/ 10cm	140	185.5	160	160	200
Breaking force	horizontal	N	226	188.4	171.2	276	203
	vertical	N	238	227	217	218	236
Elongation at break	horizontal	%	39.4	38.8	55.3	48.0	50.06
	vertical	%	12.4	15.4	26.4	39.5	29.2
Thermal contraction. 10min.. 100°C	horizontal	**%**	0	0	-.0.51	-1.66	-1.19
	vertical	**%**	0	0	-0.49	-2.98	-0.66
Burst resistance		KPa	206.3	236.4	240.9	220.8	275.5
Burst deformation		mm	26.2	26.4	31.5	34.7	32.9
Mesh size		mm	1.1x0.4	1x1.6	0.8x2.3	0.6x0.8	1x1.8

From the data analysis of testing results of knitted nets variants, it can be observed that they demonstrate adequate properties compared to the corresponding agrotextiles available on the market:

- good mechanical properties (38-50% elongation at break on horizontal direction, 170-280 N for breaking force on both directions and 206.3-275.5KPa for burst resistance);
- are light weight (50-110 g/m2);
- have very good dimensional stability (thermal contraction less than 3%);
- mesh size is suitable for nets meant for insect protection, as pollination nets, shading or harvesting.
- the variants made from polyamide yarns have a higher elongation at break and a higher burst deformation but the variants made from polyester yarns prove better thermal properties (0% contraction at 100°C in 10min.).

RESULTS

The obtained nets have been experimented in the field to verify their multifunctionality for protection at pests, birds or bad weather (hail, solar radiation, strong wind etc.).

Therefore, these agrotextiles have been used to cover cabbage crops and grape crops (fig.2). The results have been compared with those obtained on uncovered crops.

Lepidopteron and aphids were the major insect pests identified on the covered cabbage crops and the grapes have been affected by wasps and starlings.

It was observed that the use of the nets enhanced the cabbage production (individual cabbage weight and yield) with about 17-20%, while the efficacy of the netting in controlling pests on grapes was about 12-15%.

To reduce the microclimate modification, the intermediate daytime removal frequency of the nets was used of 3 times a week, finally turned out to be a good tradeoff by ensuring high control efficacy with less microclimate modification.

Fig. 2 - Covered and uncovered grape crop

CONCLUSIONS

From the data analysis of testing results of knitted nets variants, it can be observed that they demonstrate adequate properties compared to the corresponding agrotextiles available on the market: good mechanical properties, light weighted, very good dimensional stability and suitable mesh size.

The use of the nets enhanced the cabbage production (individual cabbage weight and yield) with about 17-20%, while the efficacy of the netting in controlling pests on grapes was about 12-15%.

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HYDROLOGICAL MODELLING FOR DIVICI – POJEJENA WETLAND'S TRIBUTARIES / *MODELAREA HIDROLOGICĂ A AFLUENȚILOR ZONEI UMEDE DIVICI-POJEJENA*

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Keywords: *Danube tributaries, wetland, hydrological modeling, precipitation, water flow.*

ABSTRACT

In this paper were analyzed the maximum discharges produced under different rainfalls recurrence, for the river basins of Divici-Pojejena wetland's tributaries. A modelling software for the process of rainfall-runoff HEC-HMS 4.0 developed by the US Army Corps of Engineers, was used. The main input data consists in precipitation with different probability, obtained by statistical processing of observation data and physical-geographical characteristics of the river basins in GIS format.

Hydrological modelling is a useful tool in decision making process at river basin level. The results consist in the quantification of hydrological cycle elements at river basin level as consequence of precipitations variation.

REZUMAT

In această lucrare au fost analizate debitele maxime produse pentru bazinele hidrografice ale afluenților zonei umede Divici-Pojejena, în cazul înregistrării unor evenimente meteorologice cu precipitații. Acestea au fost calculate la diferite perioade de revenire. Pentru simularea procesului precipitații-scurgere a fost utilizat programul de modelare hidrologică HEC-HMS 4.0 dezvoltat de US Army Corps of Engineers. Principalele date de intrare sunt reprezentate de precipitații calculate pentru diferite probabilități de revenire obținute prin prelucrarea statistică a datelor înregistrate la stațiile meteorologice și caracteristicile fizico-geografice ale bazinelor hidrografice în format GIS.

Modelarea hidrologică reprezintă un instrument important pentru procesul decizional la nivel de bazin hidrografic. Rezultatele constau în cuantificarea elementelor ciclului hidrologic la nivel de bazin, ca o consecință a variației precipitațiilor.

INTRODUCTION

Hydrology studies the interaction of water with the environment within each phase of hydrologic cycle (*Gayathri K Devi et al. 2015*).

Hydrological modelling is a useful tool in decision making process at river basin level for water management. Considering the interested river basin area characteristics and the purpose of the hydrological analysis, different types of software can be used.

Thus, the main inputs can be represented by meteorological data and physical-geographical characteristics of the river basins. Hydrological modelling output consists in quantification of hydrological cycle elements at river basin level as result of precipitations variation (*US Army Corps of Engineers. 2015*).

The study area is located in South-Western of Romania, in the Caras-Severin County, being included in Iron Gates Natural Park (*Sorescu and Ioja. 2013*). The Danube River is crossing the study area, along its left bank tributary rivers (between km 1065 and km 1052), including Divici-Pojejena wetland (between km 1065 and km 1056) (*Babić et al. 2013*). The hydrographic network on the left Danube bank in the interest area includes zones of land that collect waters from outside the hydrographic basins of Danube's tributaries (Valea Mare, Valea Satului, Şuşca, Belobreşca, Radimna, Pojejena and Pârva Reca) (*Commission du Danube, 2005*).

Pojejena Tributary River has the confluence point with the Danube at the upstream limit of the wetland and Pârva Reca Tributary River has the confluence upstream Moldova Nouă locality. Five of the seven tributary rivers of the Danube cross localities: the watercourses of Belobreşca, Şuşca, Radimna and Pojejena cross the localities with the same name and the watercourse of Valea Satului Tributary River cross Divici-Pojejena locality (ANAR. 2013).

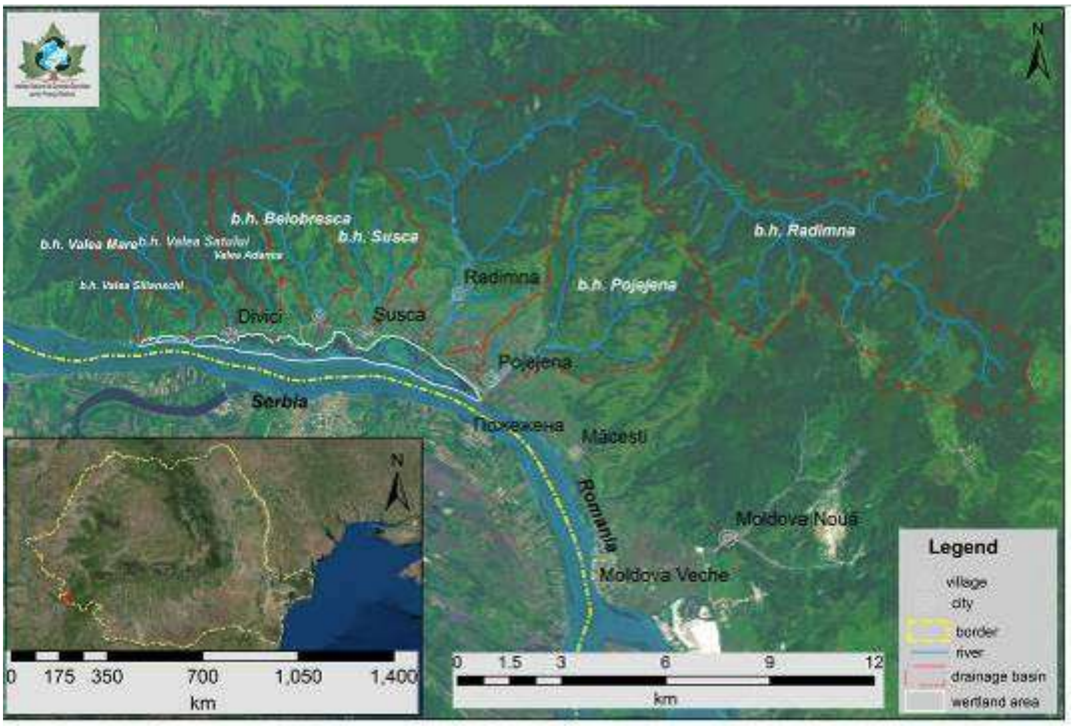

Fig. 1 - General location of the studied river basins

The total area of drainage basins is of 144 km^2, exposed on the South side of the Locvei Mountains, with heights between 713 m and 65 m., with an average elevation of 375 m and an average slope of 20.55˚, particularities that favor a rapid runoff over the basins area.

Radimna River has the largest hydrographic basin area (about 82 km^2), while Valea Satului river has the smallest hydrographical area (about 6 km^2) (*ANAR. 2009*).

In this case study, hydrological modelling was conducted to determine the effects of precipitation with the recurrence probability of 0.1%. 1%. 5% and 10% on the Danube's tributaries in the Divici - Pojejena area: Valea Mare, Valea Satului, Şuşca, Belobreşca, Radimna, Pojejena and Pârva Reca. In recent period, floods were recorded in localities crossed by those rivers *(ICPDR 2008, ICPDR 2009, LCESP. 2012a; LCESP. 2012b*). For this purpose we used the HEC-HMS 4.0 modelling software for the rainfall-runoff process developed by the US Army Corps of Engineers.

The hydrological modelling software needs input data from field measurements and statistical calculations, presented in the Material and Method chapter.

HEC-HMS modelling software offers the magnitude of the flood based on the Soil Conservation Service – Curve Number and rainfall probability for the seven rivers basins that flows into the wetland area.

The hydrological modelling results are presented in the Results chapter and the conclusions of this paper were formulated based on them.

MATERIAL AND METHOD

The maximum hourly precipitation with different recovery periods (1000, 100, 20, 10 years) were calculated by using the maximum hourly values recorded at the Moldova Veche meteorological station. By using the calculation program Hyfran Plus, the maximum hourly rainfall for various probabilities had been calculated.

The HEC-HMS 4.0 modeling software requests rainfall data needed for flows simulation with probability of return mentioned above and quantitative data of physical-geographical catchment.

The flow simulation methods included in the software are based on mathematical models which consider the values of river basin parameters as: time of concentration (Tc), time lag per river basin (Tlag), weighted curve number per River Basin (CNaw), the proportion of impervious surface in the river basin (%), initial flow of the river (m^3/s), etc.

Thus, to determine the catchment area have been followed several steps consisting of:

- identify on the topographic map 1: 25000 of each of the seven river basins studied;
- determining the location of the sections where will be imposed boundary conditions;

- delimitation based on digital terrain model of watershed water of the basin corresponding for section which settled the boundary conditions;
- calculation of the area portion of the basin (km²). bounded by the watershed, in GIS

The method of Curve Number is based on the following relation:

$$CN=f(S) \tag{1}$$

Where:

CN represents curve number;

S represents the land area retention (mm) – (storage capacity) depending on the land cover and soil hydrologic group.

For calculating the curve number- weighted of the catchment area, the following formula was used:

$$CN_{aw} = \frac{\sum_{i=1}^{n}(CN_i * A_i)}{\sum_{i=1}^{n} A_i} \tag{2}$$

Where:

CN_{aw} represents weighted curve number on the catchment area;

CN_i –Curve number assigned to an area according to land use and hydrologic soil group;

A_i –The area for each surface for which it was awarded a Number of curve;

n –Number of areas which were attributed curve numbers.

Number of curve (Curve Number) is an index that takes values from 0 to 100. It depends on the full potential of water retention which can realize each soil surface, depending on land use and hydrologic soil group.

Response time (delay) of the basin (Tlag) is defined as duration between the rainfall interval center and the flood producing at the time when the flood occurs on computing section and was determined using the following formula:

$$Tlag = \frac{(L * 3.28 * 10^3)^{0.8} * (\frac{1000}{CN_{aw}} - 9)^{0.7}}{1900 * Y^{0.5}} \tag{3}$$

Where:

L is the mainstream length measured between the source and the closing profile (section);

Y represents the average slope basin;

CN is the coefficient of water retention in the soil.

The share of impervious surfaces (%) per catchment areas was determined by comparing the total surface of the area constructed with the entire area of the basin.

$$Share = \frac{A_i}{A} \; x\; 100 \tag{4}$$

Data from topographic measurements have helped to improve the volume of information on the flowing regime on studied tributaries.

Measurements regarding flowing regime on the tributaries and rainfall regime in the study area were aimed for the calibration and validation of hydrologic model. They were made in monitoring sections which were located in key points in tributaries courses depending on hydrologic model limits (border sections, upstream of the localities) and on the possibility of verifying the measured parameters in border sections (sections of control at the bridges on the tributaries).

RESULTS

The baseline scenario that provided the basis for modeling took into account a hietograma with precipitation during 4 hours and the maximum occurs at 2 hours after the rain’s start. The maximum hourly precipitation with different recovery periods (1000, 100, 20, 10 years) were calculated by using the maximum hourly values recorded at the Moldova Veche meteorological station (table 1).

Table 1

Maximum hourly rainfall for various return probabilities

Time of return [years]	Probability [%]	Quantity of precipitation [mm]
1000	0.1	97.6
100	1	58.9
20	5	39.8
10	10	33.1

For a return period of 1000 years, the quantity of precipitation fallen during an hour is 97.6 mm, while for a return period of 100 years, the quantity of precipitation fallen during an hour is 58.9 mm. The properties of the studied hydrological basins were obtained using GIS (table 2).

Table 2

Physical - geographical parameters of the river basins

Catchment	Surface [km^2]	CN_{aw}	Concentration time (Tc) [minutes]	Response time (Tlag) [minutes]	Share of waterproof surfaces [%]
Parva	8.64	72	38.7	64.5	0.2
Pojejena	21.50	72	43.2	72	1.26
Radimna	84.00	70.7	126	210	1.2
Belobresca	8.00	72.4	21.6	36	1.9
Susca	7.89	75.9	34.8	58	3
Valea Mare	5.46	79.7	16.2	27	0.1
Valea Satului	5.20	80	17.4	29	0.6

For the Pojejena river were simulated rainfalls with probability of 0.1%, 1%, 5% and 10% on a hydrological model that used the above mentioned river basin parameters and the following rainfall characteristics (presented as example for the rainfall with 1% probability - figure 2).

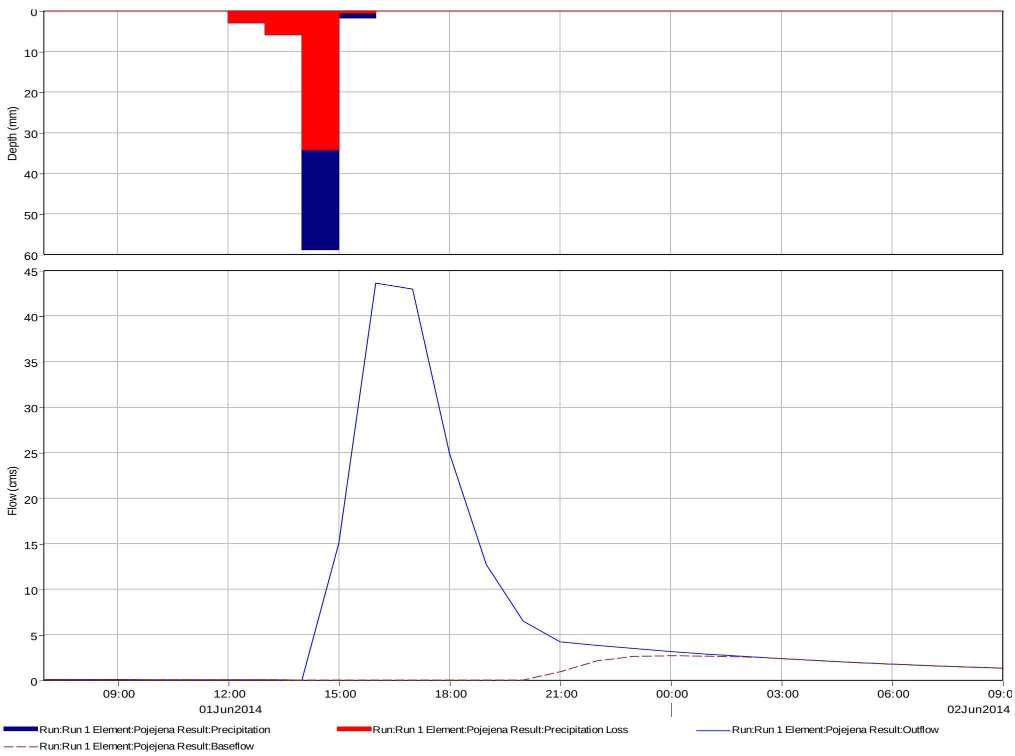

Fig. 2- Histogram and flood hydrograph generated by precipitation with probability of 1% on Pojejena River

By the hydrologic modelling resulted information regarding the percentage of precipitations infiltrated into the soil during the rain with return probability of 0.1%, 1%, 5%. 10% and 50% (table 3).

Table 3

Percentage of precipitations infiltrated into the soil

Return Probability	0.10%		1%		5%		10%		50%	
	Inf %	Exc.%	Inf.%	Exc.%	Inf.%	Exc.%	Inf.%	Exc/%	Inf.%	Exc.%
Pârva Reca	64.3	35.7	72.9	27.1	80.4	19.6	84.1	15.9	93.6	6.4
Pojejena	63.5	36.5	71.8	28.2	79.3	20.7	83.2	16.8	92.5	7.5
Radimna	63.5	36.5	72.5	27.5	78.7	21.3	82	8	88.4	11.6
Şuşca	59.9	40.1	71.8	28.2	81.5	18.5	85.8	14.2	97	3
Belobreşca	68.5	31.5	77.8	22.2	85.6	14.4	89.1	10.9	97.5	2.5
Valea Satului	60.5	39.5	68.6	31.4	75.8	24.2	79.68	20.32	89.6	10.4
Valea Mare	61.9	38.1	69.9	30.1	77.4	22.6	81.26	18.74	91.1	8.9

The analysis of the precipitations quantities scenarios gets in front the next distribution disposal. presented in table 5. observing the increases of the infiltrated precipitations as the return probability increase. An example is represented by the hydrographic basin of the Radimna River where the infiltrated proportion increases from 63.5 % in the base scenario with 0.1% probability to 88.4% for the precipitation with return probability of 50%.

The situation presented above is available also for the rest of the hydrographic basin which has the infiltrated precipitations quantity bigger as the rains are quantitative reduced.

Following the hydrologic modeling, for the base scenario the flood picks are presented in the next table (Table 4).

Table 4

Flows coresponding to the flood pick produced after precipitation with different probabilities

No	Return probability / Q [m³/s]	0.10%	1%	5%	10%	50%
1	Pârva Reca	45.4	17.1	6.9	4.1	0.4
2	Pojejena	108.2	43.6	19.1	12.1	2.1
3	Radimna	241.3	109	56	38.1	13.9
4	Şuşca	47.2	17.1	6.2	3.5	0.2
5	Belobreşca	61.2	22.4	8.3	4.3	0.3
6	Valea Satului	70	30.8	14.4	9.2	2.1
7	Valea Mare	70.9	30.5	13.9	8.7	1.7

According to this analysis, it can be observed the magnitude of the flow during the extreme flood (0.1%), so the highest increases will be produced on Şuşca River, where it is recorded a flow increasing exceeding 236 times comparing with the flow with 50% probability; the next river where it can be recorded spectacular increasing is Belobreşca, with variations exceeding 204 times compared to high flow. Radimna River recorded the smallest variations in the ratio of high flow rates and the one resulted at lowest probability analysis.

CONCLUSIONS

For the hydrological modelling of the studied tributaries, it were analyzed the aspects regarding the physical characteristics of the hydrographic basins, the determination of the precipitations quantities and also the specific return probabilities.

In the first stage, it was calculated the maximum hourly precipitations with different return periods (1000, 100, 20, 10 years) at the Moldova Veche meteorological station, using the maximum hourly quantities recorded. Hereby, it was observed that for 1000 years period of return, the precipitations quantity falling in one hour has 97.6 mm, meanwhile for 100 year the precipitation hourly quantity is 58.9 mm.

Taking into account the rainfall characteristics in the interest area and the floods magnitude resulted from the hydrological model, it is necessary to establish measures to reduce the possible negative impact on the environment, households and population caused by extreme weather events.

The results of hydrological modelling show that the smallest River Basins have instantaneous responses to the studied return probabilities of the rainfall, as we seen on Pârva Reca, Șușca, Belobreșca, Valea Satului and Valea Mare, due to the small surfaces of the reception basins.

The high values of the CN coefficient favor fast water drainage over slopes and in conjunction with the area determines small concentrations times, as we seen in the table 2.

Radimna River has the highest water volume contribution to the Divici-Pojejena wetland, resulting that the surface controls the water volume transported in the wetland.

In the context of the climate change, there is likely to expect higher extreme events in terms of intensity and frequency, so additional scenarios should be considered.

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ASSESSMENT OF PEDOLOGICAL STRESS IN ROMANIA BASED ON DROUGHT INDICES
/
EVALUAREA STRESULUI PEDOLOGIC IN ROMANIA PE BAZA INDICILOR DE SECETA

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Keywords: *pedological stress, drought. Indices, extreme temperature, SPI.*

ABSTRACT

The impact of drought events on agriculture is particularly important for society. The main aim of the present paper is to analyse the specific drought events in Romania. by using the Standard Precipitation Index at a number of 20 meteorological stations. For getting an insight of the phenomenon, in this paper are presented aspects related to trends identified in air temperature and precipitation data. There are highlighted aspects related to the heat wave that hit our country in the summer of 2007, being concluded that the variability of the climatic system suggests extreme events occurrence, atypical for the Romanian climate.

REZUMAT

Impactul exercitat de fenomenul de seceta asupra agriculturii este important pentru societate. Principalul scop al acestei lucrari este Acela de a analiza evenimente specific de seceta din Romania. utilizand Indicele Standardizat de precipitatii la un numar de 20 de statii meteorologice. Pentru a analiza aspect referitoare la acest fenomen, sunt prezentate totodata aspect legate de tentindete identificate in datele de temperature si precipitatii. Sunt prezentate aspect legate de valul de caldura care a lovit tara noastra in vara anului 2007. concluzionand faptul cavariabilitatea sistemului climatic sugereraza aparitia evenimentelor extreme, atipice pentru climatul Romaniei.

INTRODUCTION

Generally. drought is defined as extensive occurrence of below average water availability for a given territory (*EEA. 2009*). Its effects have increased in recent years considering that global surface temperature has significantly risen and most probably will continue to rise (*Fischer and Knutti, 2015)*. The impacts of climate change are manifold and vary regionally, even locally, in their severity. An increase in global temperature leads to the intensification of hydrological cycle, which, in turn, affects spatio-temporal characteristics of precipitation. The distribution of precipitation plays an important role in water resources planning at regional and local scale (*Mishra and Singh, 2010).*

Because of this, it is necessary to express a better scientific interest regarding this issue in order to evaluate the changes in the characteristics of precipitation (amount, intensity, frequency, duration and type). Climate change indices based on daily precipitation observations have been developed to provide some insights into changes in these extremes.

They can be obtained from simple climate statistics to describe extremes such as very warm daily temperatures or heavy rainfall amounts. These indices are valuable for studying the impact of climate changes on regional activities, agriculture and economy. They are also helpful for monitoring climate change itself and can be used as benchmarks for evaluating climate change scenarios.

The most relevant studies regarding climate change signal are indicating that atmospheric concentrations of greenhouse gases (GHG) are increasing. One of the most important concerns regarding GHG concentration growing into the atmosphere is that these changes can have significant impacts on water within the hydrologic cycle in many regions of the world. Efficient use of water all over the world has become more and more important because of rapid depletion of water resources, industrial development and population increase. Despite the remaining uncertainty related to climate variability and change, this still represents a growing crisis with economic, health and safety, food production and security dimensions. A real fact is that the world becomes more and more vulnerable at a variety of extreme events, such as droughts, floods or heat/cold waves.

Further analysis must be undertaken in order to prevent upcoming events, these being significant for determining the character and evolution of many natural systems. One of the main issues regarding the studies related to climate change topic is the data availability and accuracy. At international level, many efforts have been undertaken for provide needed data to understand the climate system (*IPCC. 2014*).

Given the fact that is important to analyze and understand extreme weather events, the present paper presents some aspect and results related to drought events in Romania. The section 2 of this paper presents material and methods used in the study development, while the results are presented in the section 3. Section 4 includes the conclusions and discussions.

MATERIAL AND METHOD

In order to investigate the drought intensification in Romania, the 3 months-Standard Precipitation Index (SPI) was used for a number of 20 meteorological stations uniformly distributed over the Romanian territory (fig. 1). The SPI values are provided by the European Climate Assessment and Dataset project (ECA&D). (*Klein Tank et al. 2002*), and the time interval used for the analysis is 1961-2010.

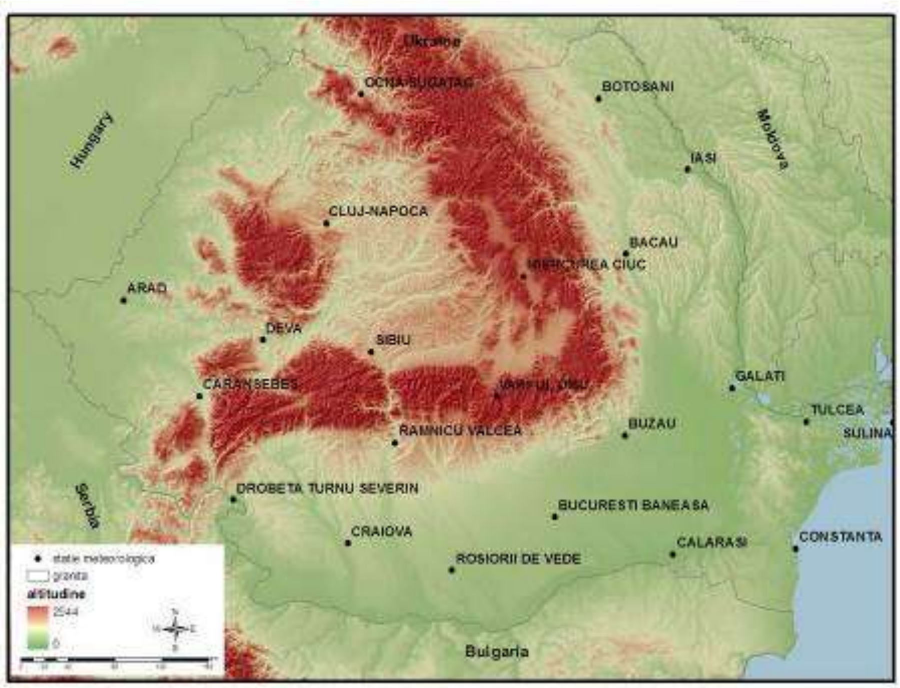


Fig. 1 - The meteorological stations used in the study to assess SPI index

The values of SPI (*WMO. 2012*), (table 1) represents 3 months accumulation: soil moisture/crop production in rainfed areas and measures rainfall conditions over a 3-month period, the anomalies of which impact mostly on soil water conditions and agricultural production (*Keyantash, 2016*).

The three-month SPI provides a comparison of the precipitation over a specific 3-month period with the precipitation totals from the same 3-month period for all the years included in the historical record. In other words, a 3-month SPI at the end of August compares the June–July–August total amount of precipitation in a particular year with the June–August total precipitation amounts of all considered years.

Table 1

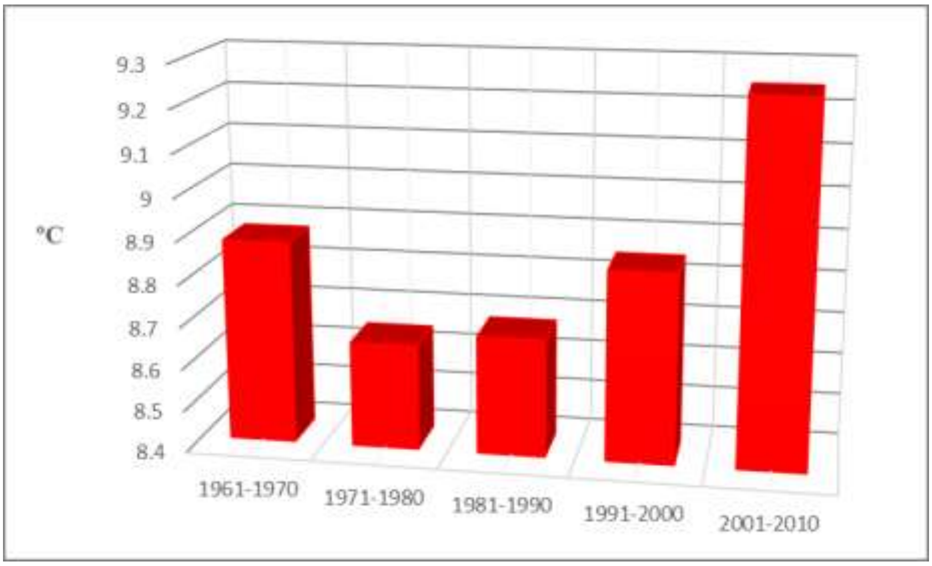
SPI values

2.0+	extremely wet
1.5 to 1.99	very wet
1.0 to 1.49	moderately wet
-.99 to .99	near normal
-1.0 to -1.49	moderately dry
-1.5 to -1.99	severely dry
-2 and less	extremely dry

Considering that SPI computation involves only precipitation data, in the present paper are analyzed also the spatial and temporal variability of mean air temperature data and precipitation amount for the same time period, being used observational data from a number of 22 meteorological stations. The trend of each time series was detected by applying the Mann–Kendall test (*Sneyers. 1975*), while the changes of the seasonal mean of air temperature and precipitation amount were detected by using the Pettitt test (*Pettitt. 1979*). Regarding the Mann-Kendall test. positive values greater than 1.97 shows an increasing trend, while negative values, lower than -1.97 reveal a decreasing trend. On the other side, the Pettitt test detects the changing points in the data series analyzed by revealing the changes occurred in time series averages. For both tests used, the level of significance of 5% (0.05) was considered as being reasonable to obtain meaningful conclusions related to data series investigated (*Busuioc et al., 2010*).

RESULTS

In Romania, the heating phenomenon follows the same trend of evolution registered at European level, so in the first decade of this century, according to the National Meteorological Administration (2013). the average annual air temperature increased by approximately 0.4 ° C compared to decade 1961-1970 (fig. 2). In the 20 and 21 centuries there have been recorded extremely droughty agricultural years as can be seen in the table below (table 2). These events of frequent and prolonged drought affected 48% from the total agricultural land (table 3).



Source: ANM. 2010

Fig. 2 - Multiannual average air temperature at national level

Table 2

Extremely droughty agricultural years in Romania

Decade	Extremely droughty agricultural years
1901-1910	1907-1908
1911-1920	1917-1918
1921-1930	1923-1924, 1927-1928
1931-1940	1934-1935
1941-1950	1945-1946, 1947-1948, 1949-1950
1951-1960	1952-1953
1981-1990	1982-1983, 1985-1986, 1987-1988, 1989-1990
1991-2000	1992-1993, 1999-2000
2001-2010	2001, 2002, 2003, 2007, 2009

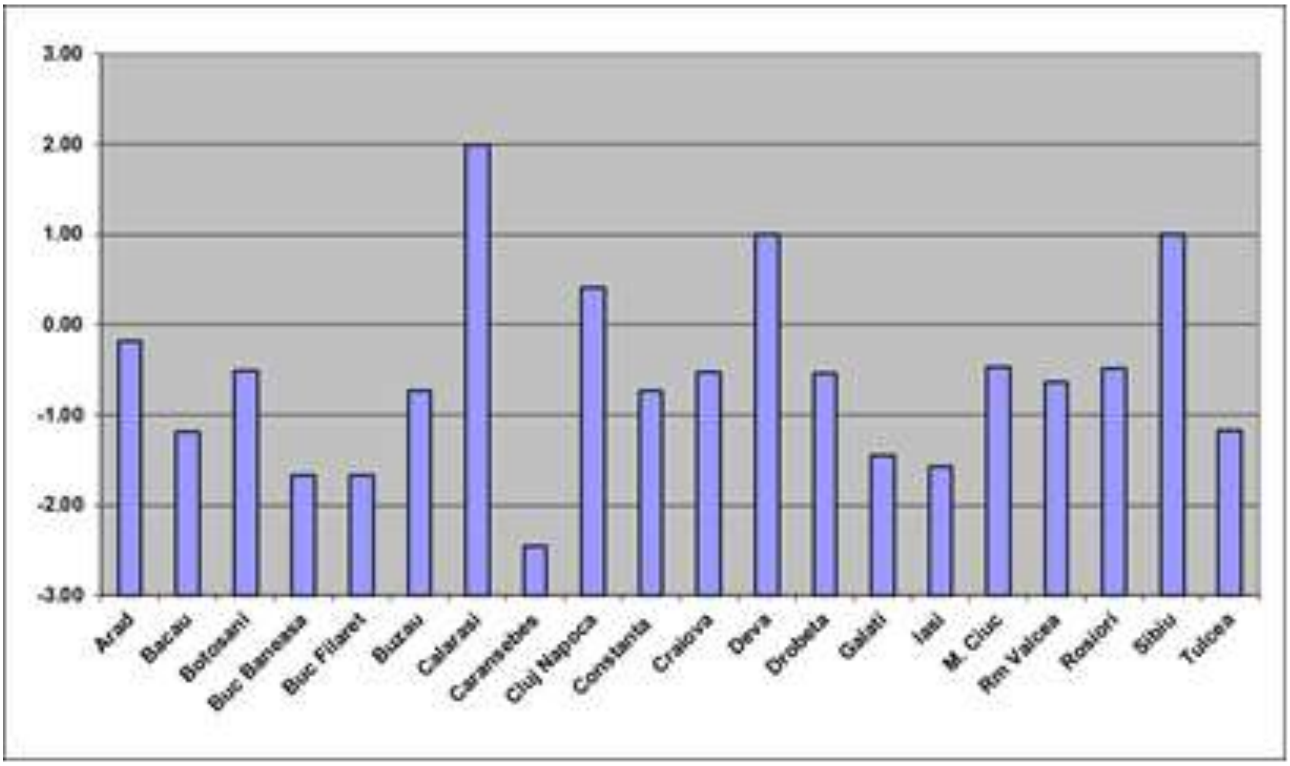
Table 3

Agricultural areas affected by drought in Romania

	Agricultural area (thou ha)	Structure (%)
TOTAL	14717.4	100.0
Arable land	9414.3	64.0
Pastures	3355.0	22.8
Hayfields	1490.4	10.1
Vineyards and orchads	457.4	3.1
Agriculturale area irigated	569.1	3.9
Of which: arable	558.8	5.9
Affected by drought	7100.0	48.0

Source: Romanian Statistical Yearbook, 2006

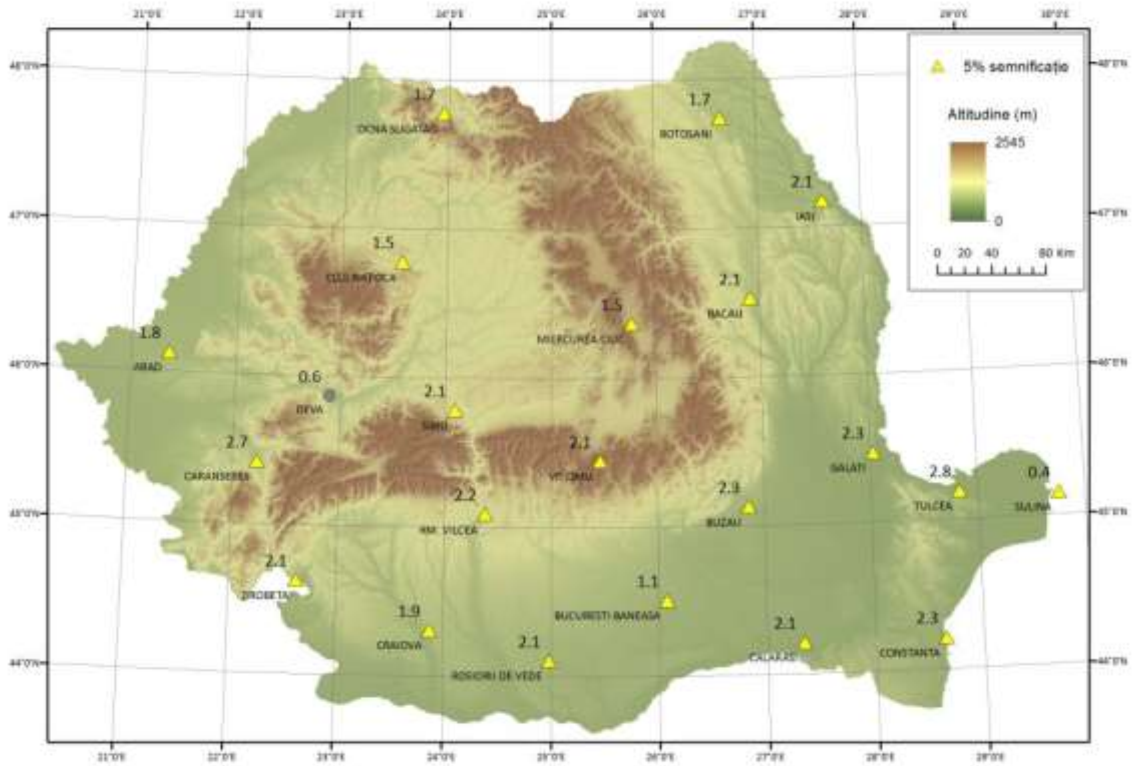
In the fig, 3 is presented the 3 months-SPI index for the time period 1961-2010 from where can be seen that excepting a number of 4 meteorological stations (Calarasi, Cluj-Napoca, Deva, Sibiu), the SPI index present values below 0.



Fig, 3 - SPI INDEX

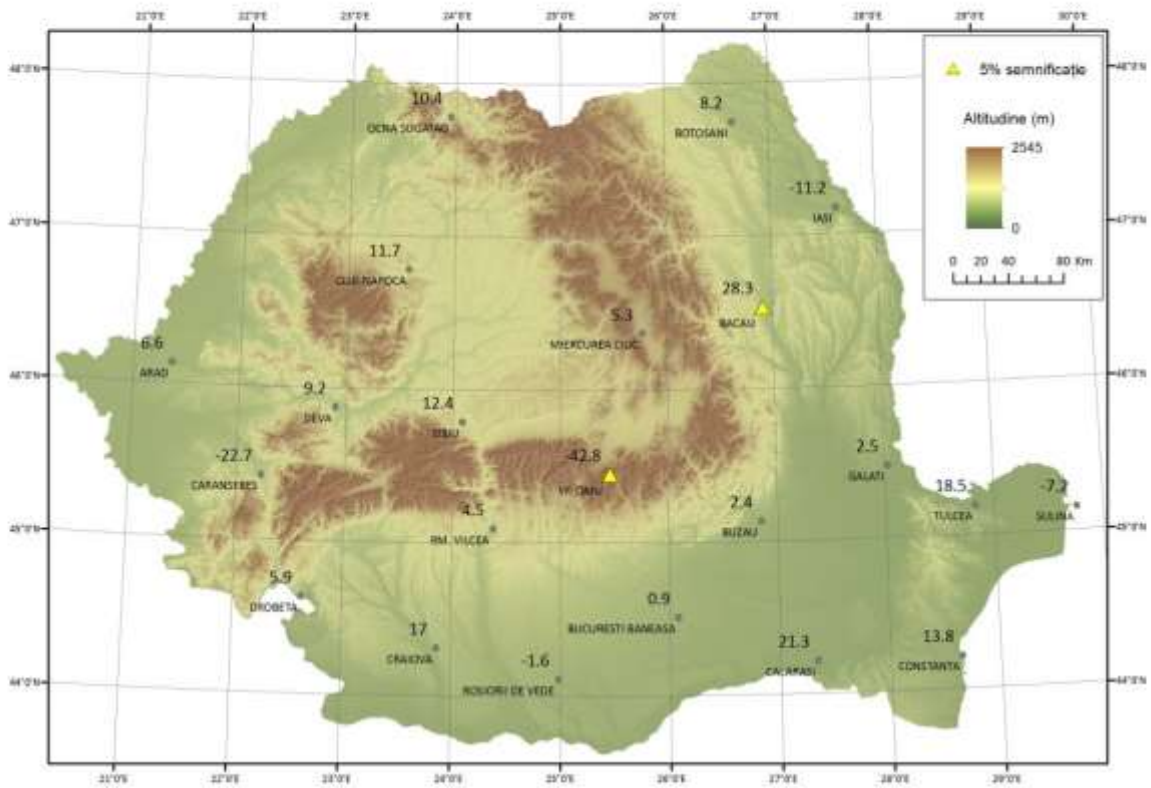
In order to investigate the climatic signal revealed by SPI index, in the fig, 4 is presented the average mean air temperature in the summer season for the period 1961-2010. A significant heating trend can be observed in the majority of the analyzed stations, the trend of growth ranging between 0.4 ° C / 50 years at Sulina and 2,8 ° C / 50 years in Tulcea.

The heating climate signal has the highest values in the eastern and south-western regions, the average heating trend being about 0.4 ° C per decade. At the Deva station, the trend is 0.6 ° C / 50 years, this being the only meteorological station for which no statistically significant increase trend has been detected at the level of 5%. Changing points detected by Pettitt test ranges at most stations around the years 1985-1987.



Fig, 4 -The linear trend (° C) of the average air temperature in the summer season for the period 1961-2010. With triangles are marked statistically significant trends at the level of 5%

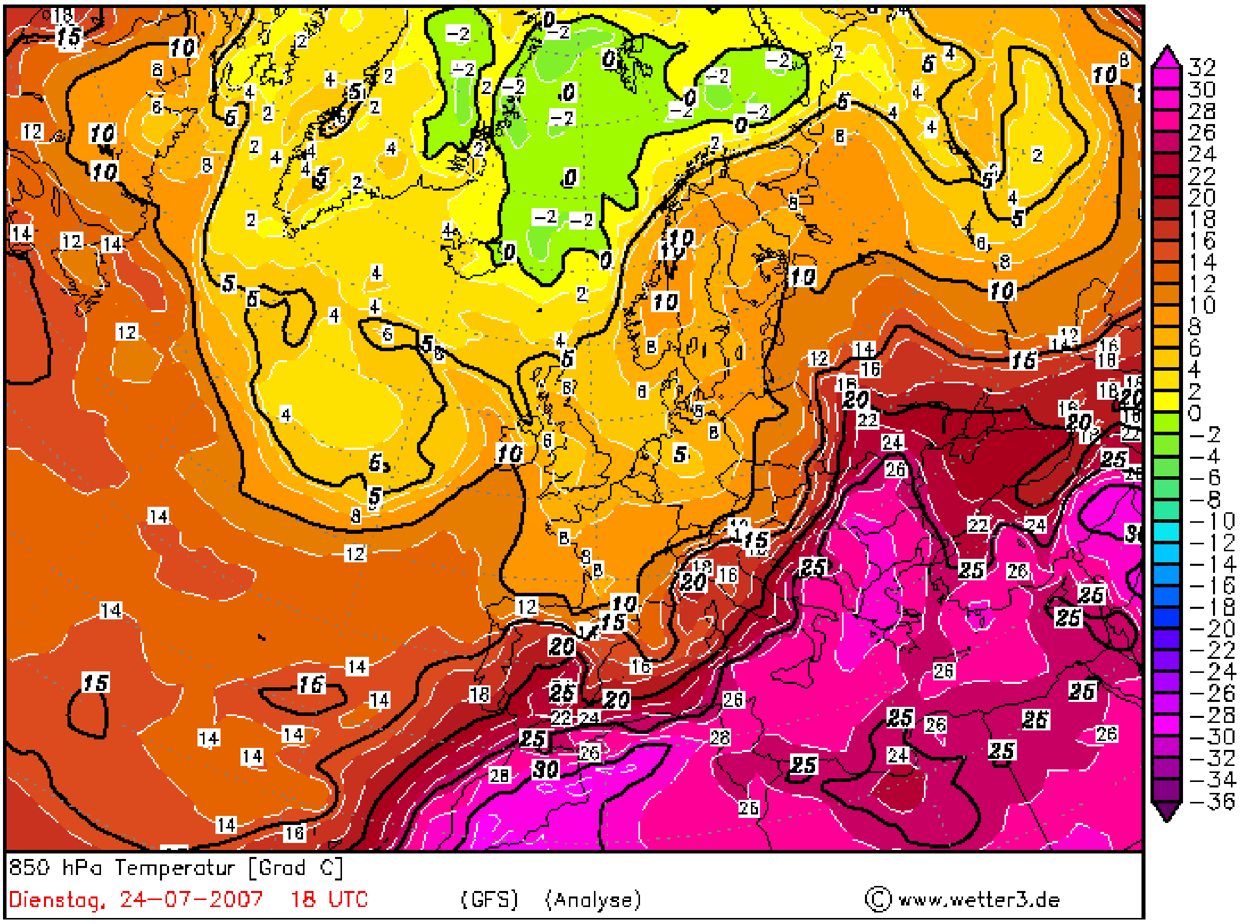
With regard to the amount of precipitation in the summer season, the results of the Mann-Kendall statistics (fig. 5) highlight the stations where the trend is statistically significant at the 5% level,



Fig, 5 -Trend of precipitation amount for summer season (mm) for 1961-2010 time period. With triangles are marked statistically significant trends at the level of 5%

Although growth trends have been identified on extensive areas, they are not statistically significant, with the exception of the Bacau station with a growth trend of 28.3 mm / 50 years. Decreasing trends were detected for five stations (Iaşi, Vârfu Omu, Caransebeş, Roşiori de Vede and Sulina), only for the Vârfu Omu station being identified a statistically significant decrease of -42.8 mm / 50 years.

In order to get an insight into the specific aspects of heat waves that could generate extreme drought events in Romania, in the fig, 6 is presented the thermal field at 850 hPa for the European region. According to the data provided by the National Meteorological Administration, the summer of 2007 was the warmest at the national level in the first decade of the current century, exceeding the summers of 1946 and 2000, mainly through the persistence of the hot days. The heat wave peak of July 2007 was reached on the 24th day when the air mass of tropical origin extended to the northeast of the continent, the mercury of the thermometers exceeding the threshold of 40 ° C in all the plain areas of our country (fig. 6).

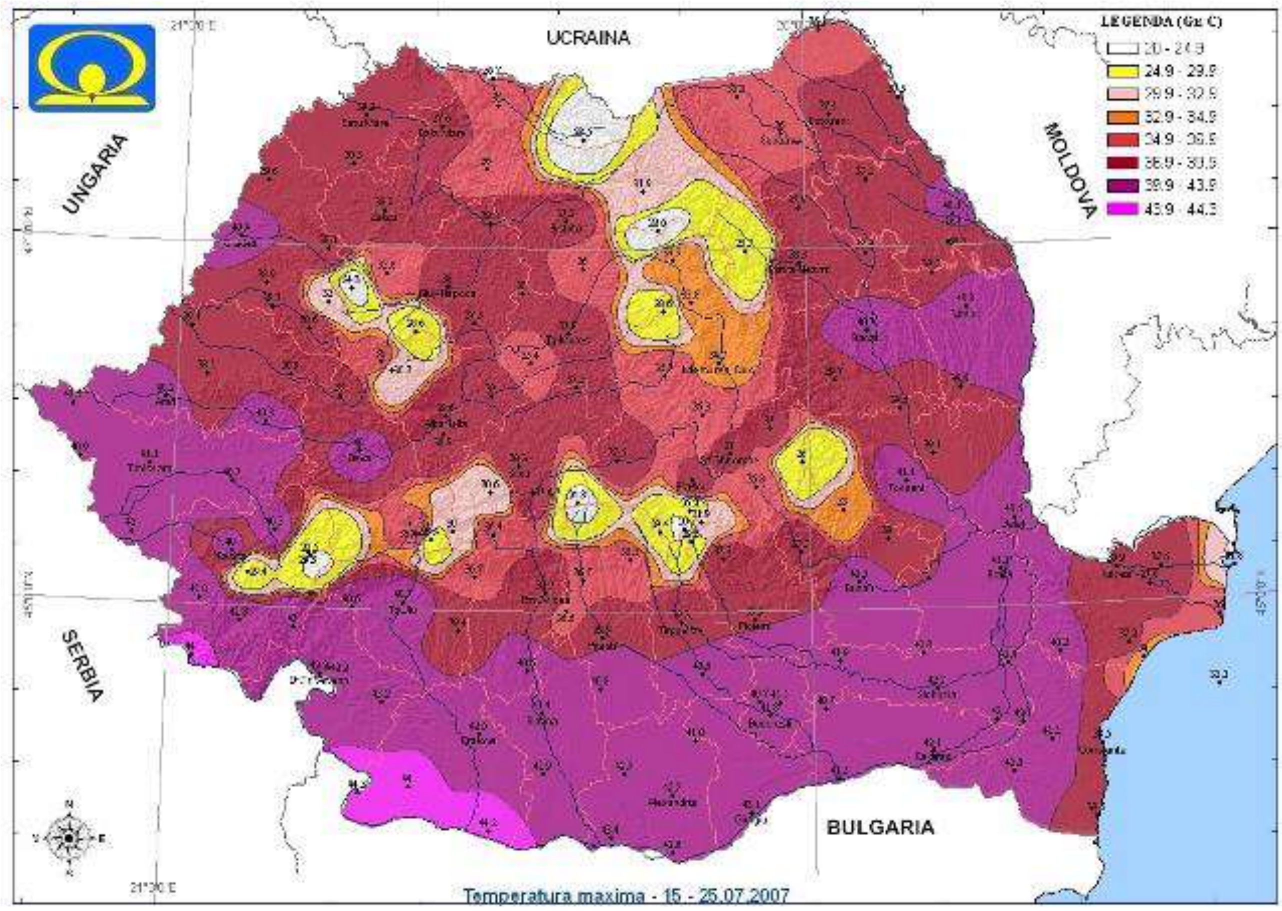


Source: www,wetter3,de

Fig, 6 - Thermal field at isobaric surface of 850 hPa, on 24.07.2007, 18 UTC

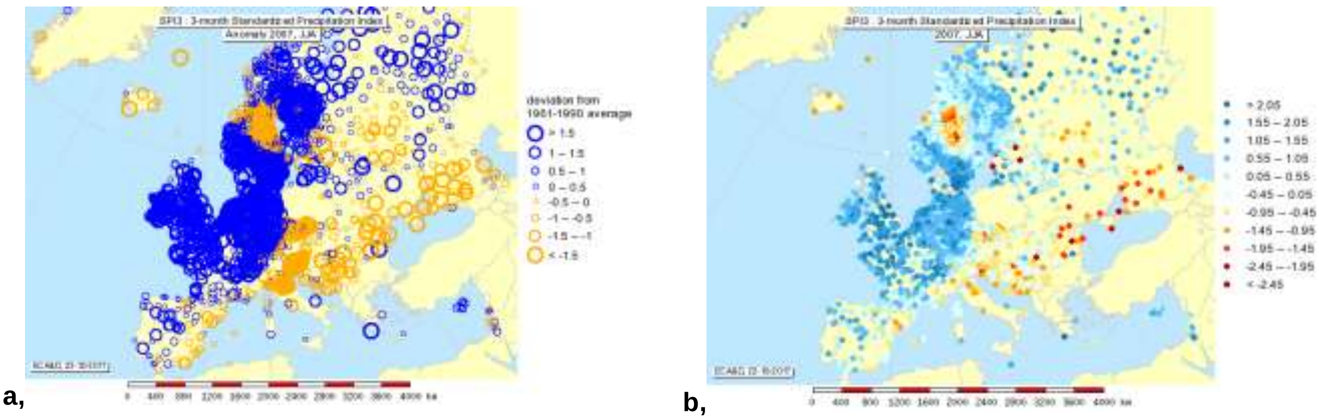
Fig. 7 shows the maximum temperature values recorded at national level in July 15-25, 2007, where it can be seen that the southern and southeast of the country has reached values above 40 °C,

In the figure 8 are presented the SPI index and the anomalies registered (deviations from the 1961-1990 average) for the July 2007, from where can be seen that in Romania are detected negative values of SPI index at the most stations analysed,



Source: National Meteorological Administration

Fig, 7 - Maximum temperature values recorded between July 15-25, 2007 at national level



Source: ECA&D database

Fig, 8, - SPI index in Europe in summer of 2007

a) SPI anomalies registered in July 2007; b) SPI index in July 2007

CONCLUSIONS

The occurrence of climate extremes has become more and more important when referred to intensity of this events. The knowledge of the patterns and changes during time contributes to understand their nature and the impacts they can have on socio-economic activities, generally. Extreme events such as the heat wave registered in the summer of 2007, destroyed nearly 60% of the stalky cereal crops of hoeing crops, wells got dry according to the statistics *(Bogdan. O. et al., 2011),* From the analysis performed can be concluded that even though is a flexible index that is simple to calculate, the precipitation being the only required input parameter, it cannot reveal the exact insights of events. In other words, this index is very effective in analysing wet and dry periods that may reveal a changing climate signal. Further analysis need to be undertaken by using more drought indexes and complex data types, considering that the climate change models results show that droughts become more frequent and last longer, being recorded higher minimum temperatures.

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NANOPARTICLES APPLICATION IN WASTEWATER TREATMENT BY FLOTATION / *APLICAREA NANOPARTICULELOR ÎN EPURAREA APELOR PRIN FLOTAȚIE*

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Keywords: *Oxide nanomaterials, wastewater treatment, flotation.*

ABSTRACT

In this study, we present the potential of nanomaterials application for improving the wastewater treatment by flotation and also the experimental investigation of using magnetite nanomaterial as froth stabiliser in flotation process applied for the removal of oil pollutant from wastewater.

In order to evaluate the magnetite (Fe_3O_4) nanomaterial potential of application for oil removal from wastewater by flotation were studied the following parameters, such as: yield of wastewater treatment [%] and the stability of froth.

REZUMAT

În acest studiu se prezintă potenţialul de aplicare al nanomaterialelor în scopul îmbunătăţirii epurării apelor prin flotaţie şi totodată investigarea experimentală a utilizării nanomaterialului magnetită (Fe_3O_4) ca stabilizator al spumei în procesul de flotaţie aplicat pentru îndepărtarea uleiului din apa uzată.

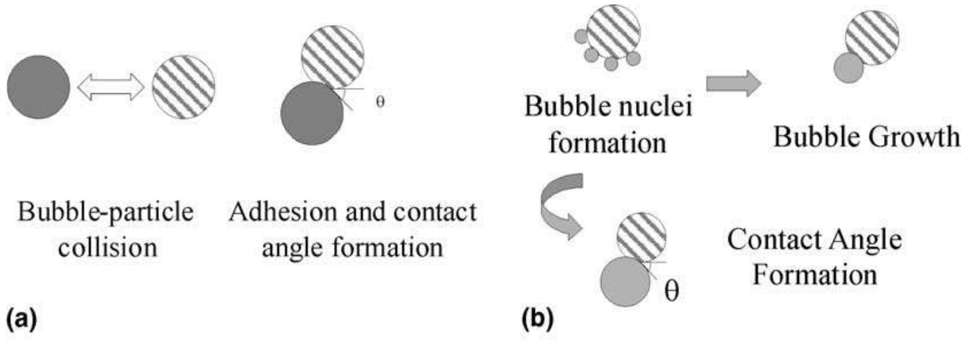
Pentru evaluarea potenţialului de aplicare al nanomaterialului magnetită (Fe_3O_4) în scopul îndepărtării uleiului din apa uzată prin flotaţie au fost studiaţi următorii parametrii: randamentul de epurare [%] şi stabilitatea spumei.

INTRODUCTION

Changes in climate conditions, combined with intensive population growth in the last decades have led to decreasing water reserves, especially in the urban areas. This combined with the increasing pollution caused by wastewater from industrial activities cumulated with the ones from households led to the necessity to find improved methods of treating wastewater.

Authorities in the field have enforced much stricter regulations in the last years, limiting the pollution caused by these wastewaters and ensuring a more efficient treatment process. Therefore, new wastewater treatment techniques were introduced, ensuring better cleaning and lower costs.

One of the most common techniques is represented by flotation. This is a process that is widely used in clarifying wastewaters by removing suspended matter (oils, solids, etc.). It consists in passing air under pressure through the liquid solution (wastewater). The air forms very small bubbles that adhere to the suspended matter and transports them to the surface where they are removed, leaving the liquid clean. (*Habibzadeha and Gurbanov. 2010; Farrokhpay. 2011*). A comprehensive view of the bubble-particle mechanisms is shown in figure 1.



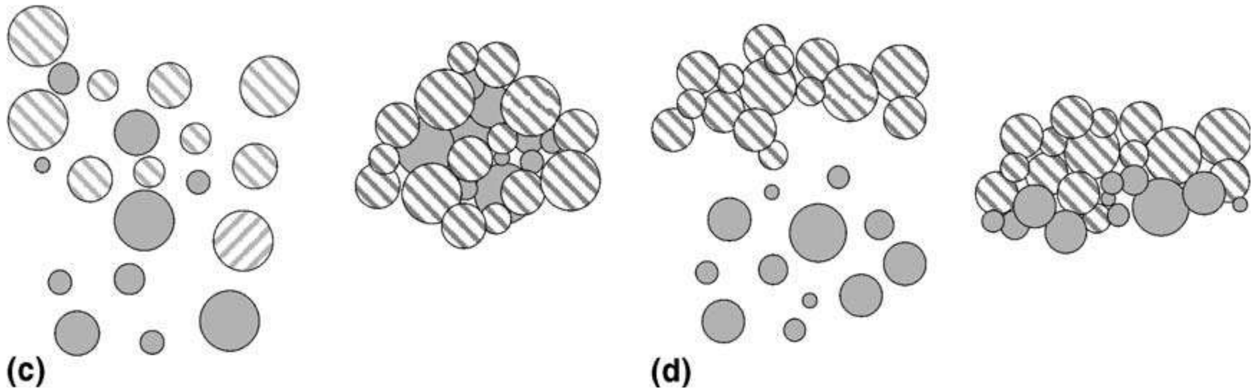


Fig. 1 - Bubble-particle mechanisms in dissolved air flotation (*Rubio et al.. 2002*)
(a) particle–bubble collision and adhesion; (b) bubble formation at particle surface; (c) micro-bubble entrapment in aggregates; (d) bubbles entrainment by aggregates.

Oily wastewater is wastewater with oils or fats from various industries. Oily wastewater has a huge potential to degrade the environment especially soil and water. As such, they represent an environmental problem. To protect the environment, oily wastewater treatment is unavoidable.

The concentrations of oil in municipal and industrial wastewater effluents are strictly monitored (*Diya'uddeen et al.. 2011; Farmaki et al. 2007; Binks 2002*; *Mueller. 2003; Raha. 2007*) as they could cause serious health and environmental problems. For example, in the water resulting from petroleum plants the discharge limits of these substances are regulated at a monthly average of 29 mg L^{-1} with a daily maximum of 42 mg L^{-1}(*Hank. 2011*).

To meet these stringent discharge limits, oil substance can be effectively separated from waste water using following practical technologies:

1. Gravity settling and corrugated plate interceptors;
2. Centrifugal separation using hydrocyclone;
3. Chemical pre-treatment (coagulation-flocculation);
4. Coalescing media;
5. Gas flotation (induced gas flotation and dissolved gas flotation);
6. Biological processes (membrane bio-reactor and activated sludge);
7. Media Filtration (Resin, polymer, sand, clay, garnet, silica, walnut shell).

The efficiency of treating wastewater using flotation systems is mainly given by the structure and stability of a froth phase and its ability to transport the particles to the surface of the liquid solution. Therefore, the separation efficiency and selectivity of the flotation process relate directly to froth stability, bubble coalescence and bubble size distribution (*Cilek and Karaca. 2015; Farrokhpay. 2011*).

One way to ensure the existence of a stable froth is to use frothers (foam stabilizers), which have a positive effect on froth stability, bubble coalescence, mobility and also on the adhesion, entrainment and drainage of suspended matter.

Nanoparticles have begun to be used as foam stabilizers and their ability to help the stability of foams has been studied by many researchers (*Binks. 2002; Du et al.. 2003; Dickinson et al.. 2004; Horozov. 2008; Liu et al.. 2010; Yu et al.. 2011*). In the scientific literature are studies which present the capacity of nanoparticles to act as foams/emulsion stabilisers (*Dickinson et.al. 2004; Liu et al.. 2010*). The stability and the formation of foams is dependent of the particles size, surfactant type and concentration (*Paunov et.al 2002; Saththasivam et.al.2016; Wang L.K. et al.. 2010. Zech O. et.al.. 2012*).

The paper addresses to the application of magnetite nanoparticles as surfactant for helping the formation and stability of foams in oily wastewater treatment by flotation.

MATERIAL AND METHOD

The preparation of magnetite nanomaterial tested was already published in another article (Covaliu et al. 2010).

The experiments were done on a synthetic wastewater containing a concentration of oil of 35% in the presence and in the absence of Fe_3O_4 nanomaterial. Dissolved air flotation system contained also 5% of anionic surfactant and 5 % of amphoteric surfactant

RESULTS

During the experiments we observed the decreasing of time for wastewater treatment when the magnetite nanoparticles were used in the flotation process, from 10 min to 2.5 min;

Also, it was observed the increasing of stability of the formed foam when was used magnetite nanomaterial in the flotation process (6 h in comparison with 40 min). This aspect is important for the large-scale wastewater treatment technologies where you need sufficient time to remove the foam having the pollutant on the surface of wastewater;

Moreover, when was used magnetite nanomaterial the yield of wastewater treatment was 100 %.

CONCLUSIONS

The preliminary study of the influence of using Fe_3O_4 nanomaterial in the wastewater treatment by flotation revealed that the main advantages were observed in the increasing the stability of the foam containing the oil pollutant and the decreasing of the time needed for wastewater treatment. The results sustain further research on this subject of interest by investigating different types of nanoparticles having different morphologies.

ACKNOWLEDGEMENT

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COMPARATIVE ANALYSIS OF HYDRODYNAMIC AND HYDROMORPHOLOGICAL PARAMETERS VARIATION RESULTING FROM ANTHROPIC INTERVENTIONS ON LOWER DANUBE – CALEIA BRANCH
/
ANALIZA COMPARATIVĂ PRIVIND VARIAȚIA PARAMETRILOR HIDRODINAMICI ȘI HIDROMORFOLOGICI REZULTATĂ ÎN URMA INTERVENȚIILOR ANTROPICE DE PE DUNĂREA INFERIOARĂ - BRAȚUL CALEIA

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Keywords: *discharge, water velocity distribution, riverbed bathymetry, Old Danube, Acoustic Doppler Current Profilers.*

ABSTRACT

In the context of the necessity to improve navigation conditions on the Old Danube, a submerged bottom sill was built on the Caleia Branch in order to ensure the discharge redistribution towards the Old Danube branch. This paper presents the analysis of results for discharge, water current velocity distribution and riverbed bathymetry differences over a gap of two years. There have been compared the processed results of two measurement campaigns carried out in 2014 and 2016 using the Acoustic Doppler Current Profilers technique.

REZUMAT

În contextul necesității îmbunătățirii condițiilor de navigație pe Dunărea Veche. în zona brațului Caleia a fost construit un prag de fund submersat, în vederea asigurării redistribuirii debitului către brațul Dunărea Veche. În acest articol se prezintă rezultatele analizei diferențelor între valorile debitului de apă, distribuțiile vectorilor de viteză a apei și batimetria albiei râului apărute după un interval de doi ani. Au fost comparate rezultatele prelucrărilor măsurătorilor efectuate în cadrul a două campanii din 2014 și 2016 utilizând tehnica Acoustic Doppler Current Profilers.

INTRODUCTION

The Danube River Basin, the Europe’s second largest river basin, with a total area of 801.463 km² that includes territories of 19 countries can be divided in three sub-regions: the upper, middle and lower basin, which includes the lowlands, plateaus and mountains of Romanian and Bulgarian territory crossed by the river. 97.4% from the Romanian territory is located within the Danube River Basin. The Lower Danube flows across a wide plain as the river becomes shallower and broader, with several major islands and the current slows down considerably.

Among the main economic value of the Danube, navigation is the reason for many hydraulic structures built in order to facilitate this process. The channelization of the river’s course has made it easier for ships to navigate 2411 km - 87% of the length of the Danube (ICPDR, 2009).

Connecting the Black Sea with the industrial centres of the Western Europe and with the Port of Rotterdam, the Danube is a major Corridor of the Trans European Transport Network (TEN-T) declared at the 2nd Pan-European Transport Conference held in Crete in 1994 (CEC. 1997).

As the Danube river sector between km197– km195 is part of the Pan-European Corridor VII ensuring the connection between the Danube River and the maritime Danube, the necessity to improve the navigation conditions in order to provide a minimum 2.5 m in depth for the navigable channel (under the Danube Commission recommendations) lead to a series of hydraulic works on the Caleia and the Old Danube branches.

Fig. 1 – Location of the Caleia branch and Old Danube km196- km183

In the frame towards the management of European basins, the EU Water Framework Directive includes the hydromorphological alterations risk and aims to identify how best to manage synergism and antagonism between the management of hydromorphological alterations in river management planning and the requirements of other policies and activities by appraising social, economic and environmental impacts and benefits (EC. 2006).

The environmental impact of the works carried out on the Caleia branch has been monitored since 2011 by the National Institute of Research and Development in Environmental Protection (INCDPM), the project finishing the 3 years post-construction phase for the area concerning this paper in July 2017 (INCDPM, 2011-present).

The assessment for the variation of hydrodynamic parameters in the context of anthropic intervention (INCDPM, 2015) is needed in order to determine the hydrological and/or morphological pressures on the structural characteristics of the water body and on the existing habitats, especially for the sturgeon populations (INCDPM, 2016).

Data processing involving spatial information on hydrodynamic and hydromorphological parameters require the use of Geographic Information Systems (GIS) technique (INCDPM, 2017).

MATERIAL AND METHOD

The datasets used in the comparative analysis presented in this paper resulted from two in situ measurements campaigns carried out in April 2014 and May 2016 on the Caleia and Old Danube branches using Acoustic Doppler Current Profilers (ADCP) technique.

The ADCP mounted on a moving boat is one of the most widely-used tools for measuring streamflow with a history of use of over 30 years for its capabilities to measure water current velocity and to compute discharge values (Christensen and Herrick, 1982; Simpson and Oltmann, 1993) on a spatial and temporary scale unattainable before.

ADCP uses a principle of physics discovered by C.J. Doppler that relates the change in frequency of a source to the relative velocities between the source and the observer. An ADCP applies this principle by reflecting an acoustic signal (in the ultrasonic range) off small particles of sediment and other materials present in the water (Mueller et al., 2013). The water velocity is measured throughout the water column, the ADCP dividing it into depth cells (bins) and providing velocity data for each cell. Being used in a moving boat-mounted system, the recorded water velocity values are relative to the boat, so the ADCP uses bottom tracking or a global positioning system (GPS) in order to account for the velocity of the boat. Thus. the technique is also used for determining the transect bathymetry and therefore, the discharge value can be accurately computed using velocity and section data.

In the measurement campaigns on the Caleia and Old Danube branches, there has been used the ADCP SonTek RiverSurveyor M9 (SonTek. 2013) that has four 3-MHz and four 1-MHz profiling beams angled at 25 degrees and one 500-kHz vertical beam that measures depth only and an auto-adaptive configuration algorithm that supports use of multiple frequencies, variable depth-cell sizes and pulse-coherent, broadband and incoherent ping configuration and processing techniques.

The transversal and longitudinal transects have been recorded along the same tracks, the course of the ADCP equipped boat following the control sections presented in Fig.2.

The following transversal sections have been considered:

- STCG1 – upstream the Caleia branch submerged bottom sill;
- STCG2 – over the bottom sill;
- STCG3 – Old Danube km 195.5;

In the analysis has also been used a longitudinal transect, represented as SLCB in Fig.2.

Fig. 2 – Position of the transversal and longitudinal control sections

The measurement sets containing water current velocity, riverbed transect bathymetry and computed discharge data have been processed in order to analyse the differences over the two years gap between the measurement campaigns.

RiverSurveyor Live, the software used for the data collection, has been also used for the measurement playback and primary data processing. The software allows graphical and tabular display for the recorded data (as shown in Fig.3) and also the possibility to export, text and mat files in order to ensure the possibility for data post processing with other software.

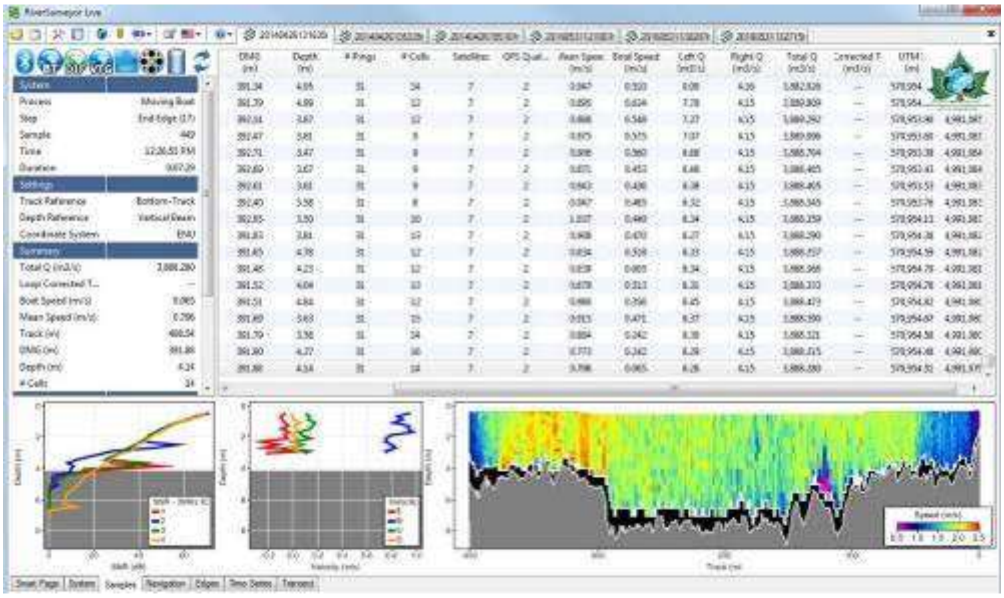

Fig. 3 – Graphical representation and tabular data in RiverSurveyor Live

The ***discharge values*** have been computed by statistically processing the recorded values from successive transects on the same transversal control section.

Using the velocity vectors data (magnitude on the East, North, Up and Down directions), there has been computed the resulting vector magnitude for every cell depth on every recorded water column. The data files have been used for the ***water current velocity distribution*** representations.

In order to determine and represent the ***water current velocity vertical profiles***, the sections have been divided in horizontal 1 m depth layers for which the average velocity value has been computed.

Using the GGA string from the GPS, essential fix data which provide 3D location and accuracy data [NMEA, 2008], the recorded bathymetry data was used for the comparative analysis of ***riverbed bathymetry*** from April 2014 and May 2016.

RESULTS

In order to ascertain the accurate analysis basis, the discharge values computed for the two measurement campaigns must be comparable.

Table 1

Computed discharge values for Caleia branch

Control section	Q_apr.2014 [m³/s]	Q_jun.2016 [m³/s]	Variation [%]
STCB1	3977	3812	**4.15**
STCB2	3888	4011	**3.16**
Variation [%]	**2.29**	**4.96**	

Table 2

Computed discharge values for Old Danube km 195.5

Control section	Q_apr.2014 [m³/s]	Q_jun.2016 [m³/s]	Variation [%]
STCB3	**3718**	**3830**	**3.01**

For the control sections located on the Caleia branch, as presented in Table 1., the maximum difference between the discharge values on the same section in different campaigns is 4.15 % and the maximum difference between discharge values on the same river branch recorded during the same campaign is 4.96%.

From Table 2. on the Old Danube the difference between the discharge values from the two campaigns is approx. 3%.

As the reason for building the submerged bottom sill was the discharge redistribution from the Caleia branch towards the Old Danube, the percentage for these specific discharge conditions is shown in Equation (1).

$$\frac{Q_{OldDanube\_june2016}}{(Q_{Caleia\_june2016}+Q_{OldDanube\_june2016})}*100-\frac{Q_{OldDanube\_april2014}}{(Q_{Caleia\_april2014}+Q_{OldDanube\_april2014})}*100=1.8\% \qquad (1)$$

The following part of the paper presents the comparative analysis carried out for the next hydrodynamic parameter: water current velocity.

In Fig. 4 – Fig.7 there were represented the water current velocity distributions along the three transversal sections and the longitudinal section on the Caleia branch.

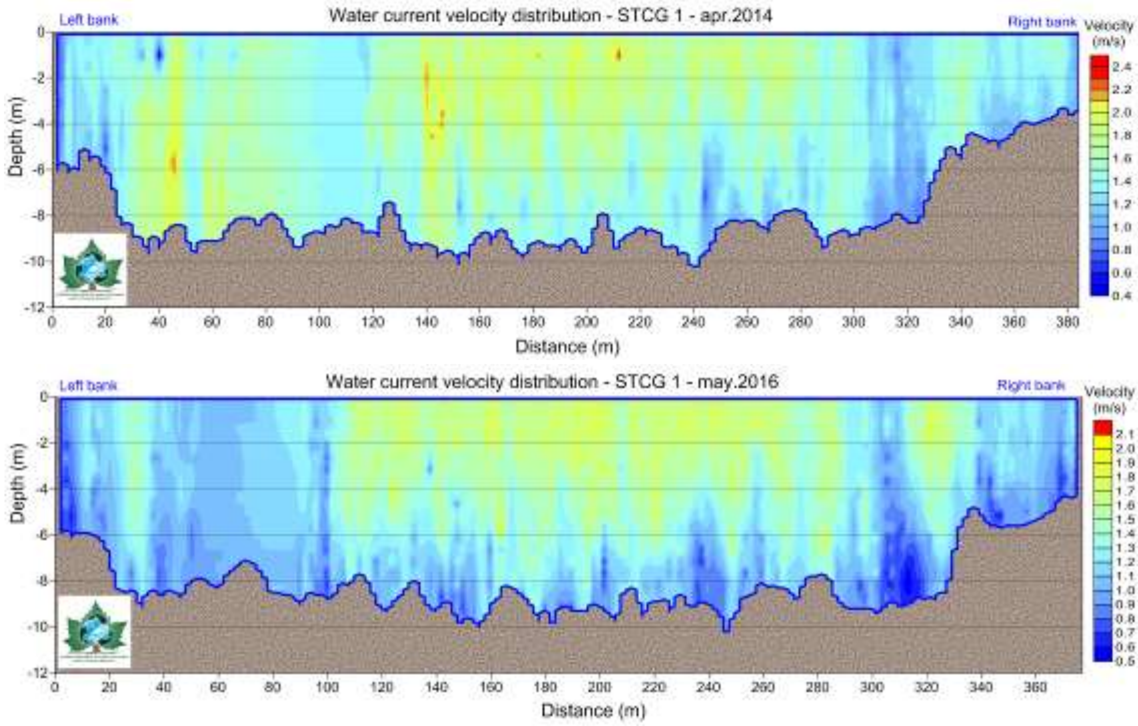

Fig. 4 – Water current velocity distribution STCG 1 - April 2014 vs May 2016

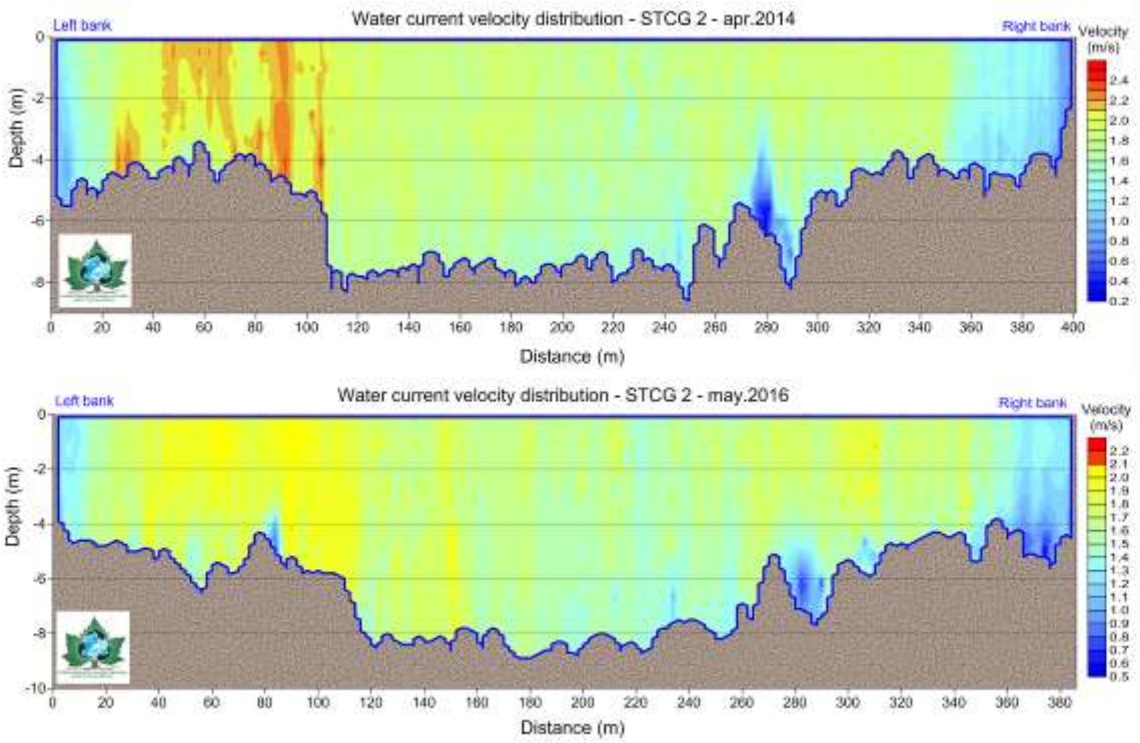

Fig. 5 – Water current velocity distribution STG2 - April 2014 vs May 2016

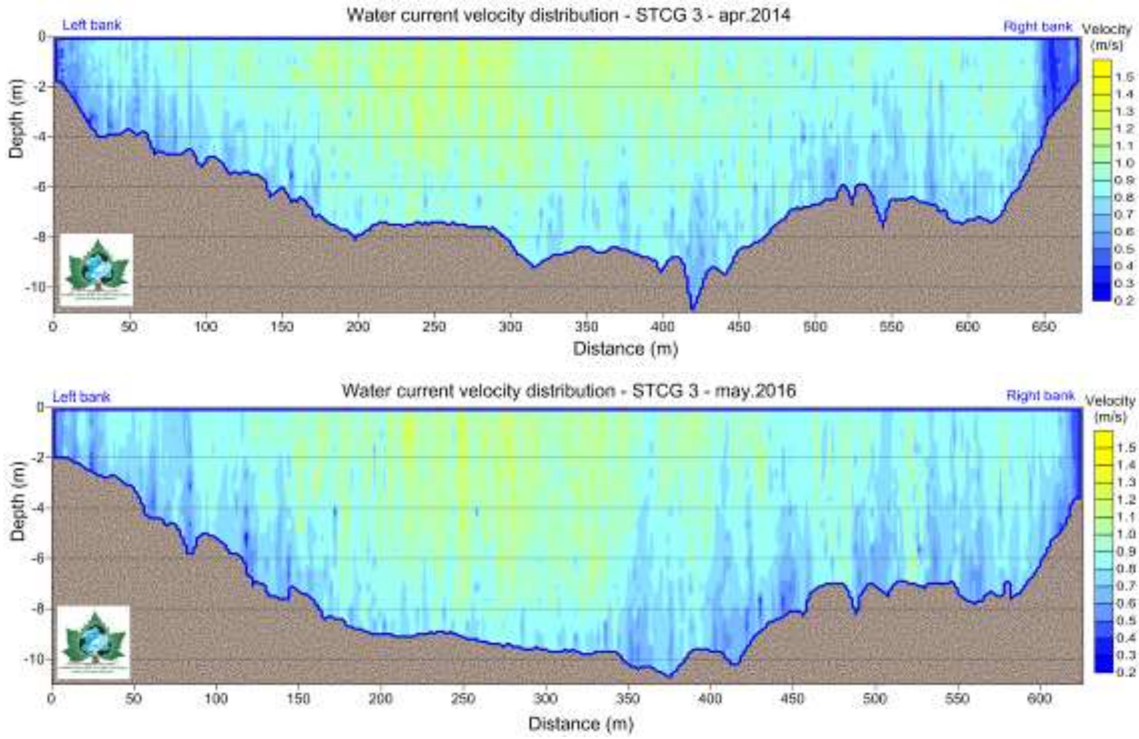

Fig. 6 – Water current velocity distribution STG3 - April 2014 vs May 2016

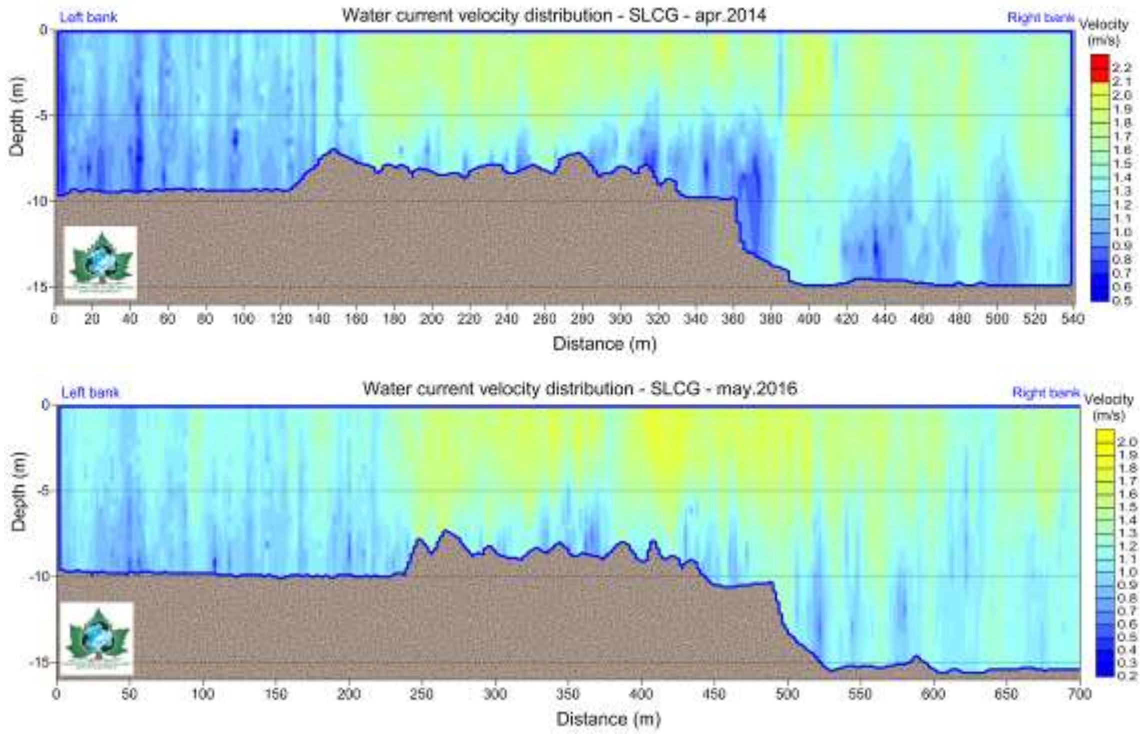

Fig.7 – Water current velocity distribution SLCG - April 2014 vs May 2016

As Fig.4-Fig.6 show from a graphical point of view, for the control sections located on the Caleia branch (STCG1 and STCG2), the values for the water current velocity have decreased and for the section on the Old Danube km195.5 (Fig. 7), there are not notable differences.

To further the comparative analysis, statistical techniques have been applied to the velocity recorded in the depth cell data. Fig.8 presents the distribution of water current velocity as histograms.

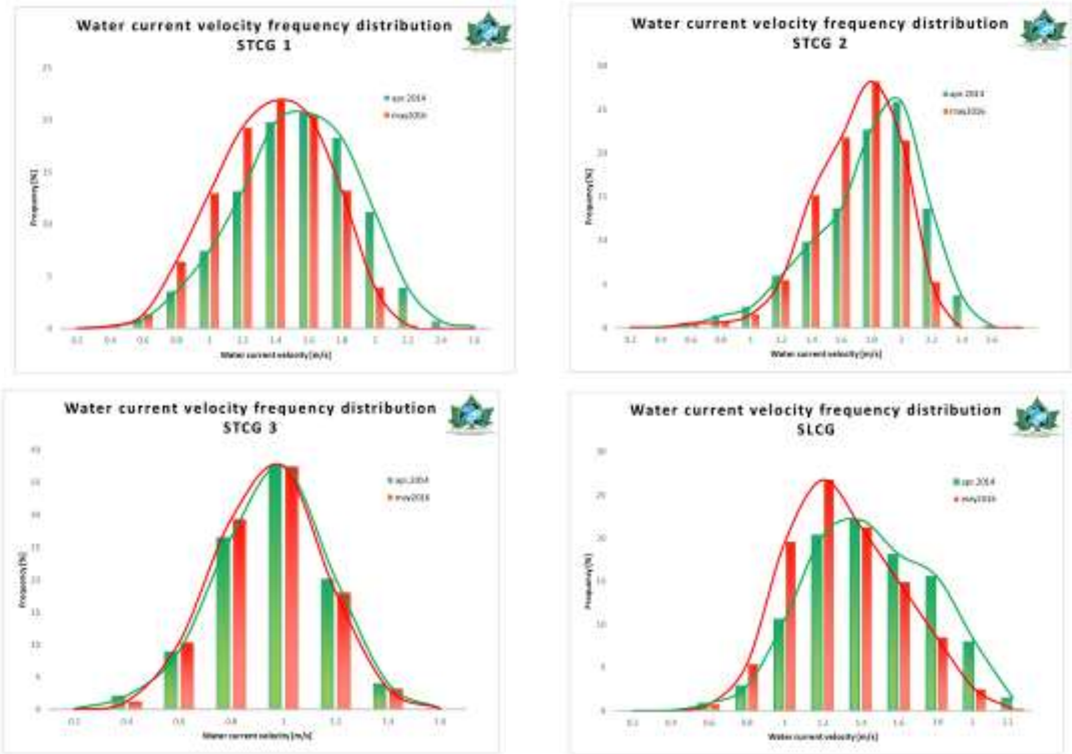

Fig. 8 – Water current velocity frequency distribution - April 2014 vs May 2016

As a general observation for the STCG1. STCG2 and SLCG sections, compared to April 2014, the water velocity values have decreased in May 2016.

For STCG1, the maximum recorded velocity values were 2.58 m/s (2014) and 2.13 m/s (2016) and the average velocity on the whole section was 1.44 m/s (2014) versus 1.28 m/s (2016). As for STCG2. 2.69 m/s was the maximum velocity in 2014 and 2.16 m/s in 2016, while the average water velocity values were 1.68 m/s (2014) and 1.60 m/s (2016).

This decrease tendency is also visible in the water current velocity frequency distributions presented in Fig.8 that shows that the velocity value with the highest frequency was:

- for STCG1 : 1.6 m/s in 2014 versus 1.4 m/s in 2016
- for STCG2: 2 m/s in 2014 versus 1.8 m/s in 2016
- for SLCG : 1.4 m/s in 2014 versus 1.2 m/s in 2016

For the section located on the Old Danube, the maximum recorded velocity was 1.6 m/s in 2014 and in 2016 1.52 m/s. As for the average values for the water current velocity for the whole section, the values are almost equal: 0.85 m/s in 2014 and 0.84 m/s in 2016. This is confirmed by the STCG3 histogram in Fig.7, where we can note that the velocity value with the highest frequency was 1 m/s for both 2014 and 2016 measurements.

After the layered in-depth water current velocity analysis and representation in Fig.9, we can state that the earlier observations on STCG1 and STCG2 regarding the velocity values decrease from 2014 to 2016 are confirmed. Also, for STCG3, the values are very close for every considered layer.

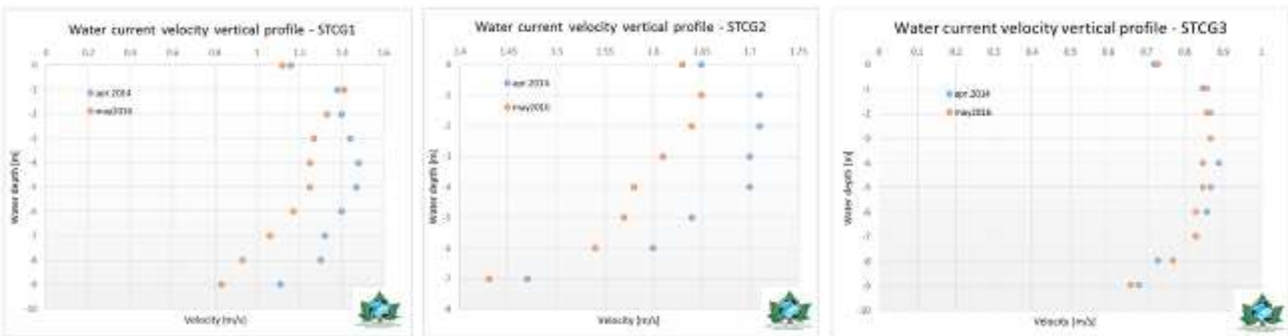

Fig. 9 – Water current velocity vertical profiles - April 2014 vs May 2016

Using the riverbed bathymetry data recorded in the two measurements campaigns, in Fig.10-Fig.13 there have been represented the bathymetric profiles for the transversal and longitudinal sections in order to determine the morphological alterations of the riverbed in the two years gap between the in situ campaigns.

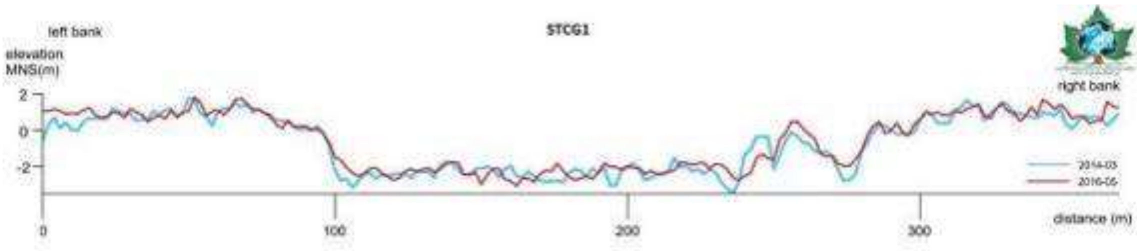

Fig. 10 – Riverbed bathymetry STCG1 – April 2014 vs May 2016

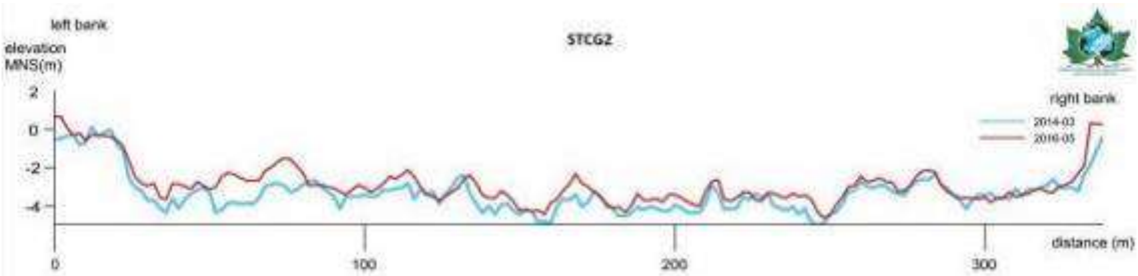

Fig. 11 – Riverbed bathymetry STCG2 – April 2014 vs May 2016

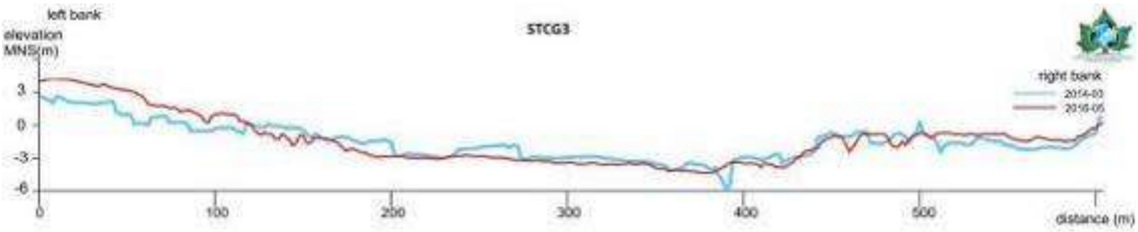

Fig. 12 – Riverbed bathymetry STCG3 – April 2014 vs May 2016

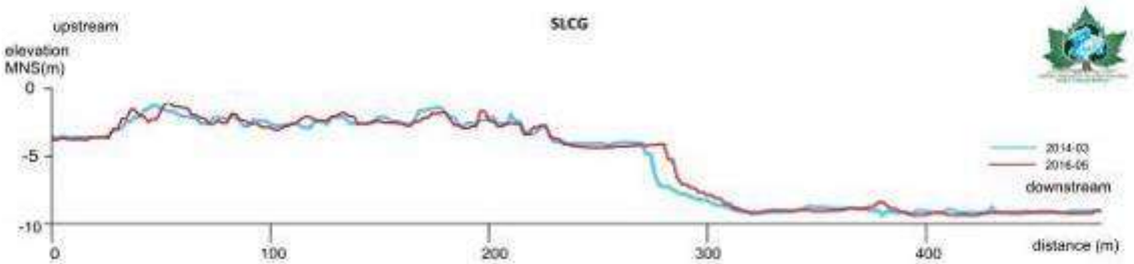

Fig. 13 – Riverbed bathymetry SLCG – April 2014 vs May 2016

The general observation that applies to all the representations is that there are not apparent significant morphological changes between the 2014 and 2016 bathymetrical profiles. There can be observed small areas that have suffered deposition or erosion, the most significant being on the Caleia branch, as it shown in Fig.13.

CONCLUSIONS

The impact of the anthropic interventions like the submerged bottom sill from the Caleia branch must be monitored over time in order to detect alterations of the hydrodynamic and hydromorphological parameters that go beyond the intended scope of the intervention.

From the comparative analysis performed on the data sets resulted from the April 2014 and May 2016 measurements campaigns, carried out in comparative discharge values conditions and using the Acoustic

Doppler Current Profiler technique in order to determine the parameters variation the following, can be stated:

- The *discharge* values recorded in 2014 and in 2016 present a slight discharge redistribution from the Caleia branch towards the Old Danube;
- The *water current velocity* distributions along the STCG1. STCG2 and SLCG sections present a decrease in value over the two years gap;
- For the STCG3 section, located at Old Danube km195.5, the *water current velocity* values show insignificant changes over time;
- The *riverbed bathymetry* profiles display only small areas of deposition or erosion, the most significant being the deposition zone downstream of the built submerged bottom sill

The presented data and approach the can be valuable for the specialists interested in the hydrodynamic and hydromorphological parameters in time variation in case of anthropic interventions on a river course.

ACKNOWLEDGEMENT

The results presented in this paper were obtained thanks to the research conducted by INCDPM in the development of the project entitled “Monitoring the environmental impact of works regarding the improving of the navigation conditions on the Danube River between Calarasi and Braila, km 375–175” financed by national and European funds (2011 – present).

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THEORETICAL DETERMINATION OF THE MATERIAL JUMPS PARAMETERS ON THE ACTIVE SURFACE OF ROLLING SCREEN FITTED WITH ELLIPTIC SHAKING ROLLS
/
DETERMINAREA TEORETICĂ A PARAMETRILOR SALTURILOR MATERIALULUI PE SUPRAFAŢA ACTIVĂ A GRĂTARELOR RULANTE PREVĂZUTE CU ROLE ELIPTICE DE SCUTURARE

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Keywords: *material jumps, rolling screens, elliptic shaking rolls.*

ABSTRACT
In the paper is presented a theoretical study for determining the material jumps on the active surface of the rolling screens provided with elliptical shaking rolls. The study is based on the mathematical modeling of the constituent elements of the working process of the active surface in the area of action of the shaking rolls, namely: the movement of the active surface of the rolling screen in contact with the elliptical shaking rolls, the detachment of the material from the active surface of the rolling screen, the displacement of the material in free-movement, the return of the material on the active surface of the rolling screen.

REZUMAT
În lucrare este prezentat un studiu teoretic de determinare a salturilor materialului pe suprafaţa activă a grătarelor rulante prevăzute cu role eliptice de scuturare. Studiul este bazat pe modelarea matematică a elementelor constitutive a procesului de lucru a suprafeţei active a grătarului rulant în zona de acţiune a rolelor eliptice de scuturare şi anume: mişcarea suprafeţei active a grătarului rulant în contact cu rolele eliptice de scuturare, desprinderea materialului de pe suprafaţa activă a grătarului, deplasarea materialului în mişcare liberă şi revenirea materialului pe suprafaţa a activă a grătarului rulant .

INTRODUCTION
During the mechanical harvesting of bulbs, tubers or other root plants, the separation of the useful products from the comminuted soil bed, resulted after their dislocation, is an extremely difficult process, especially because the great quantity of impurities which must be taken off, is frequently many times greater than the quantity of useful products. Moreover, the separation process becomes supplementary more difficult because of the presence in the mixture submitted to the separation, excepting the soil fragments of vegetal debris or impurities and of boulders and stones with dimensions and shapes similar with those of the useful products.

For this purpose, the bulb, tuber or root plants harvesters have in their structure impurities cleaning systems which usually occupy most of their technological flow. The types of separators from the construction of the impurities cleaning systems are very various, being mentioned: screening separators, successions of acting bitters or rolls with different shapes, pairs of extracting mill rolls, rigid fingers separators, elastic fingers separators, pneumatic drums and others. From these different types of separators, the most frequently used in the impurities cleaning systems and conditioning lines construction are the screening type separators, which can be classified into two major categories: *rolling screens* and *oscillating and vibrating screens*, relative equally proliferated in practice.

MATERIAL AND METHOD
Constructively, a rolling screen (see figure 1) is composed of a succession of metallic rods articulated one to another by hooks, or fixed on chains or belts. forming a continuous band. The pitch between the rods is such established that the space between two consecutive bars corresponds to the minimum admissible dimension limit of harvested products. The active surface of the rolling screen moves with a constant speed in the sense of the material advancement towards the rear of the harvester, the speed of the rolling screen being greater than the working speed of harvesting aggregate (usually 1.5 – 2 times bigger than that), fact

which makes that, at the taking over from the digging of the mixture that must be submitted to the separation, on the impurities cleaning belt conveyor device takes place a spreading of the material, which has an extremely favorable effect on the impurities separation process.

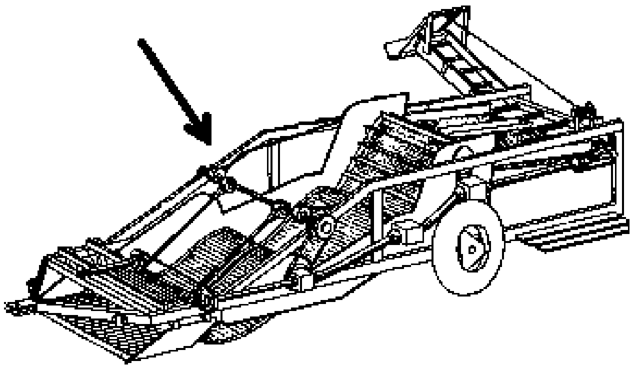

Fig. 1 - Rolling screens in the impurities cleaning system of an onion harvester

The active surface of the rolling screens is inclined towards the horizontal with an inclination angle which value is established depending on the nature of the processed products, which belong to a characteristic range.

In order that the separation process takes place, the mixture submitted to the process must jump on the active surface of the rolling screen. For this purpose, in certain zones of the active surface of the rolling screen, there are induced forced oscillatory movements by shaking devices (see figure 2). Constructively, the shaking devices from the belt conveyor of the onion and potato harvesters the most frequently used are with profiled rolls (see figure 2 a) or with knocking hammers (see figure 2 b and c).

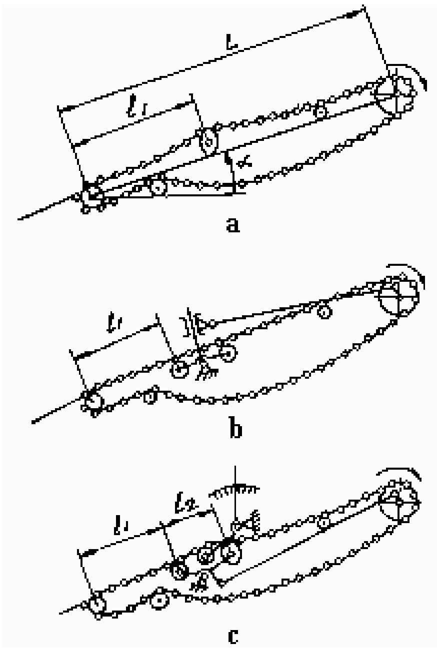

Fig. 2 Constructive variants of shaking devices for rolling screens

The advantages of the bulb or tubers impurities cleaning systems composed of succesive rolling screens are constructive simplicity and silent working without significant shocks and vibrations transmitted to the machine chassis, while the main disadvantage consists in a lower efficacy of the impurities separation because of the fact that the separation process takes place mostly in the shaking parts zones of the active surface of the conveyor, being much blurred and practically insignificant on the unshaken part of the active surface of the conveyor.

In this paper will be presented a theoretical study for the determination of the parameters of the jumps of the material on the active surface of a rolling screen provided with elliptical shaking rollers.

For this purpose, the working process of the active surface of the rolling screen in the action area of the elliptical shaking rolls will be decomposed into its constituent elements that will be mathematically modeled. These constitutives elements are: *the movement of the active surface of the rolling screen in contact with the elliptical shaking rolls, the detachment of the material from the active surface of the rolling screen*, *the displacement of the material in free-movement*, *the return of the material on the active surface of the rolling screen*.

RESULTS

For the mathematical modelling of *the movement of the active surface of the rolling screen in contact with the elliptical shaking rolls,* is used a consacrate mathematical model (see Figure 3), taken from the speciality literature (*Petrov G.D..1972*).

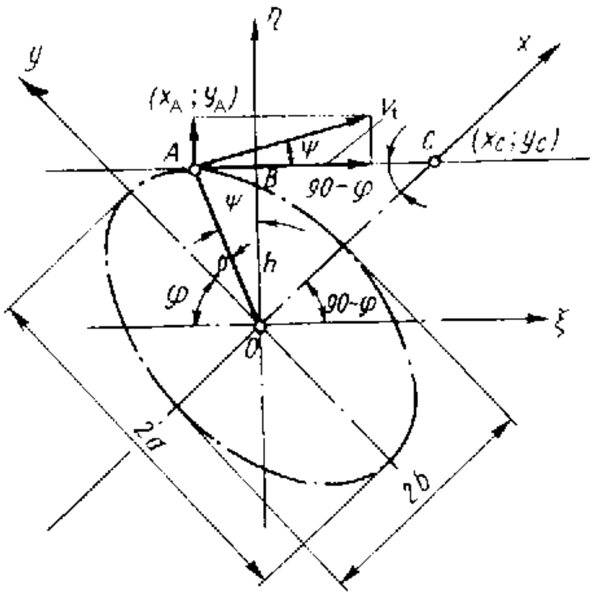

Fig. 3 - The kinematical analisys of the rolling screen active surface passing over the elliptical rolls

The analisys is done by respecting of the following simplifiing hypothesis: the rolling screen, which moves with the constant speed v_t. drive without sliding the elliptic rolls in a variable speed rotary mouvement, the active surface of the rolling screen from the elliptical rolls action area is considered sufficiently rigid so the contact between the rolling screen and the elliptic rolls is punctual and during the working process the active surface of the rolling screen in contact with the elliptic rolls occupes paralel positions.

From this model, it resuts the expresions of the movement. speed and acceleration of the point of the active surface of the rolling screen, on normal direction to the active surface of the rolling screen:

$$h = a \cdot \sqrt{k^2 + \left(1-k^2\right) \cdot \sin^2 \varphi} \tag{1}$$

$$\frac{dh}{dt} = \frac{dh}{d\varphi}\frac{v_t}{h} = v_t \frac{(1-k^2)\sin\varphi\cos\varphi}{k^2 + (1-k^2)\sin^2\varphi} \tag{2}$$

$$\frac{d^2h}{dt^2} = \frac{v_t^2}{a}(1-k^2)\frac{k^2-(1+k^2)\sin^2\varphi}{(k^2+(1-k^2)\sin^2\varphi)^{5/2}} \tag{3}$$

where: a - the big semi-axis of the elliptical profile of the roll;
k - the eccentricity of the eliptic profile of the rolls;
φ - the angle of rotation of the elliptical rolls;
v_t - the speed of the rolling screen.

The absolute speed $\bar{v}_g$ of a point from the active surface of the rolling screen in contact with the elliptical rolls is determined by the kinematic analysis of the rolling screen (see figure 4), developed in the hypothesis that the machine on which it is mounted moves at a constant working speed, constituting itself in an inertial system.

From the analysis results that the absolute speed $\bar{v}_g$ of a point from the active surface of the rolling screen in the elliptical roller action area is expressed by the following vector equation:

$$\bar{v}_g = \bar{v}_t + \frac{d\bar{h}}{dt} \tag{4}$$

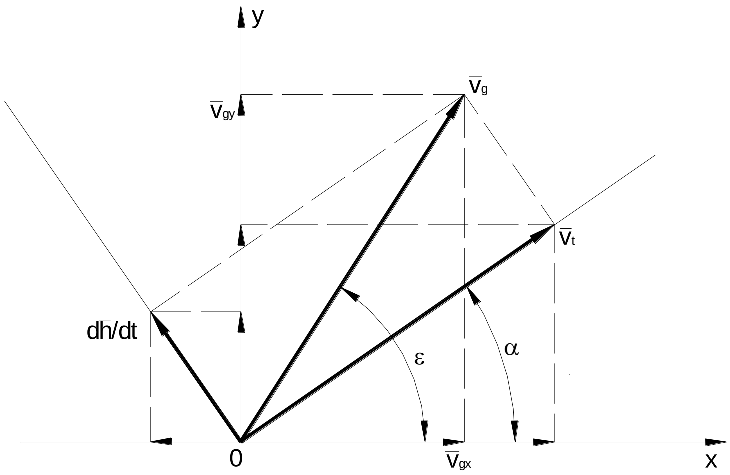

Fig. 4 - The kinematic of a point from the active surface of the rolling screen in contact with the elliptical rolls

The absolute speed module v_g shall be calculated based on its projections on the axes of the coordinate system, which have the following expressions:

$$\begin{gathered} v_{gx} = v_t \cdot \cos\alpha - v_t \cdot \frac{(1-k^2)\cdot \sin\varphi \cdot \cos\varphi}{k^2 + (1-k^2)\cdot \sin^2\varphi} \cdot \sin\alpha \\ v_{gy} = v_t \cdot \sin\alpha + v_t \cdot \frac{(1-k^2)\cdot \sin\varphi \cdot \cos\varphi}{k^2 + (1-k^2)\cdot \sin^2\varphi} \cdot \cos\alpha \end{gathered} \tag{5}$$

with the relation:

$$v_g = \sqrt{v_{gx}^2 + v_{gy}^2} \tag{6}$$

The angle ε of inclination to the horizontal of the absolute speed vector $\bar{v}_g$ is determined with the relation:

$$\varepsilon = \mathrm{arctg}\frac{v_{gy}}{v_{gx}} \tag{7}$$

Another important problem, from the point of view of the rolling screen kinematics, is the determination of the line equation that defines the active surface of the rolling screen in longitudinal plane. Taking into account the initial hypothesis that the rolling screen is considered sufficiently rigid so its active surface from the elliptical rolls action area occupes paralel positions during its working proces, then the line which defines the active surface of the rolling screen in the longitudinal plane, will be a line having a slope corresponding to the horizontal inclination with angle α and which oscillates in the normal direction depending on the position of the elliptic rolls, namely, on their angle φ of rotation. Thus, it results practically a fascicle of parallel lines whose position depends on the angle φ of rotation of the elliptical rolls.

A current line i from the fascicle which defines the surface of rolling screen during the shaking process is given by the following parametric equation:

$$y = x\,tg\alpha + \frac{a}{\cos\alpha}\left(\sqrt{k^2 + (1-k^2)\sin^2\varphi} - \sqrt{k^2 + (1-k^2)\sin^2\varphi_i}\right) \tag{8}$$

In order to determine the *the detachment of the material from the active surface of the rolling screen*, a dynamic analysis of the behavior of the material in the elliptical roll action areas will be performed. So, during a period of rotation of the eliptic rolls, on a particle of material from the active surface of the screen (mentioned that the active surface of the screen is inclined towards the horizontal with the angle α), they act the following forces (see Figure 5): the gravity force $m \cdot \overline{g}$, the reaction force $\overline{N}$ of the active surface of the screen upon the particle and the inertial force $m \cdot d^2h/dt^2$ due to the screen active surface accelaration.

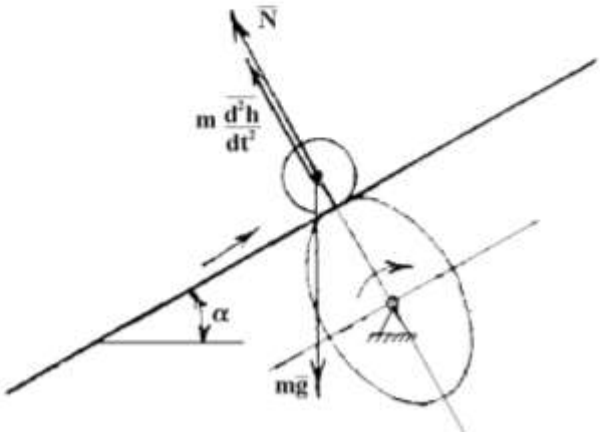

Fig. 5 - The forces that act on a particle from the screen active surface in the elliptic roll zones

The equation of equilibrium in the normal direction at the surface of the screen is:

$$m\frac{d^2h}{dt^2} = N - mg\cos\alpha \tag{9}$$

In the case of the material is detached from the active surface of the screen and jumps, the reaction force of the active surface of the screen upon the particle becomes N≤ 0.

Putting the detachment condition in relation 9 it results:

$$N = m\frac{d^2h}{dt^2} + mg\cos\alpha \le 0 \tag{10}$$

By introducing the expression of the normal acceleration d^2h/dt^2 in relation 10 and processing, it results:

$$m \cdot \left(\frac{v_t^2}{a}(1-k^2)\frac{k^2-(1+k^2)\sin^2\varphi}{(k^2+(1-k^2)\sin^2\varphi)^{5/2}} + g\cos\alpha \right) \le 0 \qquad (11)$$

We must mention that in relation 2.23. the function: $f(\varphi) = \frac{v_t^2}{a}(1-k^2)\frac{k^2-(1+k^2)\sin^2\varphi}{(k^2+(1-k^2)\sin^2\varphi)^{5/2}} + g\cos\alpha$ is a periodic function with the period φ_T = 180^0 the same as the function d^2h/dt^2 from which it derives, and if plotted according to the angle φ of rotation of the elliptical roll, the values of the angle φ corresponding to each period for which $f(\varphi) \le 0$ represent the ranges of angle φ values for the material jump from the active surface of the screen.

In order to determine the rotary angle φ_0 of the elliptic roll corresponding to the detachment of a particle with a certain mass m from the active surface of the screen, in relation 2.18 is imposed the detachment condition at limit, namely, the annulment of the reaction force of the conveyor upon the particle (N = 0). So, the value of the φ_0 angle for the first period is the following root bigger than 0 of the resulted equation:

$$\frac{v_t^2}{a} \cdot (1-k^2) \cdot \frac{k^2-(1+k^2)\cdot\sin^2\varphi}{(k^2+(1-k^2)\cdot\sin^2\varphi)^{5/2}} + g \cdot \cos\alpha = 0 \qquad (12)$$

The study of *the displacement of the material in free-movement* is done considering an inertial coordinate system x0y (see Figure 6), attached to the active surface of the rolling screen with origin 0 in the point of detachment of the material from the rolling screen, defined by the angle φ_o.

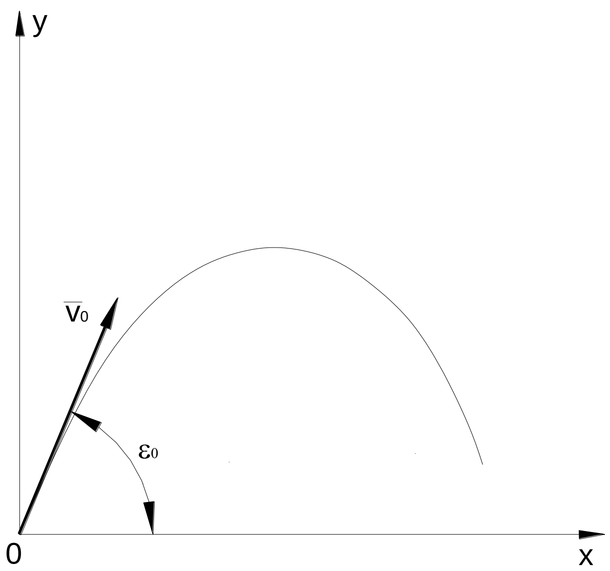

Fig. 6 - The trajectory of the material particle detached from the active surface of the rolling screen

The speed $\overline{v}_o$ of the material particle detachment from the active surface of the rolling screen is even the absolute speed of the active surface of the rolling screen when the particle detaches, corresponding to the angle φ_o of rotation of the elliptical rolls

The components detachment speed $\overline{v}_o$ can be established on the basis of the relations 5, 6 and 7 corresponding to the angle $\varphi = \varphi_o$.

So, the modulus v_o of the detachment speed as well as the inclination angle ε_o of the detachment speed vector to the horizontal axis can be determined with the following relations:

$$v_o = \sqrt{v_{ox}^2 + v_{oy}^2} \tag{13}$$

where:

$$v_{ox} = v_t \cos\alpha - v_t \frac{(1-k^2)\sin\varphi_o \cos\varphi_o}{k^2 + (1-k^2)\sin^2\varphi_o}\sin\alpha$$

$$v_{oy} = v_t \sin\alpha + v_t \frac{(1-k^2)\sin\varphi_o \cos\varphi_o}{k^2 + (1-k^2)\sin^2\varphi_o}\cos\alpha \tag{14}$$

are the detachment speed projections on the axes of the coordinate system.

$$\varepsilon_o = \mathrm{arctg}\frac{v_{oy}}{v_{ox}} \tag{15}$$

The material detached from the rolling screen moves after a parabolic trajectory which is described by the following parametric relations according to the time parameter:

$$x = v_o t \cos\varepsilon_o$$

$$y = -\frac{gt^2}{2} + v_o t \sin\varepsilon_0 \tag{16}$$

The speed of free moving material at all points of its trajectory is determined with the following parametric relations according to time t:

$$v_{mx} = v_o \cos\varepsilon_o$$

$$v_{my} = -gt + v_o \sin\varepsilon_o \tag{17}$$

In the mathematical model of *the return of the material on the active surface of the rolling screen* (see Figure 7) is taken into account to determine the moment of return of the active surface of the rolling screen.

Therefore, in the coordinate system x0y (similar to that considered in the previous model, where the point of detachement of the material from the rolling screen is the origin 0 of the coordinate system) is represented both the parabolic trajectory of the free moving material through the parametric relations 16 (in the time parameter: time t) and the line which defines of the active surface of the rolling screen through the parametric relation 8 (in the elliptical roll rotation parameter: angle φ).

The intersection of the parabolic trajectory of the free moving material with the line defining the active surface of the rolling screen (other than that corresponding to the moment of detachment) represents the point of return of the material on the rolling screen.

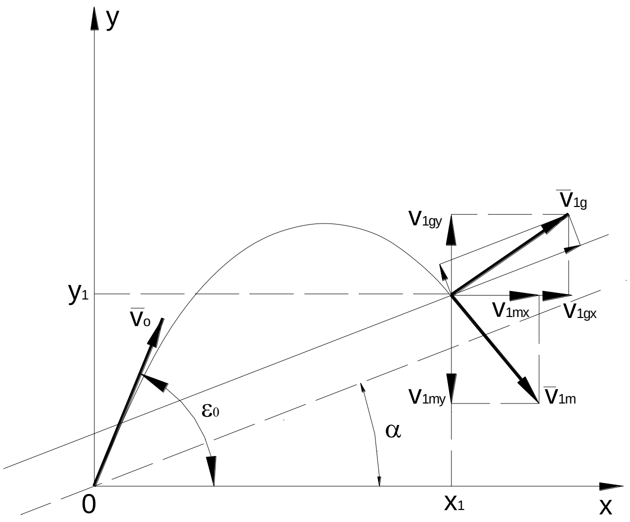

Fig. 7 - Study of the return of the material on the active surface of the rolling screen

From mathematical point of view, this intersection is represented by the solution of the following system of equations in the unknowns: x and y (representing the coordinates of the intersection point), t and φ, consisting of the parametric equations of the parabolic trajectory of the material in free movement, of the parametric equation of the straight line which defines the active surface of the rolling screen and of the relation between the parameters t and φ written in the terms of the detachment of the material from the active surface of the rolling screen. The system of equations is as follows:

$$x = v_0 \cdot t \cdot \cos\varepsilon_0$$

$$y = -\frac{g \cdot t^2}{2} + v_0 \cdot t \cdot \sin\varepsilon_0$$

$$y = x \cdot \mathrm{tg}\alpha + \frac{a}{\cos\alpha} \cdot \left(\sqrt{k^2 + (1-k^2)\cdot \sin^2\varphi} - \sqrt{k^2 + (1-k^2)\cdot \sin^2\varphi_0}\right) \tag{18}$$

$$t = (\varphi - \varphi_0) \cdot \frac{a \cdot \sqrt{k^2 + (1-k^2)\cdot \sin^2\varphi}}{v_t}$$

If in the relations (I) and (II) of the system 18 is replaced the unknown t corresponding to relation (IV) and then relations (I) and (II) are introduced in relation (III); it is obtained a relation in the unknown φ which is an equation whose solutions represent the values of the angle φ of rotation of the elliptical rolls for which the trajectory of the free-moving material intersects with the right, which defines the active surface of the rolling screen.

This equation, processed, is the following:

$$\frac{ga}{2v_t^2}(\varphi-\varphi_o)^2(k^2+(1-k^2)\sin^2\varphi) + \left(\frac{v_o}{v_t}(\varphi-\varphi_o)\sin(\alpha-\varepsilon_o)+1\right)\frac{\sqrt{k^2+(1-k^2)\sin^2\varphi}}{\cos\alpha} - \frac{\sqrt{k^2+(1-k^2)\sin^2\varphi_o}}{\cos\alpha} = 0 \tag{19}$$

(Note: In equation 19, for homogeneity, the lengths are expressed in [m], the speeds in [m/ s], the accelerations in [m/s^2] and the angles in [radians]

If the equation 19 is analyzed, it is easy to find that a first solution is $\varphi = \varphi_o$, which corresponds to the initial material detachment moment. The immediately next solution $\varphi = \varphi_1$, at which $\varphi_1 > \varphi_o$. represents the value of the rotation angle φ of the elliptical rolls corresponding to the moment of return of the material on the active surface of the rolling screen.

Knowing the value φ_1, we can easily determine: the moment t_1 of the material returning to the active surface of the rolling screen (with relation (IV) of the system 18), the x1 and y1 coordinates of the material impact with the active surface of the rolling screen (with the relations (I) and (II) of the system 18), as well as the expressions of the absolute speeds of the material and of the rolling screen in the moment when writing the material impacts the the active surface of the rolling screen.

Thus, the time period t_1 after which the material returns on the rolling screen is:

$$t_1 = \frac{a}{v_t}(\varphi_1 - \varphi_o)\sqrt{k^2 + (1-k^2)\sin^2\varphi_1} \tag{20}$$

By introducing the value of the time period t_1 in the the relations (I) and (II) of the system 18, there are obtained the relations with which the coordinates x_1 and y_1 of the point of the material return, namely:

$$\begin{aligned} x_1 &= v_0 \cdot t_1 \cdot \cos\varepsilon_0 \\ y_1 &= -\frac{g \cdot t_1^2}{2} + v_0 \cdot t_1 \cdot \sin\varepsilon_0 \end{aligned} \tag{21}$$

Knowing the coordinates x_1 and y_1 of the point of the material return, it can be determined the distance d_1 between the origin of the coordinates system and point of the material return, which represents the distance between the launching point and the return point of the material in free movement, with the following relation:

$$d_1 = \sqrt{x_1^2 + y_1^2} \tag{22}$$

In fact the time period t_1 and distance d_1 constitute characteristic parameters of the material jumps on the the active surface of the rolling screen during the working process, namely the *duration of the jumps* and the *length of the jumps*.

Another characteristic parameter of the material jumps is the *height of the jumps,* which can also be determined on the basis of the kinematic study of the material free movement using the following relation, in which it is denoted y_{max}.

$$y_{max} = \frac{v_0^2 \cdot \sin^2\varepsilon_0}{2 \cdot g} \tag{23}$$

CONCLUSION

The study for determining the material jumps on the active surface of the rolling screens provided with elliptical shaking rolls is based on the mathematical modeling of the constituent elements of the working process of the active surface in the area of action of the shaking rolls, namely: the movement of the active surface of the rolling screen in contact with the elliptical shaking rolls, the detachment of the material from the active surface of the rolling screen, the displacement of the material in free-movement, the return of the material on the active surface of the rolling screen.

The characteristic parameters of the material jumps on the active surface of the rolling screen in the area of action of the elliptical shaking rolls are: *the duration of the jumps*, *the length of the jumps* and the *height of the jumps*.

This theoretical study will be the basis for the development of an algorithm and an interactive computing program to quickly determine the characteristic parameters of the material leaps on the active surface of the grate.

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RESEARCHES CONCERNING THE BEHAVIOUR OF SHASTA PEACH VARIETY GROWN ÎN THE DOBROGEA AREA
/
CAECETARI PRIVIND COMPORTAREA SOIULUI DE PIERSIC SHASTA CULTIVAT IN ZONA DOBROGEI

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Keywords: *productivity, fruit quality, suitability for processing.*

ABSTRACT

The aim of this paper is to present the Shasta peach variety, cultivated at the Research Station for Fruit Growing Constanta, taking into consideration the production performances, both from quantitative and qualitative point of view. To this extent, observations, measurements and determinations were performed regarding the growth and fructification phases, productivity, resistance to the attack of the main pathogen agents, organoleptic quality of the fresh fruit, sensory analysis of the processed products (comfiture, stewed fruit, nectar, puree and jam). Bearing in mind the very good results, the Shasta peaches cultivar is recommended for planting on large surfaces in orchards and gardens.

REZUMAT

Scopul acestei lucrari este de a prezenta soiul Shasta. cultivat la Statiunea de Cercetare si Dezvoltare Pomicola Constanta, avand in vedere performantele de productie. din punct de vedere atat cantitativ, cat si calitativ. In acest scop s-au efectuat observatii, masuratori si determinari privind fazele de crestere si fructificare, productivitatea. rezistenta la atacul principalilor agenti patogeni, calitatea organoletica a fructelor proaspete, analiza senzoriala a produselor procesate (dulceata, gem, compot, nectar, piure). Tinand cont de rezultatele foarte bune obtinute, recomandam soiul de piersic Shasta pentru cultivarea pe suprafete mari. in livezi si gradini.

INTRODUCTION

Taking into account its economical value, the peach tree is currently occupying the second position at a global level (following the apple tree,. among the species with falling leaves. Being resistant to draught, the peach tree is among the few species which develop adequately in the plain and even the dry steppe areas, on condition that sheltered places be provided for it, given the fact that it is sensitive to frost. The evolution of the normal biological cycle is conditioned by the evolution of the temperature, both in the resting period as well as afterwards.

The expansion of peaches consumption determined a great interest for peach breeding program (Bassi and Monet. 2008).

The peach tree's resistance to disease as well as the cultivar's sensitivity are highly influenced, as far as certain pathogen agents are concerned, by the environmental conditions of the crop (Selegean 2011; Moale et al., 2012; Jinga et al. 2013, Lamureanu. 2013.

The peach tree species develop well in the pedo-climatic conditions of Romania, especially in the Dobrogea region, with climatic conditions which are highly favourable to the peach tree culture (Stanica and Branisra, 2011; Moale et al. 2016).The Black Sea seacost is the zone with the largest annual average amount of sunshine duration in our country, being beyond 2250-2300 hours.

In conclusion peach culture finds favorable conditions under which the research took place. Water is scarce but can be supplemented by irrigation, insolation is strong, winds are relatively gentle and late spring hoar frost is rare or absent, all of them being stimulating factors for peach culture (Dumitru et al. 2011; Gavat et al. 2016).

Due to their special characteristics in terms of taste, appearance and flavour and their importance in nutrition, peaches play an important role in consumption, both fresh and processed. Their superior dietary qualities are determined by their content of vitamins, minerals, cellulose, acids and peptic substances.

Peaches have the following properties: they are energizing, seizures, diuretic, slightly laxative, being indicated in treating dyspepsia, haematuria, urinary lithiasis). These are generally large, beautifully coloured, with a relatively high content of vitamins and sugar and with a fresh, pleasant taste. Being represented in crops by numerous varieties with different ripening periods, the peach tree ensures fresh fruit beginning with the second half of the month of June and ending in the first decade of the month of November. This distribution of the production also allows for a rhythmical and continuous supply of fresh fruit for the fruit processing factories.

Because they are very appreciated for consumption as fresh as well as for processing, as marmalade, compote, jam, nectar, with a special flavour and of a higher quality also as dried fruit, we made many researches about suitability for processing of this species (Lamureanu et al. 2012; Lamureanu et al. 2014; Lamureanu et al. 2015).

Due to fact that the cultivars may present certain variations in different culture areas, the purpose of this paper is to present the American variety Shasta, cultivated in the experimental crop of the RSFG Constanta, taking into account its phonological, biological and valorisation performances.

MATERIAL AND METHOD

The object of the study was the American peache of Shasta variety, provided from the experimental culture of Research Station for Fruit Growing Constanta , locality Valu lui Traian, approaching sea-cost.

The place is climatically influenced both by Black Sea and Danube, so generally spring delays with 2-3 weeks and autumns are, in general, long and warm. The average annual temperature is of 10.7°C and during the growing season (April-October) of 16.5°C, the absolute minimum was of -21.4°C (1987) and the absolute maximum 38.4°C (1988).

The planting density was of 883 trees/ha (planting distance = 3/4m), the shape of the head being a free, flat palm.

In order to establish the biological, production and valorisation value of the peaches variety Shasta, a series of observations and determinations were carried out in experimental plots, as follows: phenological observations (vegetative and fructification phenophases), determinations concerning the vegetative growths, productivity, resistance to the attack of the main pathogen agents: *Taphrina deformans* Berk et Tull (the blistering of the leaves), *Cytospora cincta* Sacc (the perennial cancer of the sprouts), *Monilinia laxa (*moniliosis or the monilinial drying of the branches) and *Monilinia fructigena* Aderh Ruhl Honey (rot and the mummification of the fruit). Taking into account the frequency (F%) and the intensity (I) of the attack upon the cultivars and hybrids from the experimental crop of the Research Station for Fruit Growing –Constanta, these were divided into 6 resistance classes, as follows: cultivars without attack (W.A.) – F% = 0 and I = 0, tolerant cultivars (T) – F% = 0.1-5% and I= 0 º +. weakly attacked cultivars (We.A.) – F% = 5.1%-10% and I = +. moderately resistant cultivars (M.R.) – F%= 10.1%-25.0% and I = +. sensitive cultivars (S) – F% = 25.1%-50.0% and I = + ² 4. very sensitive cultivars (V.S.)– F% = 50.1%-100% and I 4+ ⁴ 4.

Immediately after harvesting, the fruits were examined organolepticaly to estimate the appearance (size, shape, colour), the dimension of stone, the taste and the fruit firmness, It was also determined the content of soluble dry substance (by refractometer method) and titratable acidity (by titrimetric method).

Organoleptic quality assessment was done by performing a sensory testing, by means of a method of assessing the fruit with a scoring scale of 1 to 100. Tasting ships were used which comprise three criteria for the assessment (appearance, texture, taste). Each of the three criteria of evaluation has a different weight in the general scoring, according to their importance: "aspect" is 15%, "texture" 35% and "taste" 50%. Depending on the obtained score, there are five different classes, as follows: very good (80-100 points), good (60-79 points), acceptable (40-59 points), mediocre (20-39 points) and unsuitable (0-19 points).

The fruit were processed into comfiture, stewed fruit, nectar, puree and jam at the Research and Development Institute for Processing and Marketing of the Horticultural Products, Bucharest, in the micro-production laboratory.

The packaging was made in glass jars with a capacity of 720 millilitres for stewed fruits and 370 millilitres for comfiture and jam and in glass bottles with a capacity of 1000 millilitres for nectar and puree, with hermetically closing, using twist-off lids.. The sensory analysis of processed products was made according to STAS 12656-88, that establishes the analysis methods with unitary scoring scales (method A,. used for the evaluation of organoleptic characteristics of alimentary products. These methods are applied for the appreciation of a set of organoleptic properties: appearance, colour, taste, texture or the consistence.

The evaluation of each organoleptic characteristic was made by comparison with scoring scales from 0 to 5 points and it was obtained an average score given by the group of tasters on the basis of registration of awarded points on individual sheets. It was made the calculation of the weighted average of the scores and totalize them for obtaining total average score and there were settled organoleptic characteristics of the products based on the principle of total average, by comparison with a scale from 0-20 points. Finally, there were given scores for each variety. Within the overall score achieved by the different analyzed products, there were established five quality classes: very good (18.1-20.0 points), good (15.1-18.0 points),satisfactory (11.1-15.0 points), unsatisfactory (7.1-11.0 points) and improperly (0 -7.0 points).

RESULTS

The growth and fructification phases are genetic traits of the cultivars and represent the latter's capacity to adapt to the environmental conditions.

The main growth and fructification phases of the Shasta peaches cultivar can be observed in Figure 1 and Table 1.

Fig. 1 - The SHASTA variety

The analysis of Table 1 reveals the fact that during the studied period (2014-2016) the beginning of the cracking of the vegetative buds occurred the second decade of March.

Table 1

The evolution of the main vegetative and fructification pheno-phases

Specification	Year							
	2014		2015		2016		Average	
	Date	Active thermal sum -ºC	Date	Active thermal sum -ºC	Date	Active thermal sum- ºC	Date	Active thermal sum -ºC
Beginning of the cracking of the buds	17.03	216	20.03	154	17.03	108	17-20.03	159
Beginning of sprout growth	7.05	719	27.05	942	11.5	733	07-27.05	798
Ending of sprout growth			29.07	2570				
Beginning of the blossoming of the flowering buds	25.03	267	02.04	223	26.03	192	25.03-2.04	227
Flowering - beginning - ending - duration (days) - intensity	30.03 18.04 20 5	282 468	07.04 26.04 20 4	265 445	05.04 21.04 17 5	294 465	30.03-07.04 18.26.04 19 4-5	280 459
Hardening of the stone	03.06	1158	08.06	1167	06.06	1213	03-08.06	1179
Beginning of ripening	28.07	2381	23.07	2227	18.07	2156	18-28.07	2254
Harvesting maturity	18.08	2888	06.08	2736	20.08	3042	06-20.08	2888

The carried out observations reveal that the Shasta is a medium variety, which usually reaches harvesting maturity in the second decade of August, requiring a total of 2888°C active thermal sum.

The flowers are rosaceous and the beginning of the flowering occurs in the period March 30th – April 7th (280°C required t active thermal sum) and ends in the period April 18th – 26th (459°C required active thermal sum), with a duration of 17-20 days.

Vegetative growths

In order to establish the vigour of the trees, a series of measurements and determinations were carried out and are presented in Table 2.

Table 2

The vigour of the trees

Specification	Value
Circumference of the trunk (cm)	53.6
Surface of trunk section (cm^2)	229
Average height of the trunk (cm)	66
Average height of the head of the tree (cm)	210
Average height of the tree (cm)	276
Vigour index	85
Head diameter – perpendicularly on the row (m) – in the direction of the row (m)	2.08 2.93
Average length of annual sprouts (cm)	48.6
Number of leaves per sprout	26
Length of the inter-knot (cm)	1.9
Number of leaves per linear metre of annual sprout	53

Shasta is a variety with a medium vigour, the circumference of the trunk being of 53.6 cm and the surface of trunk section of 229 cm^2 . The average height of the head of the tree is 201 cm, the average height of the trunk is 66 cm, so the average height of the tree is 276 cm. The average length of the annual sprouts is of 48.6 cm, while that of the inter-knots is of 1.9 cm. The vigour index, which allows for the correct classification of cultivars and hybrids according to their vigour, is not so elevated, being of 85.

Productivity

The main criterion according to which the value of the cultivars and hybrids is being established is the fruit production.

The cultivars and the hybrids have a different biological potential as far as fruit production is concerned, the latter being influenced among others by the intensity of the flowering and the climatic conditions during the tying of the fruit, which can be favourable or less favourable.

In order to establish the biological potential for ripening, the method we used consists in counting the number of eliminated fruit as well as the number of harvested fruit; the obtained data can be observed in Table 3.

Table 3

The biological fructification potential and the fruit production

Specification	Year			
	2014	2015	2016	Media
Eliminated fruit	120	97	100	106
Harvested fruit*	572	457	512	511
Total	692	554	612	617
Production per tree (kg)	40.1	37.3	41.1	39.5
Production per hectare** (kg)	33403	31070	34236	32903
Productivity index - kg/cm^2 trunk section	0.173	0.162	0.179	0.171
Production index **(**kg/m^3 head of the tree)	7.979	8.235	7.498	7.90

* harvested fruit = $\frac{\text{fruit production/tree}}{\text{average weight of a fruit}}$

** density 833 trees/ha

The obtained data concerning the number of harvested fruit and the number of eliminated fruit differs from one year to the next, the highest number of eliminated fruit belonging to the year 2014 (120 fruit), while the lowest number belongs to the year 2015 (97 fruit). As far as the harvested fruit are concerned, the highest number was recorded in the year 2016 (572 fruit), while the lowest number was recorded in the year 2012 (457 fruit).

The largest production was recorded in 2013, of 41.1 kg/tree and 34.236 kg/ha. The average of the production for the 3 studied years was of 39.5 kg/tree and 32.903 kg/ha.

Resistance to the attack of the main pathogen agents

Among the pathogens agents which are important from an economic point of view for the industrial peach trees, the blistering of the leaves caused by the *Taphrina deformans* Berk et Tull, fungus is undoubtedly the most damaging foliar pathogen agent. For all that the analysis of the data in Table 4 reveals the fact that the Shasta variety displayed an elevated resistance towards the attack of this damaging pathogen. The sensitivity of the cultivar is also influenced by the environmental conditions specific to each studied years.

Table 4

The behaviour of the variety when confronted with pathogen agents

Pathogen agents	Intensity of the attack								
	2014			2015			2016		
	WA	T	WeA	WA	T	WeA	WA	T	WeA
Taphrina deformans		x				x		x	x
Cytospora cincta	x			x			x		
Monilinia laza	x				x		x		
Monilinia fructigena	x			x				x	

WA = cultivars without attack (F%= 0 and I= 0)
T = tolerant cultivars (F%= 0.1-5% and I= 0 ± +)
WeA = weakly attacked cultivars (F%= 5.1% - 10% and I= +)

The perennial cancer of the peach tree caused by the *Cytospora cincta* Sacc fungus is, together with the blistering caused by the *Taphrina deformans* a very important pathogen which reduces fruit production. With regard to its attack observations revealed that the sensitivity and the resistance towards the pathogen rely exclusively on the cultivar itself. In case of Shasta variety this pathogen did not attack the trees in studied period, both the frequency (F) and the intensity (I) of the attack being marked with 0.

As far as the attack of the *Monilinia laxa* and *Monilia fructigena* (Aderh et Ruhl) Honey fungi is concerned, Shasta variety, studied in the period 20014-2016, pertain to the classes cultivars without attack (WA) or tolerant cultivar (T).

Fruit quality

Apart from the production potential, the quality of the fruit is another primordial factor when it comes to choosing new peach tree cultivars for the assortment.

The fruit of the Shasta variety is medium to small (over 80 g), with a spherical shape, yet slightly flat. The main colour of the skin is yellow, while the covering one is ruby-red on most of the surface. The pulp is yellow, with good taste, sweet, juicy and flavoured.

The data regarding the size of the fruit (weight and dimensions) can be found in Table 5. The measurements we performed upon the fruit (large diameter, small diameter and height, all expressed in mm) offer a comprehensive perspective upon the shape of the fruit.

Table 5

The value of the main physical and chemical characteristics of the fruit

Specification	Year			
	2014	**2015**	**2016**	**Media**
Dimensions of the fruit (mm): - large diameter - small diameter - height	 56.3 53.8 48.1	 55.5 55.1 51.3	 53.0 52.2 55.2	 54.9 53.8 51.5
Weight of the fruit (g)	83.7	81.5	80.2	81.8
Weight of the core (g)	9.0	8.0	7.0	8.0
% core from the weight of the fruit	9.1	9.8	8.7	9.2
Content of dry substance (%)	10.6	10.7	10.5	10.6
Acidity (mg acid malic per 100 g fruit)	0.62	0.57	0.61	0.60

In addition, as far as cultivars meant for an industrial usage are concerned, the size of the stone is highly important because this indicator greatly influences the processing efficiency. As far as the Shasta variety is concerned, the stone represent 9.20% of the fruit, which is a good percentage in comparison to other peach tree and nectarine tree cultivars.

The content of dry substance is good as well (10.6%), while the acidity which balances the taste, is elevated (0.60 mg/100g).

Organoleptic quality

The results of the organoleptic testing (Table 6) reveals that, in the moment of the harvest, peaches got high marks because of their attractive appearance (14.45 points), firmness (32.85 points) and taste (46.10 points), the total score obtained being 93.40 points) and "very good" qualifying.

Table 6.

Organoleptic assessment of peaches at harvest

Specification	Organoleptic assessment
Total	93.40
Aspect	14.45
Firmness	32.85
Taste	46.10
Qualifying	very good

Sensorial analysis of the products

The sensory analysis of processed products (Table 7) highlights the fact that, according to the product, their quality differs greatly from “satisfactory”. to ”very good’’.

Table 7

Sensory analysis of the peaches processed products from the Shasta cultivar

MU=points

Specification	**Product**				
	Compote	**Comfiture**	**Jam**	**Nectar**	**Piure**
Aspect	5.72	5.12	4.80	5.32	4.80
Colour	5.32	3.68	3.52	4.86	3.68
Taste	3.72	5.76	6.00	3.49	3.84
Consistency	3.72	3.68	4.00	3.55	2.40
Overall average score	18.48	18.24	18.32	17.22	14.72
Qualifying	very good	very good	very good	good	satisfactory

Out of the four types of processed products, the compote, confiture and jam are highlighted with the qualification ''very good'' (18.48; 18.24 and 18.32 points, respectively). For nectar (17.22 points), the qualificative that was awarded was ''good''. The product puree, with only 14.72 points scored ''satisfactory'

CONCLUSIONS

Shasta cultivar usually reaches harvesting maturity in the second decade of August, requiring a total of 2888°C active thermal sum, being a medium variety.

The flowers are rosaceous and the beginning of the flowering occurs in the period March 30th – April 7th (280°C required active thermal sum) and ends in the period April 18th – 26th (459°C required active thermal sum), with a duration of 17-20 days.

The Shasta cultivar, having the head of the tree in the shape of a free, flat palm, is a variety with a medium vigour, the circumference of the trunk being of 53.6 cm and the average height of the tree is 276 cm.

Taking into account the fact that the average production for the 3 studied years was of 39.50 kg/tree and 32.903 kg/ha, we can conclude that Shasta is a very productive cultivar.

The resistance to the attack of the main pathogen agents is very high, Shasta variety being without attack, tolerant and weakly attacked by *Taphrina deformans, Cytospora cincta, Monilinia laxa and Monilia fructigena* fungi, in the studied period.

The peaches of Shasta are appreciated from an organoleptic point of view. The fruit are of high quality, with pleasant appearance (14.45 points), very good taste, flavoured(46.10 points), relatively crispy (32.85 points) sweet-acidulated and content of dry substance is good as well (10.6%)

Cultivar Shasta is very well suitable to the processing into four types of canned: compote, confiture, jam and nectar, the resulting product having remarkable sensory qualities, but are less suitable for processing as puree.

Bearing in mind the productivity, the resistance to the attack of the main pathogen, the fruit quality, as well as the high quality of the processed (preserved) products, the Shasta peaches cultivar is recommended for planting on large surfaces in orchards and gardens.

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SOME ASPECTS ON MAINTAINING THE QUALITY OF PEACHES AFTER HARVESTING
/
UNELE ASPECTE PRIVIND MENȚINEREA CALITĂȚII DUPĂ RECOLTARE A PIERSICILOR

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Keywords: peaches, storage conditions, biochemical components, quantitative and qualitative losses.

ABSTRACT
The aim of this paper is to establish the influence of variety and storage conditions on the storage capacity of peaches. The paper presents the results obtained in 2016 with two Romanian peach cultivars, Collins and Jerseyland, preserved at Horting Institute of Bucharest under different technological conditions: ambient temperature (20-22ºC); temperature 10-12 ° C (refrigeration conditions), with or without modified atmosphere and temperature 3-5 ° C (in cold). The initial level and evolution during storage of fruit firmness and the main biochemical components of peaches were determined: soluble dry matter, soluble carbohydrates, titratable acidity and vitamin C. At the end of each storage period, total losses due to mass losses and damaged fruit were determined.

REZUMAT
Scopul acestei lucrări este stabilirea influenţei soiului şi condiţiilor din timpul păstrării asupra capacităţii de păstrare a piersicilor. Lucrarea prezintă rezultate obţinute în anul 2016 cu două soiuri de piersici româneşti, Collins şi Jerseyland, păstrate la Institutul Horting Bucureşti în diferite condiţi tehnologice: temperatura mediului ambiant (20-22ºC); temperatura de 10-12ºC (condiţii de refrigerare), cu sau fără atmosferă modificată şi temperatura de 3-5ºC (la frig). A fost determinat nivelul iniţial şi evoluţia pe durata păstrării a fermităţii fructelor şi a principalelor componente biochimice a piersicilor: substanţa uscată solubilă, glucide solubile, aciditatea titrabilă şi vitamina C. După scoaterea de la păstare au fost stabilite pierderile totale, pierderile de masă şi pierderile prin stricare ale fructelor.

INTRODUCTION
Peach is one of the most valuable tree species cultivated both in Romania and abroad, being highly appreciated for the qualities of its fruits. Peach and apricot are among the few species that do well in the plains, even in the dry steppe, being resistant to drought; the condition is to be in sheltered places, because they are sensitive to frost.

The expansion of peach culture has been favored by ecological plasticity, early and constant fructification, high production potential and superior fruit quality. They are generally large, beautifully colored, rich in vitamins: A and C, minerals, such as potassium, fluorine and iron, and in polyphenolic flavonoids, having a refreshing and pleasant taste. Being represented in culture through numerous varieties with different ripping periods, peach provides fresh fruit from June until the first decade of November. From peaches can be made confiture, jams, very delicate and high quality flavored compotes, sugary fruits. etc. They are also suitable for drying, freezing and boning champagne by using alcoholic flavored extracts. Delicious, fleshy and juicy, peaches have a low calorie content and do not contain saturated fat, but abound in minerals, vitamins and other compounds that play an important role in maintaining optimal health.

In our country, not many data on the storage of apricots in refrigerated and controlled atmosphere (CA) are available in the literature, especially concerning the effect of CO_2 level in CA. In Italy, Europe's main producer of apricots, Andrich and Fiorentin , 1986 studied two varieties of peach to determine their storability and to examine the effect of the CO2 level on weight decrease, firmness, total titratable acidity, pH, refractometric degree and physiological and pathological changes. In other countries, the researchers determined effects of controlled atmosphere storage and ethyllene on specific biochemical changes in peach fruits (Brecht et al.. 1982; Bartley .1970; Palou and Crisosto. 2003).

MATERIAL AND METHOD

The experience with peaches includes a number of 8 experimental variants. The experiment was organized according to cultivars and storage conditions. The peaches were harvested and introduced into experimentation in 2016, coming from Research Station of Fruit Growing Constanta.

The scheme for organizing the peach experience is shown in Table 1. and aspects regarding the way of organizing are shown in Figure 1. The peaches used in experiment are presented in Figure 2.

Table 1

The experimental scheme for the preservation of peaches

Var.	Variety	Storage conditions *)
V1	**COLINS**	20-22ºC
V2	-idem-	10-12 ºC
V3	-idem-	10-12 ºC+AM
V4	-idem-	3-5 ºC
V5	**JERSEYLAND**	20-22ºC
V6	-idem-	10-12 ºC
V7	-idem-	10-12 ºC+AM
V8	-idem-	3-5 ºC

**) Legend: AM = modified atmosphere*

Fig.1 - Aspects regarding the way to organize peach experiences

Fig.2 - The appearance of peaches of the cultivars studied

RESULTS

Before placing the peaches in the cold storage, biometric measurements were performed regarding to: average fruit weight, height, diameter and shape of the index. The initial level and evolution during storage of biochemical components were determined: soluble dry matter, total sugar, titratable acidity and vitamin C.

The data regarding the evolution of losses during storage is shown in Table 2. The peach storage period was: 5 days when stored at 20-22 °C, 15 days for storage at 10-12 °C and 20 days for 3-5 °C.

The table shows that the shelf life of peaches was 5 days for storage at 20-22 °C, 15 days at 10-12°C and 20 days at 3-5 °C.

Table 2

Losses of the peaches during storage (%)

Var.	Cultivar	Cond. of storage (°C)	Duration of storage (zile)	Weight losses (%)	Impairment loss (%)	Total loss total (%)
V1	**COLINS**	20-22°	5	11.23	59.38	70.61
V2	- idem-	10-12 ºC	15	6.29	68.75	75.04
V3	- idem-	10-12 ºC+AM	15	0.54	54.17	54.71
V4	- idem-	3-5 ºC	20	11.00	68.75	79.75
V5	**JERSEYLAND**	20-22°	5	9.97	28.13	38.10
V6	-idem-	10-12 ºC	15	3.04	5.56	8.60
V7	-idem-	10-12 ºC+AM	15	0.44	16.67	17.11
V8	-idem-	3-5 ºC	20	10.84	34.38	45.22
Overall Medium		20-22°	5	10.60	43.76	54.36
		10-12 ºC	15	4.67	37.15	41.82
		10-12 ºC+AM	15	0.49	34.42	35.91
		3-5 ºC	20	10.91	51.57	62.48

At ambient temperature, peaches recorded after 5 days of storage, a weight loss of 9.97-11.23%, impairment losses of 28.13-59.38% and total losses of 38.10-70.61% depending on the cultivar. Variant 5 of the Jerseyland cultivar's storaged at room temperature showed weight, impairment and total loss much lower than the V1 variant of Collins' cultivar. Besides, V1 has the largest volume of weight loss among all variants of the experience and the loss level by impairment was more than twice.

The degradation of Collins' fruit was extremely fast and strong, nearly 2/3 of the peaches being depreciated by disease attack. The appearance of peaches of the Jerseyland cultivar stored for 5 days at ambient temperature, is shown in Figure 3.

Fig.3 - The appearance of Jerseyland peaches stored at ambient temperature(20-22 ºC)

The V6 variant of Jerseyland peaches showed weight, impairment and total losses much smaller than recorded by the V2 variant of Collins peaches. The V6 variant recorded the best results of the entire experience.

The level of weight losses was over 2 times lower, the impairment loss was over 12 times lower, and the total loss almost 9 times lower compared to V2.

The appearance of Collins peaches stored for 15 days under refrigeration conditions is shown in Figure 4.

Accumulation of a high concentration of CO2 under modified atmosphere conditions carried out in sealed containers placed in rooms with temperature of 10-12ºC led to record after 15 days of storage of peaches to weight losses of 0.44-0.54%, impairment loss of 16.67-54.17 % and total losses of 17.11-54.71%, depending on the cultivar. Lower values were recorded for variant V7 belonging to the Jerseyland cultivar and the highest were recorded for variant V3 belonging to the Collins cultivar.

Fig.4 - Appearance of peaches stored under refrigeration conditions (10-12 ºC)

The appearance of Jerseyland cultivar peaches stored for 15 days under refrigeration conditions (10-12 ° C) and modified atmosphere is shown in Figure 5.

Fig.5 - The appearance of Jerseyland peaches stored under refrigeration and modified atmosphere conditions

At 3-5 ° C, the peaches stored for 20 days recorded 10.84-11.00% weight losses, 34.38-68.75% impairment losses and 45.22-79.75% total losses, depending on the cultivar. Under these cold conditions, the Jerseyland cultivar in the V8 variant showed lower losses than the Collin's V4 variant, which had higher weight, impairment and total losses. In both cold storage, variants the weight and impairment losses were superior to the other variants of the experience.

The main problem of peaches stored in cold conditions with level of impairment losses raises a causal issue regarding the sensitivity of peaches to cold. The comparative results obtained identify differences between varieties related to the sensitivity to cold, including the maturity of the fruits. While much more ripe fruit of the Collins variety became more addle in both conditions (refrigeration and cold conditions), the less ripe fruits of Jerseyland variety maintained the best quality al 10-12°C, but they were the worst rotten at 3-5°C. Aspects of the impairment of peaches are shown in Figure 6.

The results of the initial level and evolution of chemical components during the storage of peaches are shown in Table 3.

Fig.6 - Depreciation caused by pathogens during peaches storage

Table 3

The level and evolution of chemical components during peaches storage (selective data)

Var.	Variety	Storage conditions (°C)	S.U. (%)	Titratable acidity (%)	Total sugar (%)	Vit.C mg/100g
-	**COLINS**	**initial**	**10.7**	**0.49**	**4.47**	**12.32**
V4	-idem-	3-5 ºC	11.6	0.40	5.13	10.89
-	**JERSEYLAND**	**initial**	**9.2**	**0.78**	**4.26**	**13.41**
V5	-idem-	20-22°	13.6	0.52	4.80	10.76
V6	-idem-	10-12 ºC	11.2	0.60	4.68	11.74
V7	-idem-	10-12 ºC+AM	10.7	0.65	4.61	12.86
V8	- idem-	3-5 ºC	14.6	0.52	4.95	12.26
Overall average		**initial**	9.95	0.64	4.37	12.87
		3-5 ºC	13.10	0.64	5.04	11.58

From the date presented in the table results that peaches had initial a content of 9.2-10.7% soluble dry substance(S.U.), 0.49-0.78% titratable acidity, 4.26-4.47% total sugar and 12.32-13.41mg/100g vitamin C. Initially,. the Collins cultivar had a higher content of soluble dry substance and total sugar and the Jerseyland cultivar had a higher content in titratable acidity and vitamin C. S.U. content showed only increases during storage under different conditions. These increases were lower or higher depending on the variant.

The highest increases in S.U. content occurred in V5 and V8 variants for ambiental and refrigeration storage, when values of 13.6-14.6% were determined depending on variant. The lowest S.U. content was determined for variant V7 of Jerseyland cultivar storage under refrigeration with modified atmosphere conditions.

Titratable acidity of peaches decreased for all valid storage variants compared to initial values, but in varying proportions depending on cultivar, duration and storage conditions. The highest decrease in titratable acidity was recorded for V5 and V8 variants storaged under ambient and refrigerated conditions, the level being 0.52% for both variants. The highest value for titratable acidity was determined for variant V7 of Jerseyland cultivar storaged under refrigeration with modified atmosphere conditions.

The initial total sugar content was 4.26-4.47% depending on the cultivar. The total sugar content increased in all cases during storage. The highest increases in total sugar content occurred in the V5 and V8 variants storaged under ambiental and cold conditions and the lowest increases ocurred in V6 and V7 variant storaged under refrigeration conditions.

The initial content of vitamin C in peaches was between 12.32-13.41 mg / 100g depending on the cultivar, the Jerseyland cultivar having more vitamin C than the Collins cultivar. The vitamin C content decreased in varying proportions depending on the storage variant. V5 variant, stored under ambiental conditions, had the highest decrease in vitamin C content, the smallest decrease being determined for V7 soraged under refrigeration and modified atmosphere conditions.

The results of the initial level and evolution of the firmness of the peaches during storage are shown in Table 4.

Table 4

The level and evolution of firmness during peaches storage

Den. No.	Cultivar	Storage temperature (°C)	Pulp firmness (UP)*)	Firmness decreasing (%)
-	**COLINS**	**initial**	**63.25**	**-**
V1	- idem-	20-22°	-	-
V2	- idem-	10-12°	164.55	-260.16
V3	- idem-	10-12 ºC+AM	131.20	-207.43
V4	- idem-	3-5°	148.75	-235.18
-	**JERSEYLAND**	**initial**	**19.00**	**-**
V5	- idem-	20-22°	128.63	-677.00
V6	- idem-	10-12°	144.85	-762.37
V7	- idem-	10-12 ºC+AM	100.00	-526.32
V8	- idem-	3-5°	101.65	-535.00
Average		initial	41.13	-
		20-22°	-	-
		10-12°	154.70	-376.12
		10-12 ºC+AM	115.50	-280.82
		3-5°	125.20	-304.40

*) UP-Penetrometric unit

The data from the table shows that the initial firmness of the peaches of the two cultivars showed great differences between them, indicating the existence of different degrees of maturity of the fruits. During storage, for all variants was determined a drastic decrease of the firmness and in different proportions. The decrease of the firmness was in the proportion of 207-762%, depending on the storage variant. The highest decrease of firmness occurred in the V6 variant of Jerseyland cultivar storaged under refrigeration condition. and the lowest decrease occurred in the V3 variant of Collins cultivar storaged under refrigeration and modified atmosphere conditions

The data also shows that for Collin cultivar with a lower initial firmness, the decline of firmness was 207-260.16% depending on storage variant, while for Jerseylad cultivar with a higher initial firmness, the decline of firmness was 526.32-762.37% depending on storage variant.

CONCLUSIONS

From the observations made it was revealed that peaches were susceptible to storage with a maximum storage life of 5-20 days depending on the storage conditions. The main problem was the large amount of impairment losses determined in one of the cultivar unconcerned of the storage conditions and the large diferences of impairment losses existing for other cultivar between variants of storage conditions. After the first experimental cycle, the results lead to the idea of a high sensitivity at 3-5°C of peaches in general and optimal temperatures of 10-12 ºC for storage peaches less ripe. Harvesting in the prone phase and storage under refrigeration with or without modified atmosphere conditions can provide a shelf life of peaches for 15-20 days.

For Collins cultivar with a lower initial firmness, the decline of firmness was 207-260.16% depending on the storage variant, while fot Jerseyland cultivar with a higher initial firmness, the decline of firmness was 526.32-762. 37% depending on the storage variant.

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SEMI-AUTOMATIC GRAFTING SYSTEM USED ON SEEDLINGS PRODUCTION AT HORTING INSTITUTE - TECHNICAL AND ECONOMIC ASPECTS
/
ASPECTE TEHNICE ȘI ECONOMICE PRIVIND UTILIZAREA SISTEMULUI SEMIAUTOMAT DE ALTOIRE LA MICROSERA DE RĂSADURI A I.C.D.I.M.P.H. – HORTING

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Keywords: *robot, grafting, scion, rootstock, yield, griping rate.*

ABSTRACT
An important technological measure to prevent crops infestation with diseases and pests from soil is the rotation of crops, but this method is very rarely adopted in greenhouses. The use of grafted plants on resistant genotypes is now widely widespread in worldwide. Plants with a greater resistance to infection from soil-borne pathogens and an increased tolerance towards abiotic stress are obtained from the different grafting techniques. In the last 10 years, in grafting vegetables is a trend to replace the manually grafting with semi-automatic or automatic grafting robots.

The objective of this study was to evaluate a series of technical and economic aspects regarding the use of a semiautomatic system to grafting eggplants cultivatrs in order to increase the productivity of grafting. Research has determined that the use of an automated grafting system GR-800CS, manufactured by Helper Robotech Co., Korea, reduces grafting errors and thus increases productivity compared to manual grafting.

REZUMAT
O masură tehnologică importantă de prevenire a infestării culturilor cu boli si dăunători din sol este rotația culturilor, însă această metodă este foarte rar aplicată în sere. Utilizarea răsadurilor altoite pe genotipuri rezistente este foarte răspândită în întreaga lume. Plantele cu o rezistență mai mare la infecții cauzate de agenții patogeni din sol și o toleranță sporită față de stresul abiotic se pot obține prin altoire. În ultimii 10 ani, în procesul de altoire a legumelor este o tendință de renunțare la altoirea manuală cu metode de altoire cu ajutorul unor roboți specializați.

Obiectivul acestui studiu a fost evaluarea unei serii de aspecte tehnice și economice privind utilizarea unui sistem semiautomat pentru altoire a vinetelor, în scopul creșterii productivității altoirii. Cercetările au stabilit că utilizarea unui robot semiautomat model GR-800CS, fabricat de Helper Robotech Co.. Coreea, reduce altoirile defectuoase și astfel crește productivitatea în comparație cu altoirea manuală.

INTRODUCTION
The interdiction of the use of Methyl Bromide for soil disinfection has led to the development of alternative methods for seedling production such as grafting, which has expanded rapidly. The method is based on joining the cultivar (scion) and a wild variety (rootstock) which have a high resistance to soil pests and diseases and have tolerance to the less favorable conditions of soil type and environment (Edelstein, 2004)

More than 80% of vegetable grafting worldwide are performed manually. Taking into account that the need for grafted seedlings is steadily increasing and grafting requires a qualified workforce, the cost of seedling production became a very significant issue. For partial or total replacement of manual operations, semi-automatic and automatic devices for grafting vegetables have been developed. Iseki & Co. Ltd.. from Japan – Matsuyama, built a GR 800 robot for grafting green and yellow melons in 1993 (Kobayashi. 2005). Later, many more robots were built in East Asia and Europe (Kurata, 1994; SUZUKI et al., 1998). In 2004, Leonardi and Romano (Leonardi and Romano, 2002) show that because of the higher costs of manual grafting, it is necessary to adopt semi-automatic or automatic systems for grafting, according the rapid expantion of growing techniques of grafted vegetables.

Manually grafting requires an effort of upper limbs of workers, owing to the great number of repetitive movements (Colantoni et al., 2012). An other important risk factor during manually grafting is the posture of the worker. Manually grafting operations force workers to maintain an elbow pronation greater than 60° with respect to a resting position for 80% of the cycle time. The frequent repetition of the same movement in very short cycles for more than 50% of the working time, is also an health risk for farm workers.

For an successfully grafting it is necessary to work in controlled environments and the grafting is generally carried out in greenhouses where the various climatic conditions like air temperature, relative humidity and solar radiation must be very precisely respected. Some studies indicate that in these environments the air temperature must not fall below the values of 24°C - 27°C, the relative humidity must be close to 100% and solar radiation must be reduced by using shade cloths. In the healing phase the plants must be put into environments with an air temperature of 28°C - 30°C and a relative humidity of 95% (Kubota et al., 2008; Oda, 2006. 1999).

This microclimate conditions with elevated temperatures and humidity can affect the cardiovascular system and the thermoregulatory system of workers. These environmental conditions can cause to the workers an increase in aggression, distraction, sweating, tremor, lack of precision in the work, etc. So, these conditions not only have adverse effects on productivity but also on the safety of the workers (Marucci et al., 2012)

In the months in which risk of worker stress is higher, that means in April, May, June, September and October it is a must take some technical and procedural decisions in the grafting vegetables activities. One of this decision is to introduce the automatization of grafting process.

Currently, a total of six models of semi- or fully automatic grafting robots are available in the market; three of these models have been developed in Japan and one each in Korea, the Netherlands and Spain, as described in table 1 (Bie et al.. 2017)

Table 1

Features of grafting robots available in different countries.
(adapted from Bie et al.. 2017)

Made	**Country of origin**	**Distribution**	**Suitability**	**Properties/characteristics/ specification**
Helper Robotech (semiautomated machine)	Korea	Distributed to Asia. Europe and North America	Cucurbits and tomato	The first model that can graft both cucurbits and tomato. Widely marketed in Asia and North America. Produces 650–900 grafts h^{-1} at ≥95% success rate. Needs two to three workers to operate the machine.
Iseki (semiautomated machine)	Japan	Distributed to Asia and Europe	Cucurbits	Introduced to the Asian and European market. One machine has been introduced in the USA for trial use. Produces 900 grafts h^{-1} at ≥95% success rate. Needs two to three workers to operate the machine.
Iseki (semiautomated machine)	Japan	Distributed to Asia	Tomato and aubergine	Produces 800 grafts h^{-1} at ≥95% success rate. Seedling size required for grafting was too large for Japanese standard. limiting the market. However. the seedling size is acceptable for USA standard. Needs two to three workers to operate the machine.
Iseki (fully automated machine)	Japan	-	Cucurbits	Introduced in Japanese market in 2009. Produces 800 grafts h^{-1} at ≥95% success rate. A tomato model is also under development at IAM BRAINa.Only one person needed operate the machine.
ISO Group (fully automated machine)	The Netherlands	-	Tomato and aubergine	Introduced in 2009. Produces 1000 grafts h^{-1}. A semiautomated model is also available that requires manual feeding of plants into the system.
Conic System (semiautomated machine)	Spain	-	Tomato	A semi-automated robot to cut tomato scions and rootstocks at a selected angle. Produces 400–600 grafts h^{-1}. Only one person needed to operate the machine.

MATERIAL AND METHOD

For this study in the pilot station of the Institute of Research and Development for Industrialization and Merketing of Horticultural Products – HORTING, we used two eggplant scions 'Sharapova F_1' produced by Rijk Zwaan from Netherlands and ' Aragon F_1' produced by Hazera Genetics from Israel. Both of these hybrids are very well know by the Romanian farmers and their fruits are highly appreciated by Romanian consumers.

For rootstocks were used even two plants :

(i) 'Hykiaku' developed by a Japanese company 'Kaneko Seeds' and has good resistance against *Fusarium oxisporum* var, *lycopersici race 0.1*., at *Fusarium oxisporum radicis-licopersici race 0.1* . at *Verticilium albo-atrum,* at *Verticilium dahliae* and *Meloidogine ingognita.* This rootstock confers tolerance to the negative action of abiotic factors and vigor to the scions and is recomanded to be used in fields infested with vascular diseases.

(ii) ' Emperador' developed by Dutch company Rijk Zwaan which has resistance at KVP (*Pyrenochaeta licopersici, Dydinella licopersici, Verticilium spp., Fusarium spp.),* it is very vigorous, has good tolerance to low temperatures and high resistance to nematodes.

Each type of scion was grafted on two types of rootctock : 'Emperador + Aragon ' , 'Emperador + Sharapova' , 'Hykiaku + Aragon' , 'Hykiaku + Sharapova'.

The grafting operations were done in an specialized greenhouse inside of HORTING institute, greenhouse with an area of 1450 m^2 protected against condensation by a double layer cover, with an under pressure air layer as thermal insulation and equipped with a system for shading, ventilating and cooling.

Grafting operations were done manually and semi-automatically using an grafting robot GR-800CS made in Korea at Helper Robotech Co. The stages of both methods.,manually or mechanically, are illustrated in figure 1.

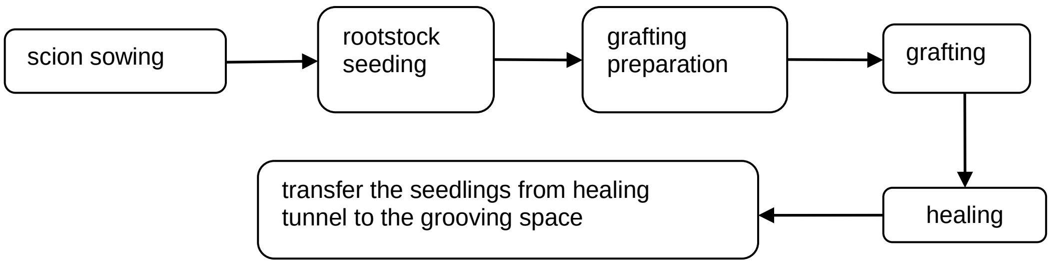

Fig. 1 – The flow diagram of the grafting stages

The main difference between the two methods consists in the biologic material preparation for grafting and the grafting operation itself. The rest of the operations are relatively similar.

During the experiments were measured the temperature sums required for the seeds to grow and for the seedlings to reach the necessary phenophase for grafting. The operator's work efficiency was also determined during 8 working hours per day. Was also determinated the average number of grafted plants per day by a single operator and the average number of grafted plants by a single worker per hour.

48 hours before grafting, the seedlings were fertilized with a mineral fertilizer (19:19:19+MgO) in a concentration of 0.3%. One day before grafting, the plants were irrigated. Very important was the process of sorting the seedlings for grafting. The stem diameter of scions and rootstocks must be uniform for both grafting methods. For mechanized grafting, the optimal diameter is 2-3 mm.

For the manually grafting we used a team of 10 specialized workers (a qualified horticultural worker in Romania can do between 80 and 100 grafted plants h^{-1}) and 2 workers in addition for handling the seedling and the alveolar trays.

For the robot we used 3 operators, 2 to feed the robot with scions and rootstocks and a third to manipulate the trays with the seedlings.

The analysis was made for eight working hours. During the experiment it was determinanted the operator's yield dynamics in these 8 hours, the average number of grafted plants per day by an operator and the average number of grafted plants by a single worker per hour.

RESULTS

For manual grafting, in table 2 is presented the dynamics of the number of plants grafted by operators within 8 hours, the average number of grafted plants per day by one worker and the average number of grafted plants made by a single worker per hour.

The total number of plants grafted in 8 hours by 12 workers was 4996 plants. The first and the last working hours are those with the lowes yields. The average grafted plants per hour by one operator is 62.5 plants.

Table 2

Dynamic of manual grafting

Working period	Total plants / h·10 workers	Average plants / h· one worker
Hour 1	540	54.0
Hour 2	618	61.8
Hour 3	655	65.8
Hour 4	668	66.8
Hour 5	658	65.8
Hour 6	660	66.0
Hour 7	634	63.4
Hour 8	563	56.3
	Total : 4996	**62.5**

The cost of labour, estimating the medium net salary for qualified workers of 18.2 euro/day and 11euro/day for handling workers, is 204 euro/day and that means 0.041 euro/grafted plant. Another useful indicator is: for produce 1000 seedling in 8 working hours is need of 2.4 qualified workers.

In table 3 is presented the dynamics of grafting using an semiautomatic method.

Table 3

Dynamics of semiautomatic grafting

Working period	Average plants / h·robot team	Average plants / h· one worker
Hour 1	517.0	172.3
Hour 2	545.2	181.7
Hour 3	554.5	184.8
Hour 4	557.1	185.7
Hour 5	554.0	184.6
Hour 6	548.9	182.9
Hour 7	537.0	179.0
Hour 8	499.1	166.3
	Total : 4312.8	**179.7**

During the experiments, it is performed an average of 539 plants/h·work team. In one day one worker grafted 1437.6 plants corresponding to 179.7 grafts/h·worker. At a salary of 18.3 euro/day for qualified workers and 11 euro/day for handling workers, the cost for each grafted plant is 0.011 euro/plant for labour.

The results show that the semiautomatic grafting improved the productivity of grafting operation by 3.43 times comparing with the manual grafting.

A complete cost analysis requires taking into consideration both the direct and indirect costs involved in the technological process of grafted vegetables seedlings production. From the cost analysis presented in table 4, it is cleat that the cost achieved with the semiautomatic method is lower than the costs of the manual method of grafting vegetables.

Table 4

Total cost of eggplant seedlings produced manually and semiautomatically (euro/1000 seedlings)

Costs	Manual method	Semiautomatic method
Salary	41.00	11.00
Materials	132.17	134.81
Total direct expenditure	173.17	145.24
Indirect expenditure	31.17	26.24
Profit 5%	10.21	8.57
VAT 19%	40.77	8.57
Total	**255.32**	**214.26**

CONCLUSIONS

For grafting vegetables using the robot, are needed three operators - two operators supply the grafting robot with seedlings and the third operator takes the grafted seedlings from the strip and places them in the alveolar tray and after filling it, puts the tray in healing tunnel .

The semi-automatic method improves the yield of grafting operation over 2.88 times.

At the semi-automatic grafting has been realized a lower cost price with more than 16.08% comparing with manual grafting, respectively a cost price of 41.06 Euro per 1.000 grafted seedlings.

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PRELIMINARY ANALYSIS OF SEDIMENT TRANSPORT IN THE CONTEXT OF THE HYDROTECHNICAL CONSTRUCTIONS INFLUENCE. CASE STUDY BRANCH BALA – OLD DANUBE BIFURCATION

ANALIZA PRELIMINARĂ PRIVIND TRANSPORTUL DE SEDIMENTE ÎN CONTEXTUL INFLUENȚEI CONSTRUCȚIILOR HIDROTEHNICE. STUDIU DE CAZ BIFURCAȚIA BRAȚ BALA – DUNĂREA VECHE

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Keywords: *Danube, sediment transport, cohesive sediments, numerical simulation, anthropic interventions.*

ABSTRACT

The Danube sector between Calarasi and Braila ensures the connection between the Danube River and the Danube - Black Sea Canal and maritime Danube. In order to ensure the optimal conditions of navigation throughout the year on the Danube main branch, it was necessary to construct some hydrotechnical works. Taking into account these anthropic interventions and the fact that the sediment transport developed in the watercourses is of great importance for the hydraulic and for the riverbed dynamics, the present paper aims to reviewing the results obtained after the preliminary analyses on sediment transport, using the Delft3D numerical modelling software.

REZUMAT

Sectorul Dunării cuprins între Călărași şi Brăila asigură legătura între Dunărea fluvială şi canalul navigabil Dunăre – Marea Neagră şi Dunărea maritimă. Pentru a asigura condițiile optime de navigație pe tot parcursul anului pe brațul principal al Dunării, a fost necesară construcția unor lucrări hidrotehnice. Ținând cont de aceste intervenții antropice şi de faptul că transportul fazei solide dezvoltat în albiile cursurilor de apă are o mare importanță pentru hidraulică şi pentru dinamica albiilor, prezenta lucrare are ca obiectiv trecerea în revistă a rezultatelor obținute în urma efectuării analizelor preliminare privind transportul de sedimente prin utilizarea programului de modelare numerică Delft3D.

INTRODUCTION

With a length of 2783 km, out of which 2414 km are navigable, the Danube is the second longest river in Europe. The Danube is of particular importance for Romania, the country covering about one third of the basin surface and of the total watercourse length (*ICPDR. 2009*).

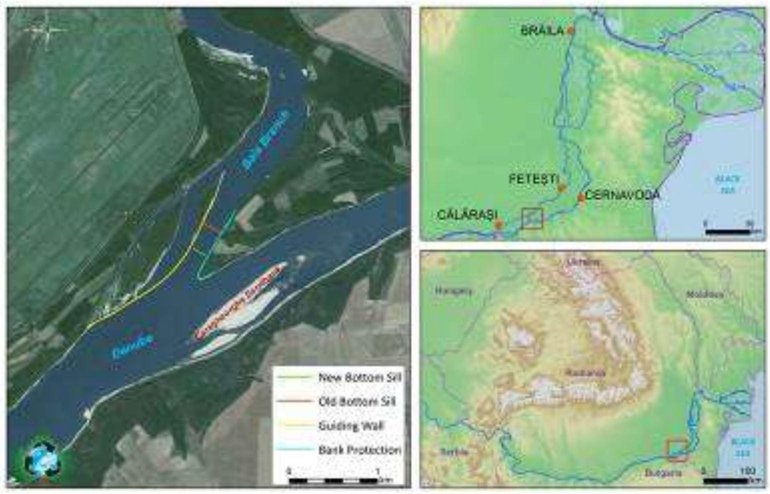


Fig.1 – Location of the study area

The segment between Calarasi and Braila (km 375 – km 175) connects the Danube River to the navigation channel Danube - Black Sea and the maritime Danube. Taking into account the recommendations of the Danube Commission on the above-mentioned sector, hydro-technical works have been carried out to ensure the optimal conditions for navigation on the Old Danube - the Danube main branch. Thus, in order to improve the navigation conditions on the Lower Old Danube, in the Bala Branch – Old Danube bifurcation area, a bottom sill, a guiding wall and a bank protection were constructed to redistribute the flows between the two branches (*INCDPM. 2011-present*).

Taking into account these anthropic interventions and the fact that the sediment transport developed in the watercourses is of great importance for both the hydraulic and the riverbed dynamics (*D. Bătucă, 1981*), this paper has as main objective the review of the results obtained from preliminary analysis of sediment transport using the Delft3D numerical modelling program, for the area covering the Danube course between km 348 - km 343 [Old Danube] and km 10 - km 7.5 [Bala branch] (fig. 1). This subject is the object of multidisciplinary research, requiring knowledge from various fields such as hydro morphology, hydrology, hydraulics, sedimentology, geomorphology, geography, numerical modelling and geographic information systems, but also a good technical training in order to obtain and process the field data (*INCDPM, 2015*).

MATERIAL AND METHOD

The study area analysed in this paper is of particular importance from the point of view of the hydro-morphological complex processes of the riverbed. The Bala branch is detached from the Old Danube near Km 345 and flows into the Borcea branch at Km 68. This branch is characterized by an alternation of areas with intense hydro morphological dynamics with relatively low energy areas. The bottom sills area (Km 4 and 9) is also characterized by the presence of vortices (fig. 2) and shore erosion phenomena (*INCDPM. 2011-present*). (*Egis, 2015*).

Fig. 2 – Vortices from the bottom sill area - Bala branch

Due to the dynamic processes specific to sensuosities and confluences, the shape of the riverbed is asymmetrical. The banks of the Bala branch (fig. 3) are steep, with frequent traces of collapses caused by increased erosion, produced in several cases by the presence of inverse currents near the banks (*Egis, 2015*), (*INCDD, 2004*). Less dynamic areas are characterized by the flattened shape of the riverbed, lower depths and lower water velocities compared to the rest of the branch (*Egis. 2015*).

Fig. 3 – Bala branch shores

The Old Danube branch runs between Km 373 and Km 241, the sector between Km 347 and Km 343 being studied in the present paper. Due to the fact that the Bala branch takes a large volume of water from the upstream, on the Danube Old branch the river energy is diminished, downstream of the bifurcation, with sediment deposition processes prevailing, as evidenced by the presence of numerous islands and sand banks, with negative implications for navigation (*INCDPM. 2011-present*), (*Egis, 2015*).

After the bifurcation with the Bala branch, the Old Danube manifests an obvious tendency of atrophy - cross-section area reductions, depths and water velocities reductions. An obvious example is the Caragheorghe sandbank (fig. 4), which occupies more than 50% of the riverbed width and has a length of about 1.5 km. It is located in the bifurcation zone with the Bala branch (Km 345) (*INCDPM, 2011-present*). (*Egis, 2015*).

Fig. 4 – Caragheorghe sandbank

In order to analyse the transport of sediments, the hydrodynamic regime and effects of the anthropic factor must be taken into account. In this regard, it was used the information volume obtained from field measurements related to bathymetry, discharge, water level, water velocities that were performed during the filed campaign preconstruction-post-construction time interval. For single beam measurements the RiverRay was used, being based on the Acoustic Doppler Current Profiler [ADCP] technology. At the same time, this system can provide information on water velocities and discharge (*SonTek/YSI. 2010*). Taking into account that the multibeam equipment provides a picture of the riverbed in which details are presented, that are often not obtained by conventional measurements with the single beam sonar (*Kongsberg, 2010*), the data used in this paper was also attained from bathymetric measurements using the Kongsberg GeoSwath Plus multibeam (fig.5). The obtained bathymetry is highly accurate, as a result of the data processing, resulting a 3D numerical model of the riverbed.

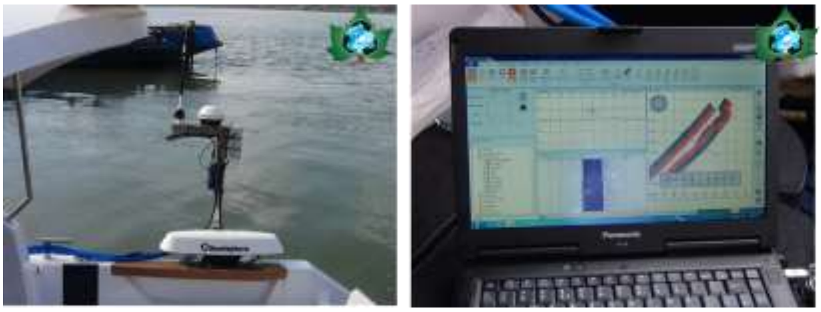


Fig. 5 - The Kongsberg GeoSwath Plus multibathymetric system

With the evolution of technology, a number of programs have been developed concerning the hydraulic modelling of water discharge in rivers (*D. Sârbu. 2015*). Delft3D is a world leader in three-dimensional modelling in order to investigate hydrodynamics, sediment transport, morphology and water quality in rivers, estuaries and coastal environments (*Deltares, 2017*). The use of the Delft3D software allows the analysis and prediction of water discharge dynamics, both bidirectional and quasi-three-dimensional, depending on the input conditions established on the basis of the determinant parameters of the riverbed and water discharge. Delft3D offers the possibility to establish hydrodynamic variables, determines sediment transport characteristics, water hydro morphologically analysis, the water course, model water quality parameters, etc. (*INCDPM. 2015*). This program uses different modules, but only RGFGRID, QUICKIN, FLOW and QUICKPLOT modules will be used in this research.

To achieve the hydrodynamic model, several stages were performed. For grid construction the Delft3D-RGFGRID module was accessed (fig. 6). Depending on the study area limits, this module allows the construction, modification and visualization of the grids. Based on the optimized grid and data from field measurements achieve in 2016, using the Delft3D-QUICKIN module. the bathymetric model for the study area was created.

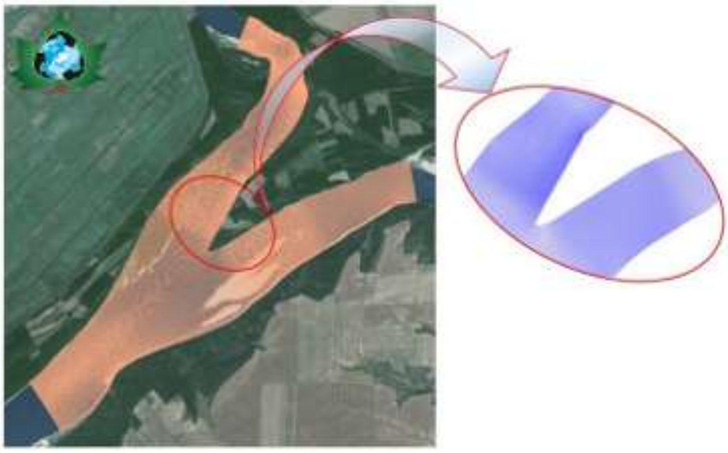


Fig. 6 – Grid detail

First. using the FLOW module a hydrodynamic qusi-3D model was created, by applying the Navier Stokes equations. After the calibration and validation of the hydrodynamic model, a 2D hydro-morphodynamic model was developed in which non-cohesive sediments were taken into account and Van Rijn (2000) was used by default (*Deltares. 2011*).

An essential element in assessing the morphodynamic behaviour of a river is the inclusion in the analysis of sufficient seasonal variations. Thus, a hydrograph variable at the upstream boundary (fig. 7), was constructed to represent the full discharge variation in a schematic manner. The schematic hydrograph is made up of several periods, each having a constant discharge based on measurements.

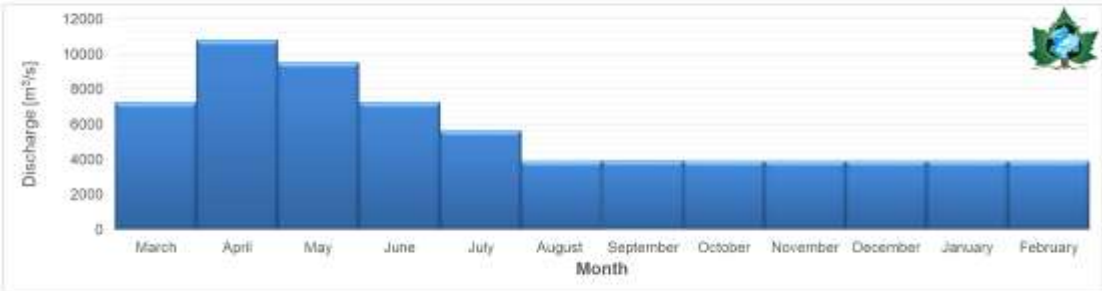


Fig. 7 – The hydrograph used for hydro-morphodynamic model

The input data required to establish the boundary conditions are represented by the discharge value in the upstream section and by the level value in the downstream sections (table 1).

Table 1.

Input data used to create the hydro-morphodynamic test

Month	**Danube km348**	**Bala Branch km7.5**	**Old Danube km343**
	Q. m^3/s	H (MNS*). m	H (MNS*). m
March	7234	10.03	10.06
April	10800	12.5	12.51
May	9523	11.82	11.85
June	7234	10.03	10.06
July	5649	8.63	8.66
August	3908	6.98	7.01
September	3908	6.98	7.01
October	3908	6.98	7.01
December	3908	6.98	7.01
January	3908	6.98	7.01
February	3908	6.98	7.01

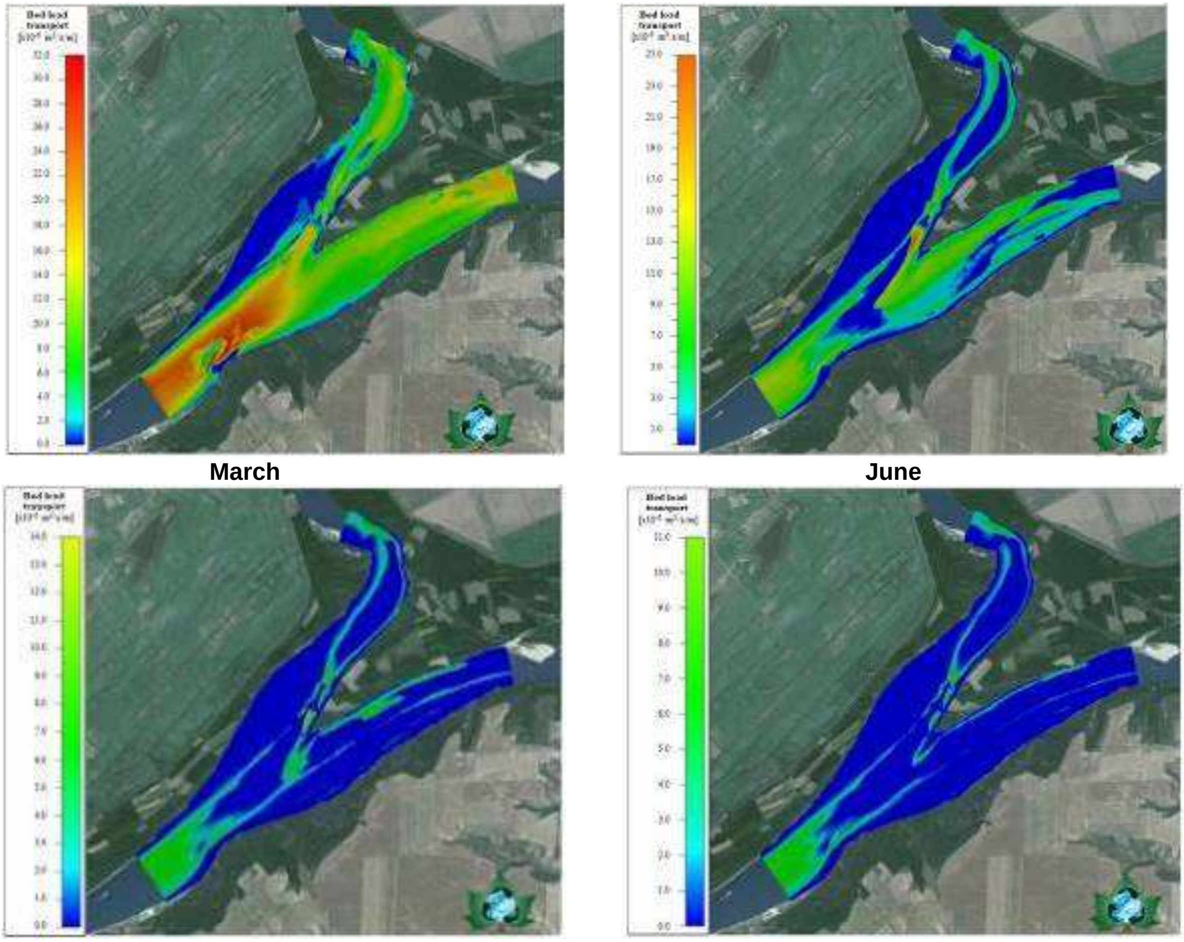
**MNS – Altimetry System Black Sea - Sulina*

Regarding the sediment transport condition imposed by the program, the following data were selected: cohesive sediment concentration: 0.07 kg/m^3, specific density of sediment: 2650 kg/m^3, bed load density: 1600 kg/m^3 and mean sediment diameter D_{50}: 250 µm.

The model thus created allows us to analyse the sediment transport process that takes place between March and February.

RESULTS

The discharge values of the bed-load transported on linear meter have varied from a maximum of 32x10^{-6} m^3/s/m, at the end of March (the investigation beginning) to 11x10^{-6} m^3/s/m at the end of January.



March June

September January

Fig. 8 – Hydro-morphodynamic test model: bed-load transport

As can be seen, the trend of bed-load dynamics is to carry a larger volume of sediment on the Bala branch. This is mainly due to the riverbed geometry at the Bala – Old Danube bifurcation, namely a higher area at the entrance to the Old Danube.

The results regarding the bed-load transport were associated with those related to the erosion-sedimentation process occurring during one year (fig. 9). According to the obtained results, the deposit process varies from a maximum of 3.5 m in March to a maximum of 13 m at the end of the calculation period. The maximum erosion value was maximum -0.5 m, given by the thickness of the erodible layer in the studied sector.

In the first part of the analysed sector, namely in the area up to the Bala branch – Old Danube bifurcation, it is noted that the tendency was that of sedimentation of the banks and erosion in the centre of the riverbed. Including in the vicinity of the Pârjoaia rock there are remarkable deposits.

In the bifurcation zone, during the first part of the analysed period. deposits are observed on an important area at the entrance to the Old Danube and by the end of the calculation period, this area will narrow and rise. The appearance of this field leads to the directing of the discharge to the Bala branch, which is also accentuated by the deepening of the riverbed due to the erosion processes.

On the Old Danube, it is noticeable that the tendency is to change the position of the sandbank on downstream - significant deposits on the right bank. Erosion processes can be noted on the left half of the riverbed.

On the Bala branch, there were areas with significant deposits downstream of the bottom sill, near the banks. According to these results, it can be noticed that in the area of the bottom sills, the riverbed has the tendency, following the transport process, to cover with sediment the erosion scours formed downstream of the bottom sills.

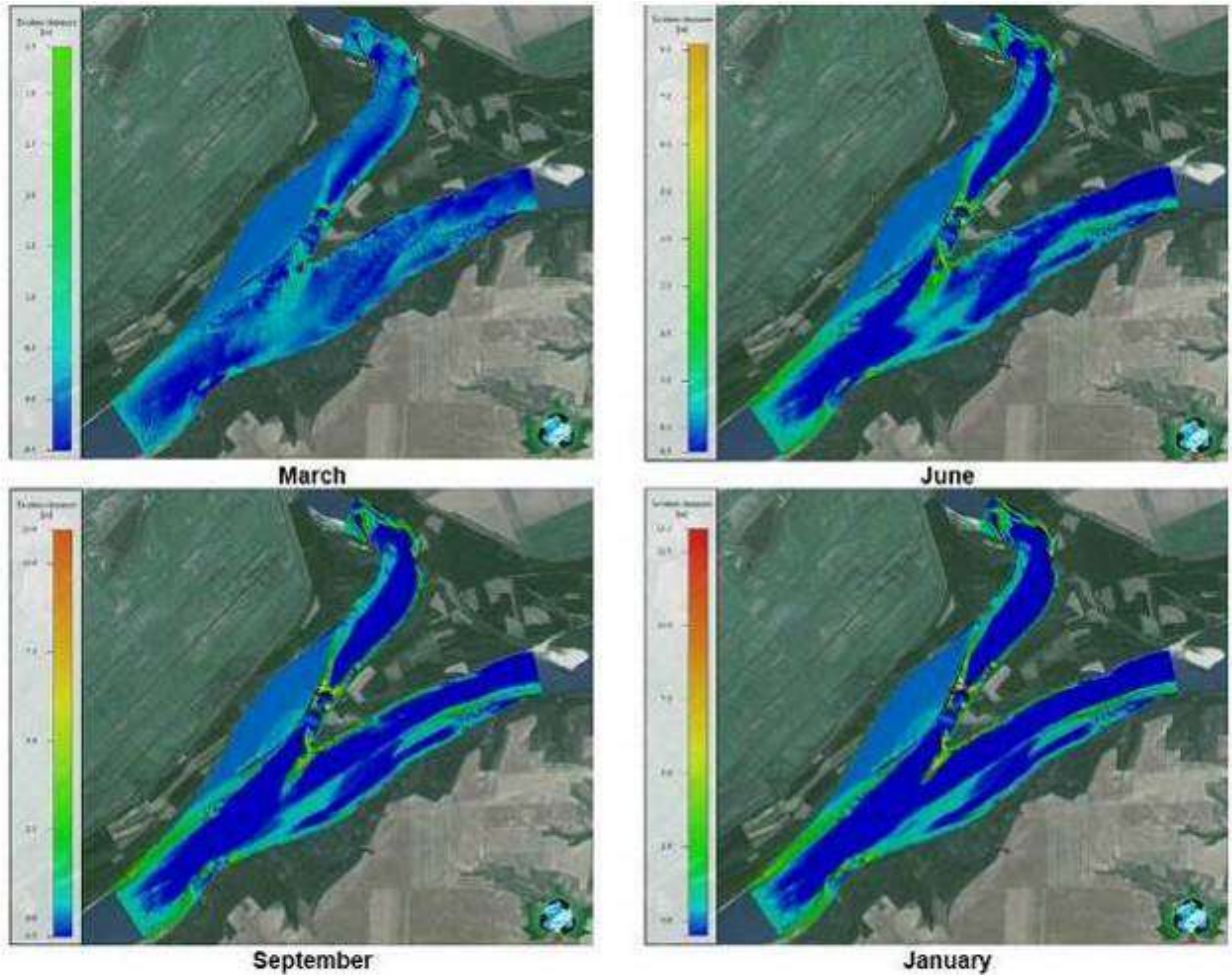


Fig. 9 – Hydro-morphodynamic test – erosion – deposition process

Figure 10 shows two details regarding the bottom sills area – results obtained from numerical modelling and from multi-beam measurements achieved in June 2017. As can be seen, in the case of the hydro-morphodynamic model, following the sedimentation process, the erosion scour formed downstream of the old bottom sill changed its geometry due to the resulting bank deposits. Another difference is given by the geometry and dimensions of the deposition area at the right of the bifurcation.

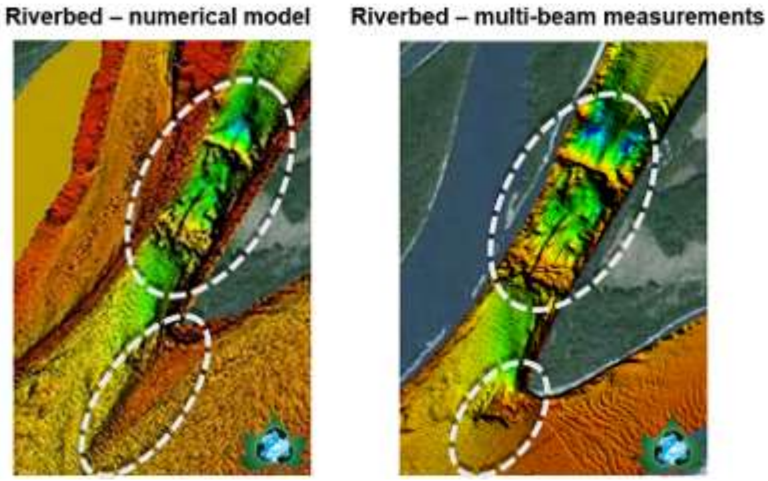


Fig. 10 - Comparison regarding the riverbed: hydro-morphodynamic model – multibeam bathymetric measurements June 2017

These differences may be due to the discharge values used as input data. Since a series of data is required to achieve a hydro-morphodynamic model, covering the entire range of values, from minimum to maximum, they do not correspond to the monthly average values of the discharges recorded by the INCDPM team during the analysed period. Thus, it is recommended to optimize the hydro-morphodynamic model and to perform new series of simulations in which the hydrological data recorded during the field campaigns should be used.

CONCLUSIONS

Based on information regarding the river dynamics in the analysed sector, a hydro-morphodynamic test model was carried out, through which investigations were carried out on sediment transport and, implicitly, the erosion-deposition processes taking place in the watercourse riverbed, over a period of one year. The results obtained from this analysis are preliminary data on sediment dynamics.

To increase confidence, it is important that this model to be calibrated and morphologically. Thus, it is recommended to continue the investigations by comparing the data from the numerical modelling program with those obtained from the measurements. The trend of sediment dynamics should be analysed based on historical data and field data.

At the same time, it is recommended to create new scenarios for longer periods of time. The information resulting from the numerical simulations will be corroborated with the results obtained from the chemical-biological analyses of the sediments, thus investigating the impact that the new hydrotechnical constructions through the sediments dynamics could have on the aquatic ecosystem.

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SOLUTIONS TO ENSURE THE LATERAL CONNECTIVITY ON THE LOWER DANUBE. CASE STUDY EPURAŞU BRANCH
/
SOLUȚII PRIVIND ASIGURAREA CONECTIVITĂȚII LATERALE PE DUNĂREA INFERIOARĂ. STUDIU DE CAZ BRAȚUL EPURAŞU

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ABSTRACT
This article investigates in a temporal dimension the manner to ensure the lateral connectivity of a main watercourse. In this regard, Epurasu branch, located between km341-334 of the Danube, was chosen as a case study area. This branch is in an advanced state of colmatation, possibly due to hydrotechnical works – submerged guiding dam. In order to ensure lateral connectivity, INCDPM experts proposed the implementation of a groove in the dam body. This solution was validated using the informational volume obtained from bathymetric-discharge measurements. The results of the research revealed the effectiveness of the groove to ensure the Danube lateral connectivity.

REZUMAT
Prezentul articol investighează într-o dimensiune temporală asigurarea conectivităților laterale ale unui curs principal de apă. În acest sens, a fost selectat ca studiu de caz zona brațului Epurașu situat între km341-km334 ai Dunării. Acest braţ se afla într-o stare avansată de colmatare, posibil datorită lucrărilor hidrotehnice - dig submers de dirijare. În vederea asigurării conectivităţii laterale. experții INCDPM au propus realizarea unei cunete în corpul digului. Această soluție a fost validată cu ajutorul volumului de informații obținut din măsurătorile batimetrice și de debite. Rezultatele obținute în cadrul cercetării au evidențiat eficiența cunetei privind asigurarea conectivității laterale ale Dunării.

Keywords: *lateral connectivity, branch, Danube, groove*

INTRODUCTION
Connectivity is now recognized as a fundamental property of all ecosystems (*Kondolf, 2006*). The concept of connectivity was introduced into ecology through ecology of landscapes as a factor explaining species distribution (*Merriam 1984, Moilanen and Nieminen 2002*). However, the definitions for this term vary greatly and are often based either on the dynamics of metapopulation or on the continuity of the landscape structure (*Calabrese and Fagan 2004*). In this paper, we focus on hydrological connectivity (*Ward 1989, Pringle 2003b*), as it is undoubtedly a defining feature of all river ecosystems.

Pringle (*2001*) defined hydrological connectivity as the "water-mediated transfer of matter, energy and organisms within or between elements of the hydrological cycle." Thus, in rivers, hydrological connectivity refers to media streams of material, energy and organisms within and between components, such as the canal, the floodplain, the alluvial aquifer, etc. of the ecosystem. This hydrological connectivity can be viewed as operating in longitudinal lateral and vertical dimensions over time (*Ward, 1989*).

The study area is represented by Epuraşu branch that defines Epuraşu Island and presents itself as a natural branch with a length of 7 km, with relatively low depths and low water discharge, which is in an advanced process of colmatation. To improve the navigation conditions by modifying the distribution of flows during the small and medium water levels, in the area of the Epurasu branch was proposed the construction of a submerged dam and bank defences (*AFDJ, 2014*). As a result of the implementation of these hydrotechnical works, the water flow on the Epurasu branch was significantly reduced, which may favour an increase in the eutrophication potential in certain periods by the excessive development of filamentous algae and macrophytes (*INCDPM, 2015*).

Fig. 1 - Epurasu branch – the dam in construction stage

Source: INCDPM. 2013

Aquatic plants can also invade the central part of the watercourse normally protected due to higher depths and velocity. Also, the distribution of aquatic species and aquatic invertebrates may change.

MATERIAL AND METHOD

Taking into account the fact that through the implementation of hydrotechnical constructions the servitude flow is not provided, it was necessary to propose a solution aiming to ensure the connectivity between the Old Danube and the Epuraşu branch, by fitting up of two pipelines with a 1 m diameter. Following the research carried out by the INCDPM experts, it was found that the full implementation of the proposed solution would have been insufficient to improve the impact on the Epuraşu branch (fig. 2). Thus, the continuation of the works according to the existing projects would have resulted in the interruption of the longitudinal and lateral connectivity between the Old Danube and the Epuraşu branch (INCDPM, 2011 – present) (*Nicolae A. et al., 2017*).

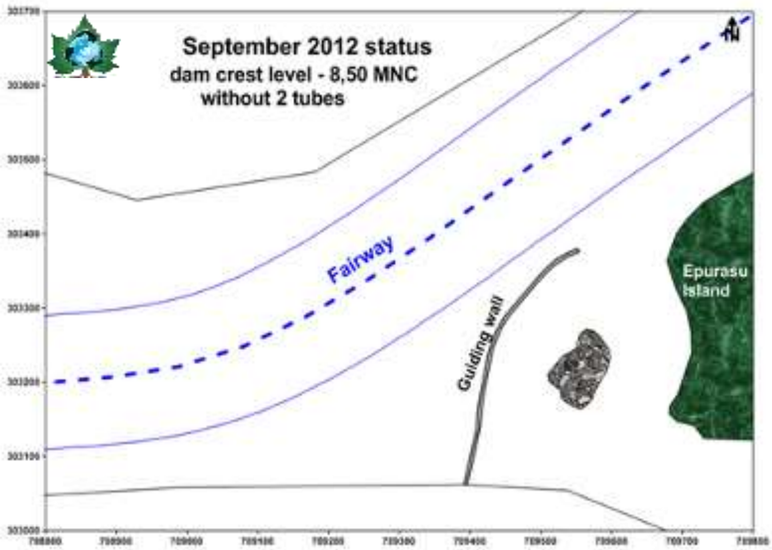

Fig. 2 - Situation of the discharge construction in Epuraşu area, September 2012

Source: INCDPM. 2011

In this context, the field situation was analysed and numerical simulations were performed with the Delft 3D software in order to develop preventive solutions and to eliminate this impact risk. Therefore, in view of the need to ensure a sufficient discharge to avoid the Epurasu branch colmatation, to maintain the longitudinal connectivity and reduce the impact, the INCDPM experts proposed the construction of a groove in the closure dam in order to replace the two pipelines proposed in the Initial Technical Project (*INCDPM, 2011-present*). The purpose of this solution is to allow a proper water discharge to the Epurasu branch to provide a win-win solution (fig. 3) for both the environment and the navigation conditions.

Fig. 3 - Groove positions analyzed and simulated by INCDPM
Source: INCDPM. 2013

The Epurasu submerged dam was built between August 2013 and May 2015. During this period, due to the works, an erosion scour was formed behind the groove. At the end of 2014, the ditch's cove was 3m MNS, rising to 6-8m in early 2015, due to the material that was discharged into the groove in January 2015. To continue the works, from April to June 2015 the connection between the branch and the Danube was interrupted, thus registering the lowest values of the discharges in this sector (*INCDPM, 2011-present*).

In order to observe the hydrological connectivity evolution in the 2011-2015 timeframe, the following equipment was used: 2 x ADCP produced by Teledyne and Sontek and a multibeam produced by Kongsberg.

The Advance Doppler Current Profiler (ADCP) system measures real-time water velocity profiles and determines the discharge rates on the profiles. This system was used attached to the craft. The ADCP RDI 600kHz (fig. 4), consisting of: Bottom Track circuit, high-resolution profiling, cables, batteries, memory card and dedicated software, required a shock-proof and moisture-proof computer for data collection. and was served by the DGPS OmniSTAR 8200 HP. and/or the built-in GPS. The ADCPs used are four/eight sensors with different orientation for generating a water-tight narrow beam without reflections due to water particles (eg. sediment and suspension, organic matter, organisms or gas bubbles) in order to determine the discharge rate of the water.

Fig. 4 - ADCP RiverRay

For data processing, a Teledyne RDI-WinRiver II software was used to record, process and analyse the velocity and discharge data.

The bathymetric profiles were executed on pre-set sections having at least one mark on which the topographic profile with the perpendicular orientation on the Danube course ran from one shore to another. At the beginning and at the end of the series of measurements, the Danube's quota was recorded at the nearest hydrometric station. The velocity of the craft was about 2 knots (about 3.5 km/h), depending on the state of the hydrometeorological regime, the wind, the nature of the riverbed, etc.

Single-beam bathymetry measurements were performed using a portable River Surveyour system, being a portable echosond with a ± 0.5% water depth accuracy. The ceramic transducer has a power of 300W at a frequency of 10KHz. The central ecosystem unit is connected to a 10-30VDC power supply with transducer. GPS and laptop to allow recording, integration and storage of information for each profile. This system was installed on the craft and was immersed at a depth of 30-40 cm., measurements being made on transverse profiles starting at a distance from the shore that provides a minimum depth of 2 m and crossing the opposite bank of the Danube the same conditions. It has been attempted to maintain a more straightforward track and a steady velocity.

Fig. 5 - Kongsberg Geoswat Plus Compact System

The Kongsberg GeoSwath Plus Compact Sonar (fig. 5) is a sonar that allows simultaneous bathymetric measurements and lateral scans of the bed with precision that meets OHI (International Hydrographic Organization) standards.

RESULTS

Figure 6 shows the spatial location of the three monitoring sections S1, S2, S3 in the area of Epuraşu branch. These are the sections where discharges and velocities were periodically monitored.

Fig. 6 - Location of monitoring sections

Figures 7, 8 and 9 show the average discharges on these three monitoring sections, each month of the analysed construction period, compared to the average of the first 4 months - the preconstruction period.

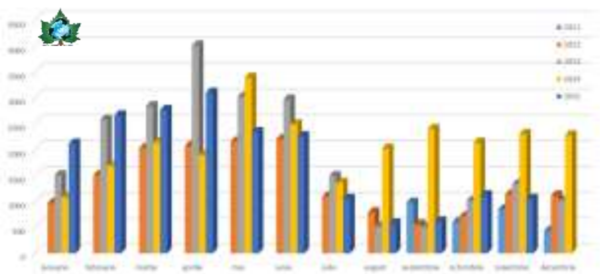

Fig. 7 - Discharges on S1

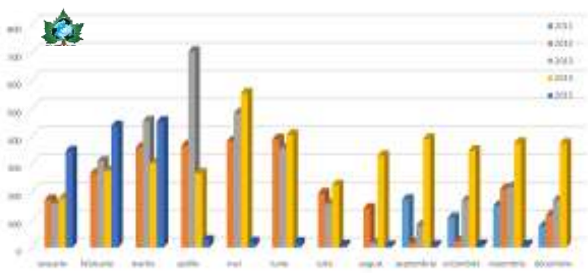

Fig. 8 - Discharges on S2

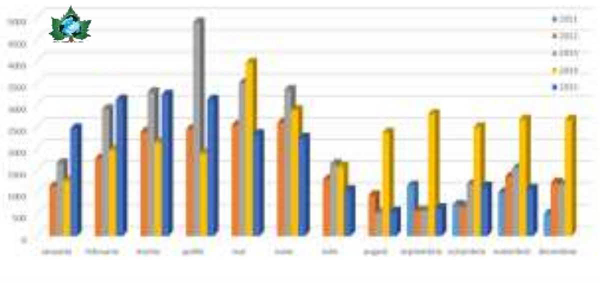

Fig 9 - Discharges on S3

In the following figures, it can be seen the water velocity distribution for April 2012, 2013, 2014 and 2015, in section 2 of the Epurasu branch.

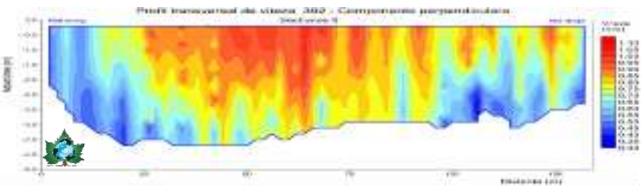

Figure 10. Velocity – April 2012

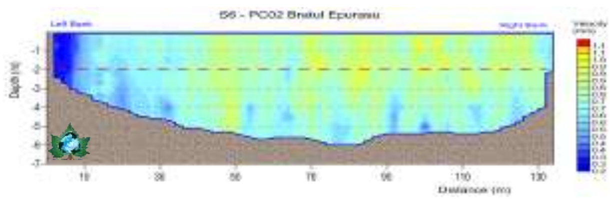

Figure 11. Velocity – April 2013

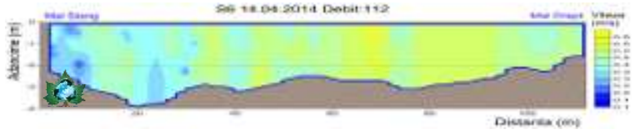

Figure 12. Velocity – April 2014

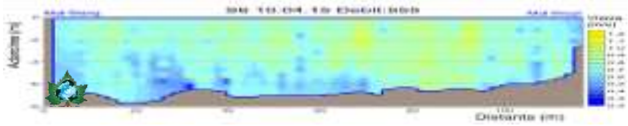

Figure 13. Velocity – 2015

During the construction period on the Epurasu branch, several campaigns of multi-beam bathymetric measurements were carried out, but the low water level during these measurements did not allow measurements to be performed in the Epuraşu bay and branch. The results obtained from the processing of these measurements combined with the single-beam measurements allowed us to continuously update the bathymetric model in the Epurasu branch.

The multibeam measurements achieved in May 2015 in the bay area behind the Epuraşu discharge led to a 3D model of this area (fig. 14).

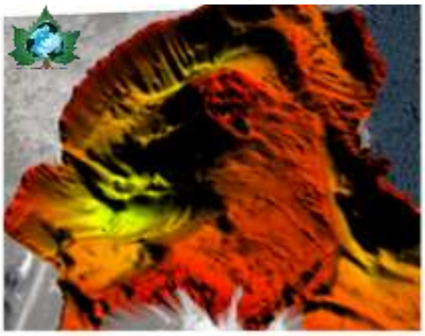

Fig. 14 - 3D detail of the area in Epurasu Bay May 2015

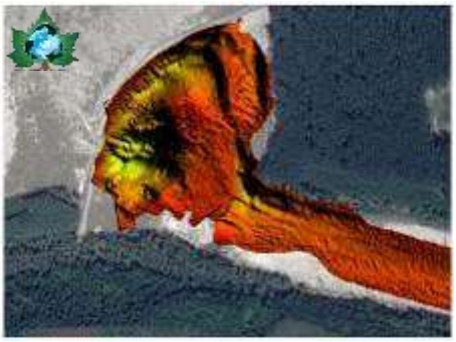

Fig. 15 - Bathymetric measured area June 2015

Figure 15 shows the areas covered by the multi-beam measurements of June 2015 behind the routing dam and the entrance to the Epurasu branch.

CONCLUSIONS

Regarding discharges in the three sections monitored during the construction period, there was a general trend characterized by relatively medium monthly average debits, especially in April, May and June in the years 2013 and 2015, the lowest discharges being recorded in December 2011.

The ADCP measurements of water flow velocities, measured during the construction period months, were processed on the characteristic cross sections, obtaining - from the raw data recorded using this technique - distributions of vector size the flow rate, both the total horizontal, as well as on the main component (in the Danube flow direction) for the respective cross-sections. For the three monitoring sections, the characteristic cross-sectional profiles with the gear distribution are presented, profiles that highlight the variations in water velocity for each section. depending on the depth and distance from the shores. During the construction period, a multitude of single-beam bathymetric measurements were performed. These measurements have led to a continuous updating of bathymetry in areas with high dynamics of deposition/erosion processes at riverbed level, and, on the other hand, gaps in areas of interest, particularly in areas where all or part of the hydrotechnical works are carried out.

These measurements allowed a detailed analysis of the riverbed changes; so, the configuration of the submersible dam as well as the Epurasu branch were analysed.

ACKNOWLEDGEMENT

The results presented in this paper were obtained thanks to the research conducted by INCDPM in the development of the project entitled: 'Monitoring the environmental impact of works regarding the improving of the navigation conditions on the Danube River between Calarasi and Braila, km 375–175' financed by national and European funds (2011 – present).

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THEORETICAL ASPECTS REGARDING THE PREPARATION PROCESS OF HARD DOUGH PRODUCTS
/
ASPECTE TEORETICE PRIVIND PROCESUL DE FABRICARE A PRODUSELOR PE BAZĂ DE ALUAT TARE

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***Keywords:** hard dough preparation, rheology models, rheological behavior.*

ABSTRACT

Wheat flour is one of the most important food materials worldwide. Huge amounts of bakery products including bread, pasta, noodles, cakes, biscuits and pastries are consumed by people every day. Dough is a multicomponent system composed mainly of proteins, lipids, carbohydrates, water and air. The fermentation process begins at the time of products kneading and continues with the subsequent technological operations and the first part of baking. In practice, through fermenting the dough is understood the fermentation period from kneading to division. The basic step in breadmaking is combining water with wheat flour and then kneading the mixture to form viscoelastic dough. Rheological properties of dough are very important in bread baking quality. Knowledge of the rheological behavior of bread dough is very important to understand mechanical properties of the dough and control finished products.

The purpose of this paper was to present two models used to predicate dough rheology such as Maxwell and Kelvin-Voigt and also Large Amplitude Oscillatory Shear (LAOS) Test mode.

REZUMAT

Făina de grâu este una dintre cele mai importante produse alimentare din întreaga lume. Cantități mari de produse de panificație cum sunt: painea, pastele, fideaua, prăjiturile, biscuiții și produsele de patiserie sunt consumate de oameni în fiecare zi. Aluatul este un sistem multicomponent alcătuit în principal din protein, lipide, carbohidrați, apă și aer. Procesul de fermentare începe din momentul frământării semifabricatelor şi continuă cu operaţiile tehnologice ulterioare dar şi cu prima parte a coacerii. În practică, prin fermentarea aluatului se intelege perioada de fermentare din momentul frământării până la divizare. Etapa de bază în obţinerea pâinii este combinarea apei cu făina de grâu și apoi frământarea amestecului pentru a forma aluatul viscoelastic. Proprietățile reologice ale aluatului sunt foarte importante în ceea ce privește calitatea pâinii. Cunoașterea comportamentului reologic al aluatului de pâine este foarte importantă pentru a înțelege proprietățile mecanice ale aluatului și a produselor finite.

În lucrarea de față sunt prezentate două dintre cele mai utilizate modele de predicție a proprietăților reologice ale aluatului, precum și testul de forfecare la amplitudine mare (Large Amplitude Oscillatory Shear - LAOS Test mode.

INTRODUCTION

Wheat is one of the most important crops in the world with total annual yields exceeding 680 million tons. The fundamental basis of wheat flour utilization is its unique property of forming dough and developing hydrated gluten protein network when it is mixed with water *(Tomoskozi et al., 2016)*. Dough formation is the process in which flour, wate,. Yeast, salt and other ingredients are mixed and kneaded to result in a solid but viscoelastic dough.

In the last period, several characteristics and measuring systems were developed in order know the baking performance and the dough properties. Bread properties mostly comprise bread volume, crumb texture and also the sensorial attributes (*Tietze et al,. 2016*).

In cereal science, rheometers have been intensively used to study the behavior of dough at certain stress states. Dough rheology plays a key role in breadmaking, cookie and frozen dough production. This includes unit operations such as sheeting, extrusion and mixing. Rheological behavior of dough is important in design and modification and also scale-up of unit operations (*Dhanasekharan et al.,1990*). In classical dough evaluation, empirical rheological methods are widely used for characterization. In these methods, shear, compression and extension as the basic types of deformation occur simultaneously (*Charalambides et al. 2006*).

The rheological properties of the dough, respectively the properties of the mechanical structure are: elasticity, viscosity, plasticity and relaxation time. Elasticity consists in the fact that the dough behaves like an elastic body, deforming reversibly when the force to which it is subjected does not exceed a certain value. When the value of this force exceeds a certain limit, the deformation of the dough becomes irreversible entering in the plastic deformation field. *(Leonte M., 2011).* In figure 1 are presented Maxwell and Kelvin-Voigt viscoelasticity models. Rheological properties of dough and gluten during mixing are affected greatly by the flour composition (low or high protein content), processing parameters (mixing time, energy, temperature) and ingredients (water, salt, yeast, fats and emulsifiers) (*Abang Zaidel et al., 2010*).

Storage modulus (G') and loss modulus (G") can describe materials rheological properties and are described according to eq. 1 *(Mirsaeedghazi et al.. 2008):*

$$G' = \frac{\sigma_0 \cos\theta}{\gamma_0} \quad G'' = \frac{\sigma_0 \sin\theta}{\gamma_0} \quad tg\delta = \frac{G''}{G'} \tag{1}$$

Viscoelastic behavior of dough is attributed to gluten protein *(Shiau et al. 2001)*. Greater amounts of protein in water starch-gluten system causes greater G' and lower G". The storage modulus can be used as a measure of the elastic component of the sample and similarly, the loss modulus- the viscous component of the sample.

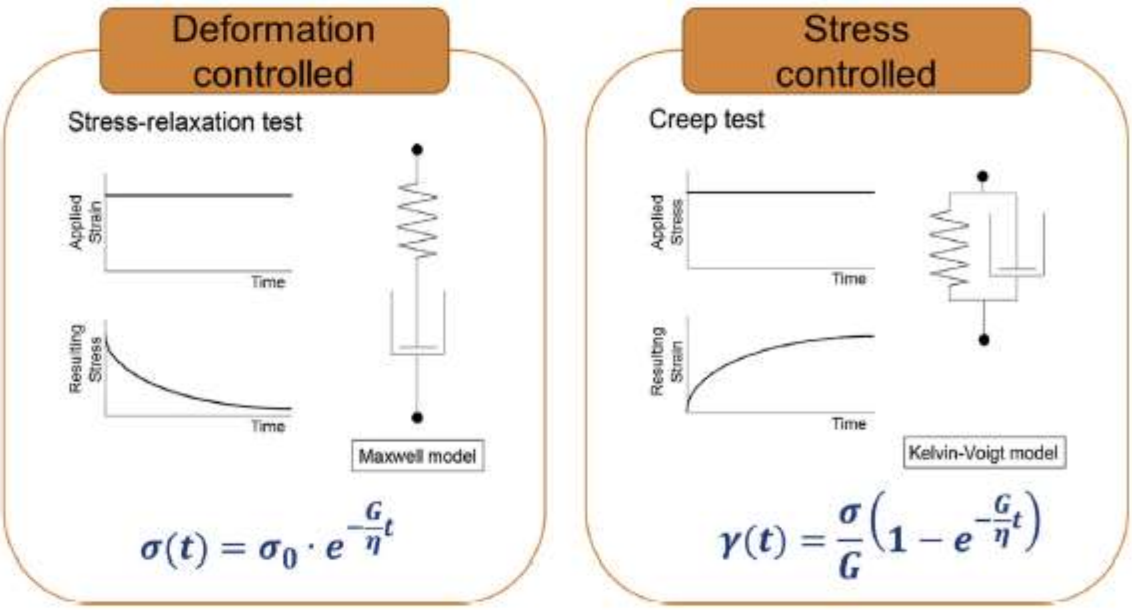

Fig.1 - Maxwell (left) and Kelvin-Voigt model (right) in viscoelasticity (γ – strain, σ – stress, G - shear modulus) *(Tietze et al.. 2016)*

There are many models to predicate dough rheology: power low, linear Maxwell model, Lethersich's model, Peleg's and Kelvin-Voigt model. In this paper, two of these models such as Maxwell and Kelvin-Voigt were presented and also Large Amplitude Oscillatory Shear (LAOS) Test mode.

MATERIAL AND METHOD

Over the years, the rheology in cereal research and in the bakery industry has gained an important significance. It is well known that when dough rheology characteristics are altered, dough processing and end product quality can be also affected *(Ktenioudaki et al., 2013).*Knowledge of the rheological behavior of bread dough is very important to understand mechanical properties of the dough and control finished products.

Dough is a viscoelastic and shear thinning material combined of Hookean solid and non-Newtonian viscous liquid. Dough has non-linear rheological behavior, but in very low strains has linear behaviour. The amount of low strain in which dough has linear behaviour depends on the type of dough, mixing and testing method *(Mirsaeedghazi et al., 2008)*.

RESULTS

Used instruments in dough rheology measurements must be capable of measuring both viscous and elastic properties of dough due to its viscoelastic behavior. One of the useful tests is Large Amplitude Oscillatory Shear (LAOS).

Yazar et al. studied the nonlinear rheological properties of hard wheat flour dough as a function of mixing time in a Brabender Farinograph. They measured the non-linear rheological properties of the dough samples with a DHR-3 Rheometer using the Large Amplitude Oscillatory Shear (LAOS) Test mode. The measurements were carried out at 25 °C using frequencies of 0.1, 1, 10, 20 rad/sec. The authors reported that at a strain of 0.01% and a frequency level of 0.1 rad/sec, the dough sample from the 1st phase of mixing had the lowest G' value whereas the dough samples from the 3rd and the 4th phases of mixing had similar and highest G' values (fig. 1). The elastic component is accounted as the storage modulus (G') and the viscous component is measured as the loss modulus (G"). LAOS data can also be useful in terms of adjusting formulations, process parameters: time required for mixing or fermentation temperature for bakery products (*Yazar. et al., 2016*).

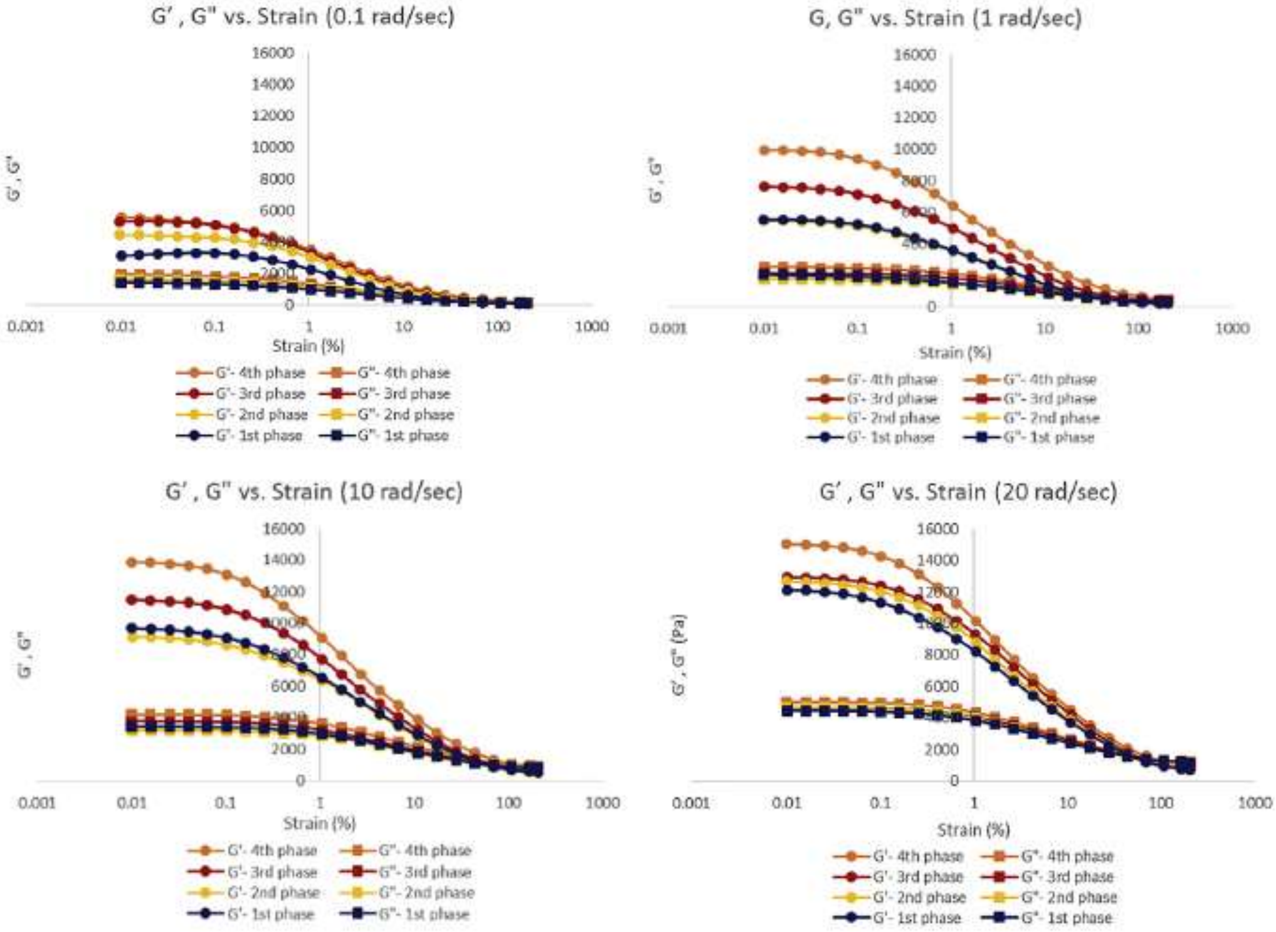

Fig.2 - G values of hard dough samples (*Yazar et al.. 2016)*

CONCLUSIONS

In the last period, the field of rheology has seen a wider application in the food industry, although it is a complex concept and food systems possess non-ideal characteristics. Nevertheless, the rheological behaviour of foods is able to be determined using various techniques and equipment. Studies on rheological properties related to dough and gluten are often challenging due to its variance in nature and high dependence on many factors.

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APPLICATION OF NANOMATERIALS IN WASTEWATER TREATMENT- REVIEW / UTILIZAREA NANOMATERIALELOR IN EPURAREA APELOR UZATE REVIEW

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Keywords: *nanotechnology, polymeric membranes, wastewater, graphene, heavy metals, water treatment, nanomembranes.*

ABSTRACT

Water pollution is an important issue worldwide, considering that water is a valuable, renewable, but limited resource. At his moment. the technology has various methods of treating polluted water, represented by both conventional and unconventional cleaning processes. This paper describes current and unconventional methods, new technologies that are applicable to wastewater treatment. The removal of contaminants represented by heavy metal ions has been and is one of the greatest challenges in this sector. Thus, studies have focused on the implementation of nanomaterials for the purpose of disposal of heavy metal ions in industrial wastewater. This review highlights some of the most widely used nanomaterials, currently in the laboratory research stage, wishing to continue the studies with a view to their widespread deployment.

REZUMAT

Poluarea apei reprezinta o problematica importanta la nivel mondial. tinand cont de faptul ca apa este o resursa pretioasa, regenerabila, dar limitata. In prezent, tehnologia dispune de diverse metode de tratare a apelor poluate, reprezentate atat de procedeele de epurare clasica, cat si de cele neconventionale. Lucrarea de fata expune metodele actuale si neconventionale, noi tehnologii ce isi gasesc aplicabilitate in domeniul epurarii apelor uzate. Eliminarea contaminantilor reprezentati de ionii de metale grele a fost si este una dintre cele mai mari provocari in acest sector. Astfel. studiile s-au indreptat spre implementarea nanomaterialelor in scopul eliminarii ionilor de metale grele din apele uzate industriale. Acest review pune in evidenta unele dintre cele mai utilizate nanomateriale, care in prezent se afla in stadiul de cercetare in laborator. dorindu-se continuarea studiilor, in scopul implementarii acestora la scara larga.

INTRODUCTION

A contemporary problem is represented by the continuous and alarming degradation of the natural environment, which is due to the strong industrialization, the increase of the population and the needs of the modern society. Environmental degradation occurs because self-regulating and self-purifying mechanisms cannot neutralize the enormous amounts of waste resulted from human activities, thus affecting the quality and characteristics of environmental factors (air, water, soil, flora, fauna), causing the pollution. Because pollution is not a specific phenomenon due to the close link between environmental factors and ecosystems, pollution is a global phenomenon that damages the entire natural environment.

Unlike the atmosphere, which acts as a dispersing factor for pollutants, water has the characteristics of a pollutant concentration factor. Pollutants can reach the surface water by discharging effluents from sewers (phenomena called primary water pollution), or they can reach surface water or groundwater under the action of precipitation in the form of drafts or floods, or through infiltration (phenomena called secondary water pollution). Certain pollutants in water affect the development of specific aquatic flora and fauna and often they get concentrated in aquatic organisms.

Therefore, the use of polluted waters for the direct consumption of humans and animals, the inclusion in the food cycle of products from polluted waters, the use of polluted waters for irrigation of agricultural crops can have multiple negative effects on human's health. Due to the water cycle, pollutants from freshwater (river water) are transported and discharged into the sea and oceans, which are considered “waste tanks”. Waste accumulated in seas and oceans has a detrimental impact on marine flora and fauna, with particularly dangerous consequences for the environment and human health, such as: the imbalance of oxygen intake of marine phytoplankton, the consumption of marine infected products. etc.

1. Classic water treatment technologies

Wastewater treatment involves the use of a process that has the purpose of retaining and /or neutralizing toxic or harmful substances present in industrial or domestic wastewater, which can be found in dissolved, colloidal or suspended form, seeking to improve the quality of the water that will be discharged into the emissary, without damaging the flora and fauna. Depending on the characteristics of the wastewater and the type of pollutants that are present in it, the water can be treated in mechanical-chemical treatment plants when the wastewater is loaded with inorganic pollutants or mechanical-biological treatment plants, when the wastewater is loaded with organic pollutants, the last one being a specific characterization for domestic and urban wastewater (Gavrila, 2002).

Depending on the type of process underlying water purification, the process of wastewater treatment can be distinguished such as: mechanical treatment, biological treatment and chemical treatment (Chiriac, 1966).

In most cases, domestic wastewater treatment plants are designed in three process steps with a mechanical-biological structure, where a chemical, tertiary step is added in order to improve the treatment process. Due to high level of pollutants present in wastewater, nowadays, the mechanical-biological treatment plants are not efficient enough, thereby is necessary to use an advance fourth treatment which can provide through many different methods and procedures both the advanced disposal from the wastewater of solid suspensions and organic matter, as well as the elimination of hardly biodegradable substances and toxic substances from the wastewater, achieving higher degrees of high purification values (Moore, 1991).

Being an economically convenient solution as well as from the point of view of the efficiency of water purification and quality, mechanical-biological wastewater treatment plants are the most widespread. In most cases, a fourth treatment step (chemical step) is added, that aims to achieve through many processes like chlorination, the disinfection of the wastewater. The solution is effective in domestic wastewater resulting high purity, no harmful or toxic substances in treated water.

2. Advanced and unconventional industrial water purification technologies

The industrial technological process requires an essential knowledge of the qualitative peculiarities and the origin of the wastewater for an optimal implementation of the wastewater treatment plants. Organic substances (expressed as BOD), such as toxic substances, suspended substances and inorganic substances such as heavy metals, are the main industrial pollutants. There are two types of wastewater: industrial wastewater and domestic wastewater. So, in order to recover the valuable substances from these waters, it is necessary to reduce the evacuated harmful substances.

The toxic action and rapid development of algae is caused by heavy metals (Pb, Cu, Zn, Cr) which can produce a direct effect on aquatic organisms and also reduce self-purification processes, BOD and COD, and also nitrogen and phosphorus (nutrients). In recent years, new toxic substances (phytopharmaceuticals, nitro chlorobenzene, etc.) have increasingly been used in industrial technological processes. Pollutants need to be transformed into substances that are easier to separate, such as insoluble precipitations, thus achieving less toxic substances, due to chemical treatment processes.

In the industrial sector, the main purpose of controlling water pollution is to reduce as much as possible the concentration of toxic contaminants, namely heavy metals. The use of heavy metals for the finishing of metallic materials takes place in various industrial processes and the treatment of the fluences must be carried out before the water evacuation (Petrescu, 2009).

Conventional treatments, such as chemical precipitation or flotation, can be one of the solutions by which heavy metals are removed from the inorganic effluent, although each treatment has its inherent limitations. Lately, the alternative treatment in this process is adsorption (Petrescu, 2009).

Heavy metals are non-biodegradable and persistent toxic pollutants with a strong bioaccumulation tendency in different elements of bicenosis (plants, organisms) or with accumulation in different elements of the biotope (soil, deposits from rivers and lakes) (Petrescu, 2009).

A necessary consideration is the removal of metal ions from the source of pollution prior to the discharge of wastewater into surface water or to the soil, because the decontamination of contaminated ecosystem components (soils and water sources) is a difficult and long-lasting process (Petrescu, 2009).

1.1. Nanotechnology and nanoadsorbents in industrial wastewater treatment

According to recent studies, nanotechnology has applications in vast areas such as: pharmaceutical industry, chemical industry, environmental protection, information and communication, heavy industry, energy, as well as cosmetics and the textile industry (Sadanand, 2017).

In the field of water treatment, nanotechnology has a high applicability and efficiency for both organic pollutants and inorganic pollutants such as heavy metals, nanoadsorbents presenting a variety of applications in the field of engineering, being biocompatible adsorbents with a high specific surface area and low intramolecular resistance (Sadanand, 2017).

Nanomaterials are typically defined as materials with pores dimensions less than 100 nm in at least one dimension, with increased selectivity. specific surface area and high permeability, good mechanical stability and thermal resistance (Sadanand, 2017). At this scale, materials often have properties dependent on new dimensions, different from their large counterparts, many of which have been explored for applications in water treatment and wastewater treatment. Some of these applications use properties dependent on scalable nanomaterials that relate to high specific surface area, rapid dissolution, high reactivity and strong adsorption.

One can take advantage of their discontinuous properties, such as superparamagnetism and the quantum confinement effect. These applications are discussed below on the basis of the nanomaterial functions in the unit's operating processes, these being still at the stage of laboratory research (Melita, Gumrah & Amareanu. 2014).

Adsorbents and membranes are two of the most important technologies applicable to water treatment and purification. Since classical adsorbents have low selective permeability and short adsorption-regeneration cycles, recent studies have focused on large-scale research and deployment of nanomaterials in water treatment and purification (Zhang et al., 2016).

Nanoadsorbents can be easily integrated into existing treatment processes as adsorbents. Apply as a powder in decanters, nanoadsorbents can be extremely effective because all surfaces of the adsorbent are used and the mixing process of the adsorbents greatly facilitates the mass transfer. However, an additional separation unit is required to recover the nanoparticles. Nanoadsorbents can also be used as liquid or fluidized adsorbents in the form of granules/pearls or porous granules loaded with nanoadsorbents. Fixed bed reactors are typically associated with mass transfer limits, but do not require separation in the future (Melita, Gumrah & Amareanu, 2014).

MATERIAL AND METHODS

1. Materials

Nanomaterials based on the adsorption of organic and inorganic compounds in wastewater, such as *carbon nanotubes*, have enjoyed great popularity due to their adsorption properties of heavy metals, but also organic compounds such as aromatic polycyclic hydrocarbons, phenols and phenol compounds, endocrine disruptors and antibiotics present in aqueous solutions. Studies have shown that the yield of these materials can be improved with the modification of specific surfaces.

Methods for changing/modifying the specific surfaces include oxidation, chemical grafting and physical alterations such as impregnation and addition of new layers. There was a similarity between the adsorption mechanism of carbon nanotubes and graphene, which involved electrostatic interstices, covalent bonds, hydrogen bonding, π-π interactions, hydrophobic properties and Van der Waals forces (Zhang et al., 2016).

Recent studies show a promising future for nanotubes with a yield of about 99% adsorption of unwanted compounds in wastewate, which encourages their large-scale deployment.

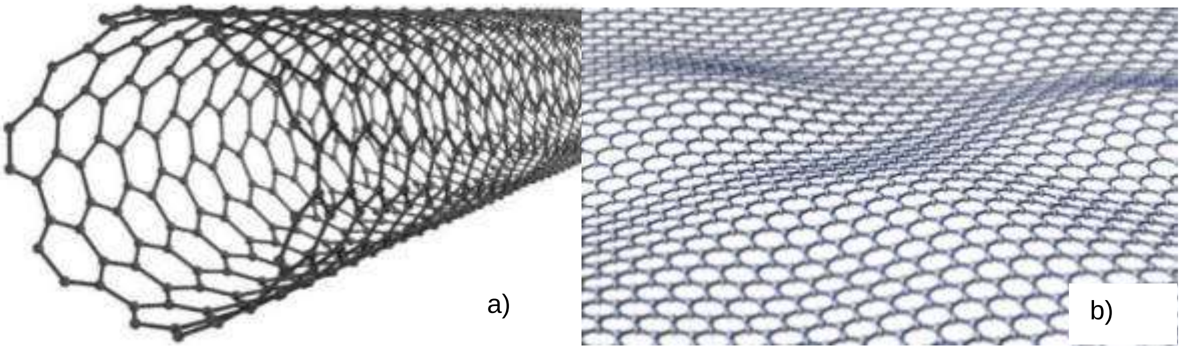

Fig. 1 - Structure of carbon based nanomaterials
a) - Carbon nanotubes; b) - Graphene

Another carbon-based nanomaterial that has a particular impact on water treatment is *graphene*. With mechanical adsorption properties similar to carbon nanotubes, this material exhibits properties that distinguish it from other materials, having a structure consisting of hybrid carbon atoms bonded together in the form of a hexagon, forming a two-dimensional layer (Hayyan, Abo-Hamad, AlSaadi. & Hashim, 2015). having the properties of a good thermal and electric conductor (Zhang et al., 2016). It can also be found in the form of graphene oxide (GO), a monolayer with a strong oxidizing form with a wide variety of oxidizing groups such as hydroxyl, carboxyl, carbonyl and epoxy groups. Also, the graphite can be found in the form of reduced graphene oxide (GFO), which is a less efficient material with lower conductivity but can be easily modified by other functional groups. Due to the properties of this material to adsorb heavy metals such as Pb (II), Zn (II), Cu (II), Cd (II), Hg (II) and As (III / V), it has been recognized as a valuable adsorbent in the treatment of wastewater loaded with heavy metal ions (Wang et al., 2013).

The performance of *membrane systems* is largely determined by *membrane* material. Incorporating functional nanomaterials into membranes offers a great opportunity to improve membrane permeability, resistance to clogging and stability (Loosdrecht, Per H. Nielsen. & Brdjanovic, 2016).

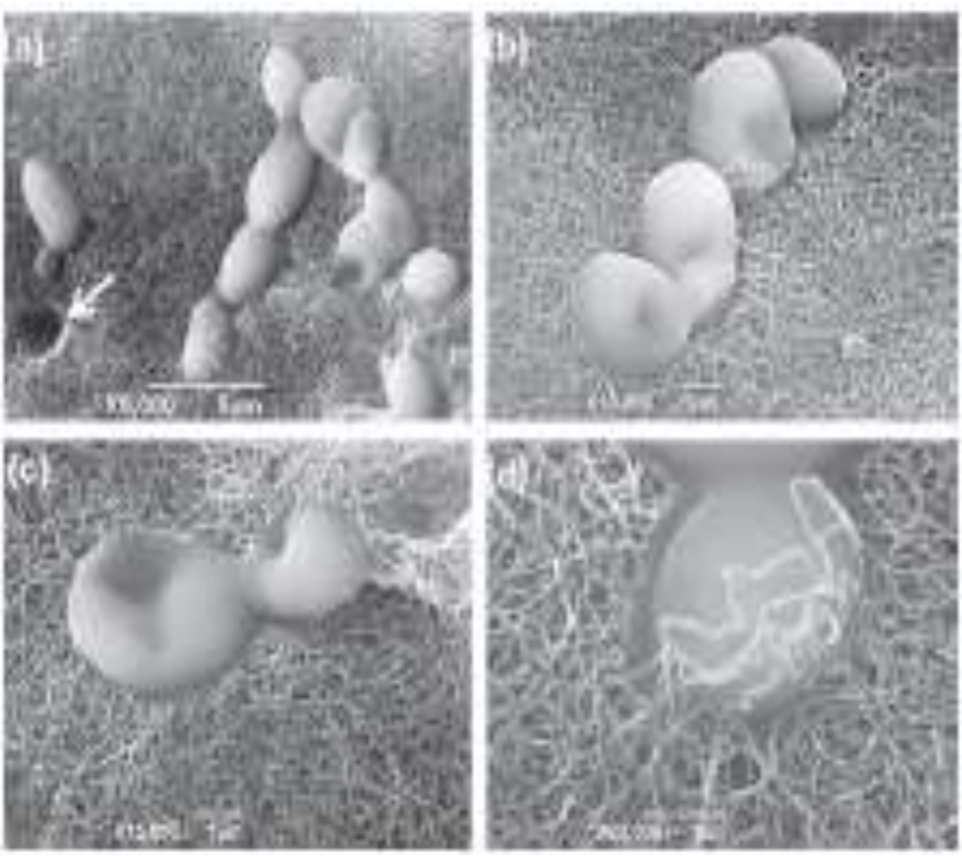

Fig. 2 - Electronic Yeast Cell Micrographs Retained on a Nanomembrane Based on Carbon Nanotubes *(Bora & Dutta, 2014)*

The electrospinning is a simple, efficient and inexpensive technique to make ultrafine fibers using various materials (for example, polymers, ceramics, or even metals). The resulting membranes have a specific surface and high porosity and a pore shape complex with unique structures. Diameter, morphology, composition, secondary structure and spatial alignment of nanofibres can be easily manipulated for specific applications (Melita, Gumrah & Amareanu, 2014). The membranes can remove particles of micron size in the aqueous solution at a high rate of rejection without significant "dirt". Outstanding features and adaptable properties make nanofibers an ideal platform for building multifunctional filters (Melita, Gumrah, & Amareanu, 2014).

Fig. 3 - Modular membrane system

Metallic nanoparticles are materials that are especially used for the high efficiency that they require in removing other toxic metals, such as cadmium, chromium, arsenic, but also common pollutants (phosphate) and organic compounds. These nanomaterials are represented by metals with zero valence, such as iron. aluminum oxides, magnesium, cerium, titanium, etc. (Zhang et al., 2016). Noble metal nanoparticulates have a much greater instability in the process of synthesis and reduction of metal salts, so to increase stability, polymer surfactants and surfactants are introduced in these processes. A particular affinity of these nanoparticles of noble metals to organic substances has been discovered, but also a great ability to detect and trace pollutants due to the optical properties of gold and silver (Pradeep & Anshup, 2009).

Preservation and reuse of nanomaterials is a key aspect of nanotechnology that allowed the design in question. These can usually be accomplished by applying a device that separates or immobilizes nanomaterials in the treatment system. Thus, raw water pretreatment is usually required to reduce turbidity. Nanomaterials can also be immobilized on various platforms such as resins and membranes to avoid continuous separation. However, current immobilization techniques resulted in a significant loss of treatment efficiency. Research is needed to develop simple, low cost methods to immobilize nanomaterials without significantly affecting their performance (Melita, Gumrah & Amareanu, 2014).

2. Methods

In the wastewater sector, there are various methods and processes where nanotechnologies have an important role to play. Some of these are listed below, as follows:

- *Adsorption* is frequently used as a step in the removal of organic and inorganic impurities in water treatment and wastewater treatment. The efficiency of conventional adsorbents is usually limited by the surface or active sites, the lack of selectivity and the adsorption kinetics. Nanoadsorbents offer significant improvement with their extremely high specific surface and associated sorption sites, diffusion spacing, short pore size, tunable pore size and surface chemistry (Melita Gumrah & Amareanu, 2014). The phenomenon of adsorption is represented by the retention of the molecules of a substance on the outer surface of the granules of a body bearing the name of the adsorbent. If adsorption appears in the mass of small granules, it is called absorbance. Thus, selectivity towards certain components in solution even at low concentrations is an advantage of the adsorption process. Also, by extracting or passing a hot air flow in the reverse direction it is possible to carry out the chemical regeneration of the adsorbent material (Dima, 1972).

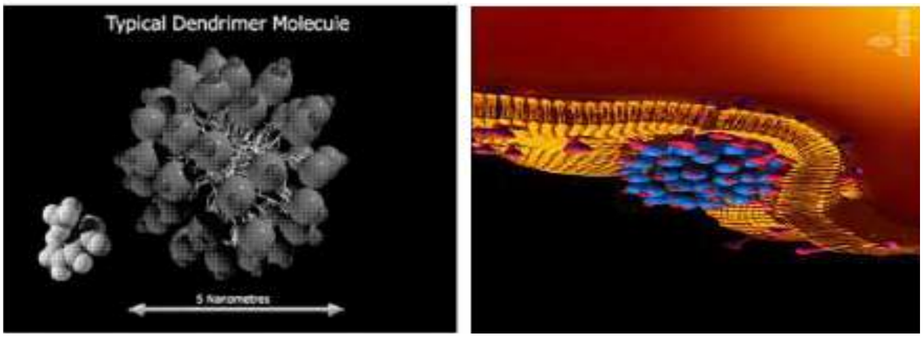

Fig. 4 - Attaching the dendrimer to several receptors on cell membranes or other biological structures, such as viruses *(Tiwari, Sen & Behari, 2008)*

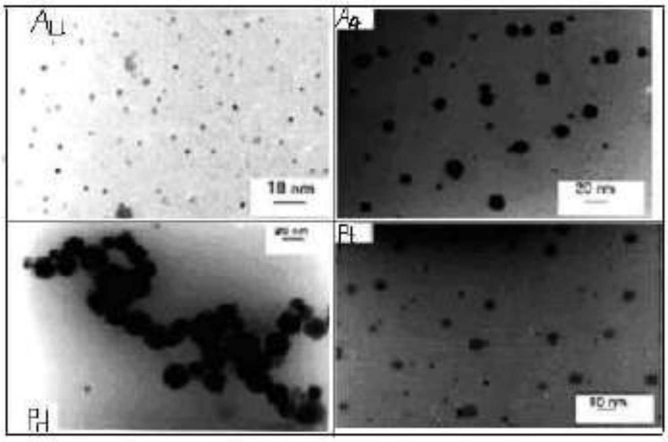

Fig. 5 - Conglomerates of metallic nanoparticles formed by fructose reduction (Tiwari, Sen & Behari. 2008)

- *Catalyst* is an advanced oxidation process that is used to remove organic and inorganic substances as well as pathogens and microbial agents. Nanocatalysts have a high specific surface area and the crystalline structure of nanosized semiconductors has a size-dependent behavior. Research has succeeded in improving nanocatalysts, making them compatible with existing photoreactor systems in technology by immobilizing nanoparticles on different substrates. Due to the high efficiency of this method of pollutant removal, research has focused on its widespread deployment (Zhang et al., 2016).
- *Disinfection* is a last step in water treatment, which aims to prevent the spread of diseases through water. Recent studies have highlighted the potential of nanomaterials, such as carbon nanomaterials, noble metal nanoparticles, in water disinfection and their antimicrobial and antibacterial properties. The process is based on the ability of these nanomaterials to release toxic metal ions, destroying microbial cell membranes. By using the appropriate process with appropriate separation technologies, certain nanomaterials can function continuously with low energy consumption with low toxicity, easy operation, process applicability becoming an excellent alternative to current methods involving the use of toxic chemicals (Zhang et al., 2016).
- *Detection* and monitoring of micro-pollutants in extremely low concentrations is impossible using current technologies implemented. Thus, in this case, nanotechnology intervenes with a saving solution. Research has shown that carbon-based nanomaterials such as graphene and nanotubes, nanoparticles of noble metals have certain optical and magnetic properties, so they can be incorporated into in-situ sensors, capable of detecting different pollutants simultaneously. Also, these nanomaterials have applicability not only in the wastewater sector, but also in other areas of environmental monitoring and pollutants (Zhang et al., 2016).

RESULTS

In the field of water purification, nanotechnology offers the possibility of efficient neutralization of pollutants and germs. Nanoparticles, nanomembranes and nanopowders used to detect and remove chemical and biological substances include metals such as cadmium, coppe, lead, mercury, nickel, zinc); nutrients (e.g. phosphates, ammonia, nitrates and nitrites), cyanide, organic, algae (e.g. cyanobacterial toxins) viruses, bacteria, parasites and antibiotics (Tiwari, Sen & Behari, 2008). Following several studies and research on nanomaterials used in the field of purification and treatment of water, promising results have been obtained in the removal of inorganic compounds.

- In order to remove arsenic As (V). As (III) (Ghosh, Poinern, Touma & Singh, 2012) used geotex nanoparticles synthesized with hydrazine sulfate. Arsenic contamination occurs due to industrial processes such as metal smelting or mining. Exposure to this metal can lead to severe kidney, lung and skin damage may cause neurological disorders, nausea, various forms of cancer, or, in extremely serious cases, the death of the individual. Thus, removing this metal from the water is essential but difficult. In order to remove the arsenic, (Ghosh, Poinern, Touma & Singh, 2012) obtained a 99% treatment efficiency of arsenic from synthetic waste water with a concentration of 50mg / l As (V) and a dose of 6g / l of nanoadsorbant with a contact of 240 minutes. The result of the research is promising in the field of wastewater treatment with arsenic ions, which encourages further studies to implement this method on a large scale.
- For the removal of copper ions (Kanthimathi, Kotteeswara, Muregasan, Manickam, & Muniasamy, 2013) used nanoFe_3O_4. yielding a 97.8% purification yield of a 1.07 g / L copper solution, having contact for 60 minutes with the nanoadsorbent. Removal of copper from water is essential because human exposure to copper leads to serious neurological problems such as demyelination, migraines, severe respiratory problems, gastrointestinal hemorrhage and collapse of the kidneys and the liver. Thus, the US EPA has established a maximum exposure dose of 50μg / L in drinking water.
- (Shan, Ma, Tong & Ni, 2015) developed a nanoadsorbent from the 1-vinylimidazole oligomer, obtaining capsulated silica magnesite nanospheres to remove mercury ions (Hg) from wastewater. The process had a yield of 94%. Research has shown that the nanomaterial can be fully recovered in approximately 5 minutes by a process involving magnetism. Studies have shown that mercury is one of the most dangerous heavy metals. both for the environment it contaminates and for humans. causing neurological, cardiac, immunological, locomotor, even genetic diseases, modifying the structure of the DNA sequence strand (Thekkudan et al., 2016).
- (Gollavelli, Chang & Ling, 2013) have synthesized magnetic grapheme, obtaining a 99% purification yield of chromium from synthetic wastewater. According to the research, the process requires an environment whose pH is 2.0 to favor the regeneration of the nanomaterial. For this purpose. 0.1 N NaOH solution was used, the process having satisfactory results. Neutralization of chromium in wastewater is essential, contamination of the body with chromium causing skin diseases and lung cancer. Mostly, the tobacco industry, paint industry and the cement industry are responsible for water contamination with chromium. Understanding these aspects, it can be concluded that the neutralization of chromium in the wastewater before discharge into the emissary is essential, both for the preservation of the normal parameters of the environmental factors, but also for the recovery of the metal for the efficient management of the raw materials (Thekkudan et al., 2016).
- For lead and cobalt, research has shown an adsorption of 92.5% for lead (Idris, Ismail, Hassan. Misran & Ngomsik, 2012) and 99.2% for cobalt, using magnetic nanoparticles (MPN) nanoFe_3O_4 (Kanthimathi, Kotteeswaran, Muregasan, Manickam & Muniasamy, 2013) . The process of neutralizing lead ions has been shown to be optimal at a pH of 5.5 and an increased temperature. basically with increasing temperature, the efficiency of the purification process increases, achieving satisfactory results in about 10 minutes. Like lead. the cobalt was neutralized from synthetic residual water in about 10 minutes of contact at a pH of 5.4 with a 2.57 g / L dose of nanoadsorbent in aqueous solution. Neutralization of these metals is essential because of the toxic effect they have on the environment as well as on human health. Heavy industry is the main culprit in the case of contamination of lead and cobalt ions and their removal from wastewater before discharge into the emissary is absolutely necessary (Thekkudan et al., 2016).

Table 1

Nanomaterial cleaning efficiency in removing heavy metal ions

Metal	Experimental Material	Wastewater treatment efficiency [%]
As (V)	Geothite nanoparticles with hydrazine sulfate	99.0
Cu(I)	NanoFe3O4	97.8
Hg(II)	Capsule silicon magnetite nanospheres	94.0
Cr(III. VI)	Magnetic graphene	99.0
Pb(II)	Magnetic nanoparticles	92.5
Co(II)	Magnetic nanoparticles	99.2

Nanomaterials can significantly influence the water purification sector in the near future, being widely exploited as highly effective adsorbents, water (photo)catalysts and disinfectants. Due to their capacities such as high adsorption capacity, rapid kinetics, specific affinity for contaminants, good photocatalytic response for a wide spectrum of light and strong antibacterial activity (Zhang et al., 2016). As discussed above, nanomaterials can be used efficiently as heavy metal adsorbents in aqueous solutions. So far, experiments have been carried out where small quantities of heavy metals have been eliminated due to their high selectivity properties and the high adsorption capacity of nanomaterials. However, one of the problems faced by this technology is the recycling of nanomaterials, namely bringing them back to their active state. Another problem faced by this technology is the lack of materials available to carry out the desorption of the nanomaterial used in the water treatment process. In order to optimize this technology, it is necessary to increase the demand for such materials on the market. Therefore, the wider implementation of such materials will enhance both the use and the economic evolution that will further support the development of this new technology (Thekkudan et al., 2016).

Research has also been carried out on the implementation of nanotechnology in ultrafiltration and reverse osmosis processes, resulting in a hybrid nanofiltration process with the characteristics of both processes mentioned above. This process can be used both for the desalination of water and for the removal of other organic and inorganic pollutants, but also viruses, bacteria and even antibiotics (Buenop, Gillerman, Gehr & Oron, 2016). Special interest was given to the use of nanofiltration (NF) instead of reverse osmosis for water recirculation systems due to reduced energy consumption, higher flow rates, while ensuring a good rejection of micropollutants. Applying NF results in the generation of a large concentrated waste stream, concentrate treatment is a major obstacle to the implementation of membrane technologies, as concentrate is usually unusable due to its high pollutant content (Azaïsa, Mendreta, Cazalsb, Petit & Brosillona, 2017).

There are four classes of nanoscale materials currently valued as functional materials for water treatment and purification, metal nanoparticles, carbon based nanomaterials, zeolites and dendrimers. Carbon nanotubes and nanofibres have also shown some positive results. Nanomaterials have a good result compared to other techniques used to treat water due to their large surface area (surface/volume ratio). Studies in this area indicate that they can be used in the future for large-scale water purification (Tiwari, Sen, & Behari, 2008).

CONCLUSIONS

Removal of heavy metals in wastewater is a rather complicated research topic. Along with the awareness of the devastating effects of heavy metal pollution on humans and the environment, various steps have been taken to determine a more effective solution to stop this phenomenon and mitigate the effects they have on the environment.

The main factors that play a decisive role in the pollution of heavy metal ion waters are the extractive industry and the steel industry. The impact of their production on the environment is devastating not only from the point of view of water pollution but also of other factors. Researches in the field of industrial water treatment are in continuous development and aim to find the optimal solution for water treatment.

The present paper highlighted the potential of experimental materials in the wastewater treatment sector. The results of the experiments are promising, which encourages further research on the use of nanomaterials in the treatment of heavy metals with heavy metal ions, but also with organic pollutants. One advantage of using nanomaterials is that they can be reused and regenerated and the heavy metal retained by them can be recovered.

The technologies presented in this article are the foundation of the sustainable development principle in this area, which promotes non harming environmental activities. Removing heavy metals from contaminated waters is a major concern because of their ability to cause a toxic hazard, affecting both flora and fauna. The use of advanced nanoengineering technologies, such as innovative technologies, the combination of surface chemistry, the fundamentals of chemical engineering and nanotechnology are becoming a point of interest in the removal of heavy metals that contaminate water. The nanoadsorbent obtained from surface engineering has proven a rapid rate of adsorption and superior adsorption efficiency over the removal of a wide range of heavy metals contaminants in wastewater. The use of these materials in water treatment has significantly improved performance characteristics such as high specific surface area, good volumetric potential, long life span, low mechanical stress level, stability under operational conditions with excellent sorption behavior, no secondary pollution, easy recovery and reuse (Thekkudan et al., 2016).

Nanoadsorption treatment processes of wastewater loaded with heavy metal ions provide the advantage of carrying out the treatment while recovering the metals, resulting a purified water. The yields obtained in the purpose of removing heavy metals using these methods support the continuation of researches in this field for the purpose of their implementation in large capacity treatment plants.

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IDENTIFICATION OF ANTHROPOGENIC FACTORS AND ASSESSMENT OF THEIR POSSIBLE IMPACT ON PRESERVATION OF STURGEON SPECIES FROM THE LOWER DANUBE
/
IDENTIFICAREA FACTORILOR ANTROPICI ȘI EVALUAREA POSIBILULUI IMPACT AL ACESTORA ASUPRA CONSERVĂRII SPECIILOR DE STURIONI DIN DUNĂREA INFERIOARĂ

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Keywords: *sturgeons, migration, hydrotechnical works, poaching.*

ABSTRACT

From the ecological, economical, social and cultural points of view, sturgeon are flagship species for Danube basin. The sturgeon population drastic decrease that occurred in the last decades draw attention of decisional factors that imposed for species' protection measures, that had not always a scientific basis. This research aims to bring an important contribution to the existing scientific knowledge at regional level and to bring novelty elements in order to facilitate the elaboration and implementation at the legislative level, of the best solutions for conservation and restoration of stocks and for the fishery communities' welfare.

REZUMAT

Sturionii sunt specii de pesti fanion pentru bazinul Dunării din punct de vedere ecologic, economic si social-cultural. Scăderea drastica a stocurilor din ultimele decade a atras atentia unor factori decizionali care au impus masuri pentru protecția speciilor ce nu au avut intotdeauna o bază științifică. Prezenta cercetare își dorește să aibe un aport important în cunostintele științifice existente la nivel regional si sa aduca elemente de noutate, astfel încât să faciliteze elaborarea și implementa la nivel legislativ a celor mai bune soluții atât pentru conservarea și refacerea stocurilor, cât si pentru bunăstarea comunităților pescărești.

INTRODUCTION

The sturgeon species natives from the lower basin of the Danube are considered to be ecologically, economically and socially culturally diverse species. In the past, according to Antipa Gr. (1909), in the Black Sea and the Danube River Basin, 6 species could be found: beluga sturgeon (***Huso-Huso***), russian sturgeon (***Acipenser gueldenstaedtii***), Stellate sturgeon (***Acipenser stellatus***), Sterlet sturgeon (***Acipenser ruthenus***), Ship sturgeon (***Acipenser nudiventris***) and Common sturgeon (***Acipenser sturio***). Today, due to the anthropogenic factors such as poaching, overfishing, hydrotechnical construction or environmental pollution, studies indicate the presence of only 4 species: beluga sturgeon (***Huso-Huso***), russian sturgeon (***Acipenser gueldenstaedtii***), Stellate sturgeon (***Acipenser stellatus***), Sterlet sturgeon (***Acipenser ruthenus***). (Deák Gy. Et al., 2013). The International Union for Conservation of Nature (IUCN) considers the first 3 species as being threatened with extinction, and the 4th one vulnerable (http://www.iucnredlist.org).

In this context, their protection has become an increasingly pressing issue in the recent decades and the decisional factors and increasingly involved. Thus, CITES convention (the Convention on International Trade in Endangered Species of Wild Fauna and Flora), an inter-governmental agreement from 1975, introduced in 1998 sturgeon species in the Annex II which regulates international trade of endangered species, this constituting a barrier to illegal trade (https://www.cites.org). Moreover, the European Union focuses its attention to environmental protection and through the accession process, Romania has assumed the responsibility to transpose and implement European legislation in all areas, including the water protection sector through the Water Framework Directive (2000/60/EC) and the Habitats Directive (92/43/EEC). The main purpose of these normes is to achieve and maintain the "good" and "very good" status of all water bodies and to preserve existing habitats and wild species, including sturgeon species, respectively.

Despite recent advances in sturgeon population's research, national knowledge remains limited, even though there is an obvious need to have detailed information regarding the sturgeon population (Lazu D. et al., 2008). One of the most challenging issues emphasized by the researchers appeared before 90's and consists of hampering sturgeon species spawning migration through the construction of Hydrotechnical constructions (Iron Gates I and II) (Reinartz R., 2002).

The perturbations were quantified by some researchers (McAllister D.E. et. al., 2001, Reinartz R.. 2002, Holcík J., 1999, Larinier M., 2001, Luca E., 2011) as consisting the interruption of longitudinal connectivity which led to blocking species migration pathways, conducting to a reduction of population and even extinction of some species, but the studies focused only on this disturbing factor without taking into account the other pressures sturgeon should face in the respective period.

Due to the fact that after 90's the sturgeon commercial fishing units from the Danube River sector from Iron gates II to the Black Sea did not report the real quantities (Lazu D. et al. 2008), together with the Non Governmental Organisations (NGO's) pressures, in 2006 The Ministry of Agriculture, Forest and Rural development and the Ministry of Environment and Water Management issued a joint order (262/330) regarding the conservation of sturgeon populations in natural waters and the development of sturgeon aquaculture in Romania published in the Official Monitor of Romania Part I, no. 385/4, May 2006. The order introduced banning of commercial fishing of sturgeon species for a period of 10 years, as well as the marketing of products and by-products obtained from sturgeon captured in Romania. In 2016, this prohibition was prolonged for another 5 years.

This measure was not the only one adopted by the Romanian Government, because it was proved not being enough for natural restore of sturgeon population, as poaching phenomenon expands in a worrying way. Thus, during 2006-2009 was performed a restocking action with 432.898 sturgeon juveniles, but due to the uncertainties regarding its efficiency the action was interrupted. Moreover, in 2013 was signed a partnership agreement between Dunarea de Jos University, the National Agency for Fisheries and Aquaculture (ANPA) and the National Institute for Research and Development in Environmental protection Bucharest (INCDPM) for the project "Evaluation of the survival and migration to Black Sea of the juveniles form critically endangered sturgeon species which were released in the Lower Danube River (2013-2015)".

Thus, this paper aims to present the results draw by this action processed based on the experience and the unique database regarding sturgeon species from Lower Danube River of INCDPM gathered during 2011-2016, in order to facilitate the development and implementation of conservation, rehabilitation and restoration measures, based on scientific research and on optimisation to the real needs.

MATERIALS AND METHODS

In order to identify anthropogenic factors and to assess their possible impact on sturgeon species preservation in Lower Danube was performed sturgeon continuous monitoring using the Acoustic telemetry, on the river sector comprised between km 633 and the confluence with the Black Sea on all three branches: Chilia, Sulina and Sf. Gheorghe.

The implied equipment consists in placing submersible reception stations along the river sector presented in fig.1 and surgically inserting acoustic tags that emit on the frequency of 069 kHz in each in the abdominal cavity of each monitored specimen, so that after its release to gather information regarding migration routes and periods, swimming depth, water velocity when it swam, but not only.

The VR2W reception stations have a battery life of 18 months and the electronic equipment is protected by a shockproof plastic case that may resist at depths of up to 500 m. Each station has a unique recognition series printed on the case in order to be recognised by the software, so that after downloading data and entering it into the database can easily be recognized the area where it comes from. Considering the necessity to place these monitoring stations in fixed submerse locations, the INCDPM team of experts developed, implemented and patented two systems that allow easy installation and unloading data, as well as eliminate the risks associated to equipment loss due to strong floods or sediment transport until some areas of river are clogging (Fig.1).

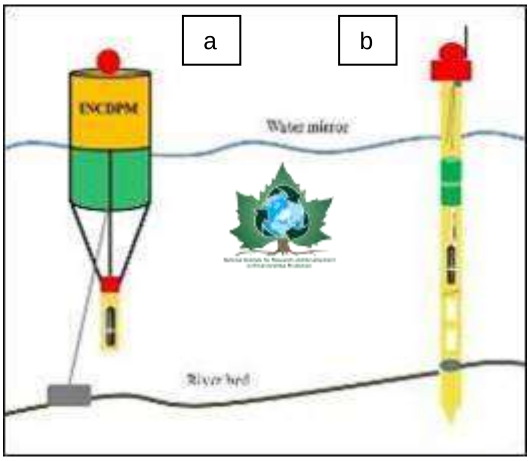

Fig.1 – DKMR-01T monitoring system (a) and DKTB monitoring system (b)

The systems were mounted in strategically chosen locations, taking into consideration the specific requirements of the projects implemented during 2011-2016,l that had a wide spread along the river sector used by sturgeon species for migration from the Black Sea until Iron Gates (fig.2).

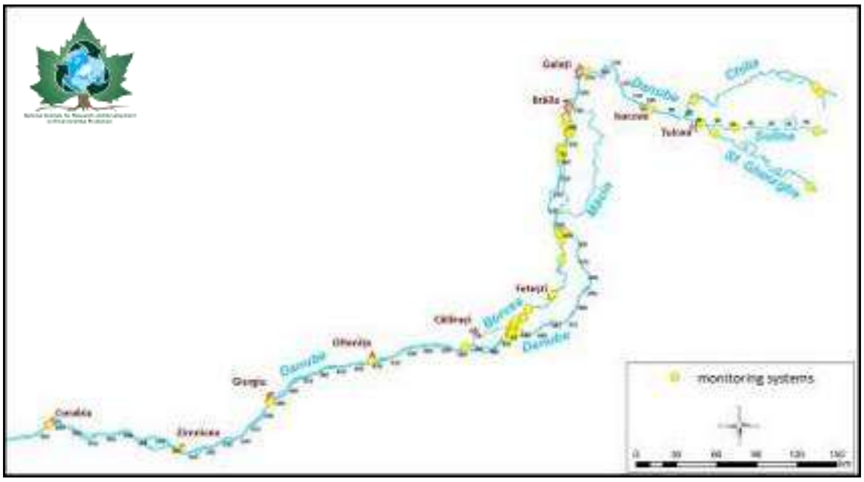

Fig.2 – Distribution of the sturgeon monitoring systems locations along the Lower Danube River

According to fish weight and the monitoring season, were implanted V9. V13TP and V16TP ultrasonic tags to the sturgeon specimens. The V13TP and V16TP tags had the advantage of using two sensors: one for swimming depth (useful in determination of swimming behaviour) and one for water temperature (used for confirmation of migration periods).

The autonomy of tags batteries is comprised between 2 and 10 years and was established taking into account the objectives of the projects. All tags were individual coded in order to establish the migration routes for each sturgeon specimen.

RESULTS

The first anthropogenic factor with potential negative impact on sturgeon species studied in this paper is hydrotechnical works performed on Danube River's Bala branch. On its upper end, at the confluence with Old Danube (km 345), was performed during 2011-2016 a bottom sill with the purpose of redistributing the water flow sharing in benefit of Old Danube for ensuring a minimum safety level for navigability in dry periods.

Raising the riverbed implied higher water flows fact that could have hampered the sturgeon swimming to upstream breeding habitats of this area, with a direct impact on sturgeon stocks, similar to the one of Iron Gates.

In almost 6 years of intensive monitoring of sturgeon species from Lower Danube River, were captured for tagging 280 adults wild sturgeon specimens from 3 anadromous species (beluga, stellate and russian sturgeon) and were released in the same area.

The results showed new issues, some of them unknowable so far. Thus, in the bottom sill area, was noticed that at the construction period end, medium water velocity on the cross section above the construction exceeds 2m/s throughout the year, with maximum speeds in certain locations of 3-3.5 m/s. Even though, it was shown that specimens from all three migratory species crossed the hydro-technical area during migration, but was not possible to establish a swimming capacity/ behaviour of the species (if during swimming they have overcome such high water velocities or if they chose some areas where water velocity was decreased by the immense blocks of stone place irregularly for the construction of the bottom sill).

So far, the investigations have not shown that this hydrotechnical work could have a negative impact on sturgeon migration.

Regarding the sturgeon migration routes, the results showed that beluga specimens migrate mostly on Borcea Branch (fig.3), most of the captures took place upstream km 30 (almost 82% of the total). This fact may be explained by the fact that in the respective area are traditional fish nets and riverbed configuration allows a higher fishing efficiency, even though is performed only in scientific purposes. The migration behaviour showed that only 16% of the total number of tagged beluga sturgeon specimens migrated upstream km 350 of Old Danube for reproduction.

The stellate sturgeon showed total different behaviour: only 87% of the specimens were captured upstream km 30 of Bala Branch and only 2% migrated upstream the km 350 of Old Danube (fig.4). These results may lead us to the conclusion that stellate sturgeon do not migrate upstream the km 350 on Old Danube, observation that is in accordance with other studies (Bacalbasa-Dobrovici, 1995) that revealed that stellate sturgeon usually migrates in the sandy area of Calarasi, therefore the conservation measures should be applied downstream km 350 of Old Danube.

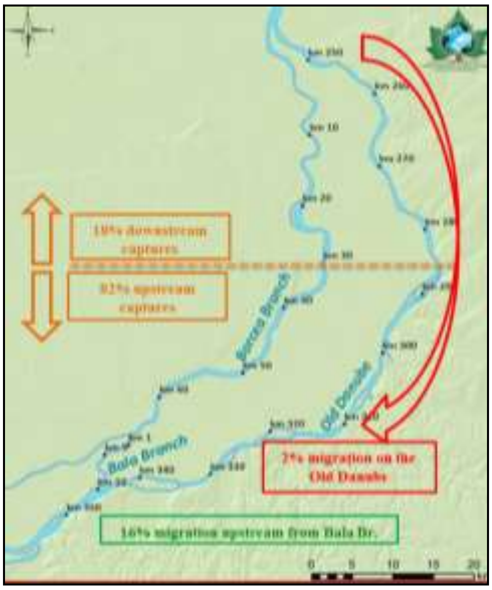

Fig.3 - Migration of the beluga species on Borcea-Bala-Old Danube Branches

Fig.4 - Migration of the stellate species on Borcea-Bala-Old Danube Branches

The second anthropogenic factor studied was the construction of Iron Gates I and II. Starting from the fact that the migratory species of beluga and stellate sturgeon do not usually migrate in the area upstream km 350 of Old Danube, was performed an analysis of the results published by Otel (2007) regarding the captures performed in Romania during 1920-2005, in order to establish if the sturgeon population decrease was totally due to the Iron Gates construction.

Thus, if on Middle and Upper Danube the migratory sturgeon species entirely disappeared due to migration blocking (Hensel K. & Holčik J., 1997), the results presented by Otel (2007) do not clearly indicate a decrease in sturgeon captures along on Lower Danube River after completion of Iron Gates hydrotechnical works. It is also not shown a sudden increase of sturgeon catches as a result of clustering in the nearby of the construction, as observed in other areas: Case of *Acipenser brevirostrum* species migration which was blocked by the Pinopolis dam from the Cooper River, South Carolina, thus the specimens remained in the dam area up to 89 days and the forced spawning had a very low survival rate (Kerr. S. J. et.al., 2011).

The results presented by Otel show rather over exploitation of sturgeon stocks which led to a drastic decrease in catches from the early 50s (fig.5). This observation is somewhat sustained by Niculescu Duvaz (1959) which states that "*Marine acipenserides, being endangered species, show a significant decrease especially in the Danube basin. Knowing in detail their migrations is not intended to assist in the industrial fishing, but, in particular, is designed to establish as rigorous as possible measures of protection, multiplication and repopulation by artificial means".*

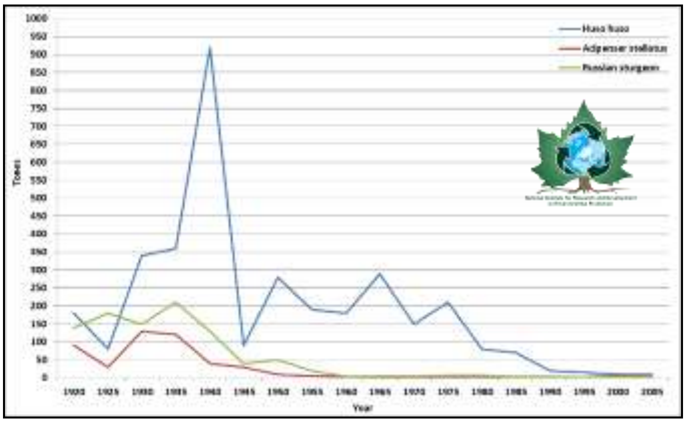

Fig.5 - The captures of sturgeon from Romania by species 1920-2005 (after Otel V. 2007)

After banning commercial fishing in 2006, an acute problem faced by sturgeons and detected by the research team during 2011-2016 is the phenomenon of poaching. Thus, it was observed that from the total of migratory sturgeons anadroms captured and tagged with ultrasonic tags to monitor spawning migration no less than 53.7% represented losses due to poaching. Most of the poached specimens were of the stellate sturgeon, with losses of 38.7%, followed by beluga with 13.8% and Russian sturgeon 1.2%. The phenomenon has spread throughout the lower course of the Danube and is practiced in all riparian countries. The poaching presence was determinate for the first time after the identification of an ultrasonic tag in a plastic bottle floating on the Danube. This was possible with the help of a mobile device for tag identification and tracking. Then there were specimens handed over by the police, confiscated from poachers or identification actions of some sacrificed sturgeons.

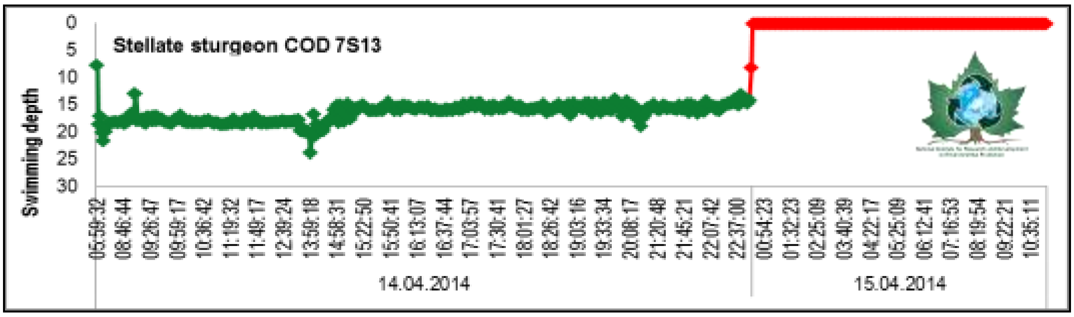

Fig.6 - Determination of poaching through the swimming pattern of a stellate sturgeon specimen

The last mode of poaching was made by processing fish swim data. In Fig. 6 it is observed that a specimen of the stellate sturgeon shows a variable swimming in depth on 14.04.2014. and the second day the sturgeon swimming is constant at the surface of water, which naturally cannot be possible. From here we can see the same procedure practiced by poachers, namely to put the tags in plastic bottles and to let them drift. One of the viable solutions of the future that could compensate the manifestation of the pressures of anthropic factors is represented by the repopulation of the Danube with juveniles from different species of sturgeon. In 2015, through a research project, the National Institute for Research and Development for Environmental Protection Bucharest tagged for the migration monitoring a total number of over 100 specimens of juveniles from the beluga, stellate and Russian sturgeon species. For the first time, at the level of the Lower Danube, using the acoustic telemetry technique, it was possible to prove that the juvenile produced and raised in aquaculture followed the natural course of migration and reached the Black Sea for feeding and development in the proportion of over 70%.

CONCLUSIONS

The problems of sturgeons began to appear after the 50s due to irrational fishing and continued with the hydrotechnical works at Iron Gates and with poaching, according to the results presented in this paper. Only throughout the correct identification and understanding of the manifestation of anthropogenic factors with direct influence on the survival of the sturgeon species, will be found viable and reasonable solutions for conservation and restocking. This requires that a permanent approach and the results obtained from the researches must be transposed into immediate legislative measures and even through the education of the human population along the Danube.

ACKNOWLEDGEMENT

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MONITORING THROUGH ULTRASONIC TELEMETRY OF JUVENILE STURGEON BEHAVIOUR PRODUCED IN AQUACULTURE SYSTEM AND RELEASED IN THE LOWER DANUBE FOR RESTOCKING
/
MONITORIZAREA PRIN TELEMETRIE ULTRASONICĂ A COMPORTAMENTULUI PUILOR DE STURIONI PRODUȘI ÎN SISTEM DE ACVACULTURĂ ȘI ELIBERAȚI ÎN DUNĂREA INFERIOARĂ PENTRU REPOPULARE

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Keywords: *ultrasonic telemetry, tagging, juvenile sturgeon behaviour, Lower Danube.*

ABSTRACT

The importance of the programs to restock the Danube with juveniles from critically endangered sturgeon species and the know-how of their migratory behaviour led, in 2015, to the implementation of a research project on sturgeon migration conducted by the National Institute of Research and Development for Environmental Protection in Bucharest (INCDPM). On this project's basis, there are three sturgeon species envisioned for tagging: beluga sturgeon, stellate sturgeon and Russian sturgeon. The tagging and monitoring of the juvenile sturgeon was carried out following the procedure developed by INCDPM experts, thus obtaining a unique database that provided information on the distribution of tagged juveniles on the main branches of the Danube, the variation of their migration according to the time of the day and the time the juvenile sturgeon spent between the monitoring systems.

REZUMAT

Importanța programelor de repopulare a fluviului Dunărea cu puiet din speciile de sturioni critic amenințate și a cunoașterii comportamentului migrațional al acestora a condus în 2015 la implementarea unui proiect de cercetare a migrației condus de INCDPM. În baza proiectului s-au marcat puieți din 3 specii: morun, nisetru și păstrugă. Marcarea și monitorizarea puilor de sturioni s-a efectuat după procedura elaborată de experții INCDPM. obținându-se astfel o baza de date unică ce a oferit informații cu privire la distribuția puieților marcați pe brațele principale ale Dunării, variația migrației în funcție de momentul zilei și timpul parcurs de puieți între sistemele de monitorizare.

INTRODUCTION

The sturgeon is a fish species that dates back to early *Cretaceous* times, about 200 million years ago (*Lazu et al., 2008*). They have continuously adapted themselves to various natural changes in their living environment, thus surviving to this day. In the past, on the Romanian territory, there could have been found 6 species of sturgeon of the *Acipenser* and *Huso* type, but due to anthropogenic influences, it seems that two of these six species are extinct, namely *Acipenser nudiventris* – ship sturgeon and *Acipenser sturio* – common sturgeon, and the populations of the other four remaining species (*Acipenser ruthenus* – sterlet sturgeon, *Acipenser stellatus* – stellate sturgeon, *Acipenser gueldenstaedtii* – russian sturgeon and *Huso huso* – beluga sturgeon) have been decimated drastically. These anthropic activities that decimated the world's sturgeon population and implicitly in our country, consists of the hydrotechnical constructions on large water courses for the production of electricity (mainly), that have led to the fragmentation of natural habitats and implicitly their loss, irrational and unsustainable fishing that was carried out and that sought especially the exploitation of these species whose caviar are also called "black gold" having a very high economic value.

The highlighting of these species' problems in research materials conducted by several authors (*Bacalbaşa-Dobrovici*, 1999; *Larinier,* 2001; *Reinartz*. 2002; *Oţel*, 2007; *Lenhardt et.al*., 2008; *Steffens,* 2008) led to their protection by *CITES* - *the Convention on International Trade in Endangered Species* of wild fauna and flora and their registration on the *IUCN* Red List - *International Union for the Conservation of Nature*.

The disappearance of the two species (Acipenser nudiventris – ship sturgeon and *Acipenser sturio* – common sturgeon) and the listing of the other 4 species on the Red List as follows:

1. *Acipenser ruthenus* (sterlet sturgeon) – vulnerable;
2. *Acipenser stellatus* (stellate sturgeon) – critically threatened;
3. *Acipenser gueldenstaedtii* (russian sturgeon) – critically threatened;
4. *Huso huso* (beluga sturgeon) – critically threatened.

has led to the awareness that the four sturgeon species, that are still reproducing on the lower course of the Danube, are in a real danger of extinction; therefore Romania has implemented through the Ministry of Environment, Waters and Forests and the Ministry of Agriculture and Rural Development a *Joint Order no. 330/2006* a ban on commercial fishing of these species which provided the development of sturgeon aquaculture to support wild surgeon by restocking with specimens raised in aquaculture. As a result, Romania released over 430.000 juvenile sturgeon of 3 different species (beluga, stellate and russian sturgeon) in the lower Danube.

These restocking programs did not involve activities for monitoring the behaviour of juvenile sturgeon released in the Lower Danube, the only way to do it consisting in applying CWT tags (which involves inserting into the pectoral fin using a special device, an encoded tag, detectable by metal detectors and lately removed in order to be microscopically read for identification) and can only be estimated by the recapturing methods. Thus, in order to identify both their actual behaviour as well as their preferred migration routes on their way to the sea and the efficiency of the restocking activity, it was necessary to implement a new technique that would allow them to be monitored.

The necessity of determining the behaviour and the efficiency evaluation of the restocking program led to a partnership agreement between the National Institute of Research and Development for Environmental Protection in Bucharest (INCDPM) with "Dunarea de Jos" University of Galati, for juvenile sturgeon monitoring using ultrasonic telemetry, under the project *"Evaluation of the survival and spread in the Black Sea of juvenile sturgeon from critically endangered species. launched in the Lower Danube Romania (2013-2015)".* This partnership has led to the achievement of a unique volume of information at the Danube River Basin level in terms of juvenile sturgeon monitoring. The present study followed both the exposure of the data obtained in 2015 and the follow-up of ultrasonic-marked juvenile sturgeon for the 2016-2017 period.

MATERIAL AND METHOD

The monitoring of juvenile sturgeon was achieved by using acoustic telemetry on the sector between Corabia, km 633 of the Danube and up to the Black Sea on the three main branches: Chilia, Sulina and Sf. Gheorghe.

The purchased submersible reception stations were of VR2W type (Figure 1), programmed to record the acoustic signals transmitted by the ultrasonic tags at a 69-kHz wavelength. The electronic equipment is protected by a shockproof plastic housing and it's also resistant to depths up to 500 m.

The ultrasonic tags that were used are of two types: V9-2X and V16TP-4X. The V9-2X model (Fig. 2) incorporates two batteries and the transmission programming of the ultrasonic impulses has been made in order to give an autonomy of approximately 3 years. The V16TP-4X has 4 batteries with 6 years of battery life. In latter model, the plus is given by the two built-in sensors (temperature and pressure) that can provide valuable information on migration behaviour. All tags are individually encoded and thus allowing a separate migration tracking for each marked sturgeon specimen.

Fig. 1 - Receiver (VR2W type)

Fig. 2 - Ultrasonic tag
V9 type (left) and V16 type (right)

The mounting of the reception stations was carried out with the help of the monitoring systems developed by INCDPM experts and presented in several scientific papers (*Badilita et al*., 2013. *Deák et al*., 2013, 2014. *Raschi et al*., 2016) that incorporates this equipment. The two monitoring systems are of two types: fixed (DKTB - fig.3) and floating (DKMR-01T - fig. 4). both proposed for patent at the Office for Inventions and Trademarks (OSIM).

Fig. 3 - Fixed monitoring system type DKTB

Fig. 4 - Floating monitoring system type DKMR-01T

The monitoring systems have been installed at various key points for fish recording during their migration to the Black Sea (Fig. 5), so that a route can be determined and also behavioural aspects such as speed, night-time and day-time swimming or migration based on water flow.

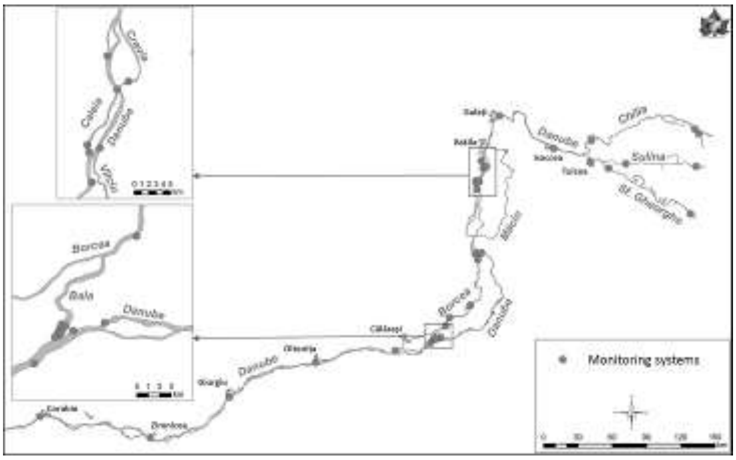

Fig. 5 – Monitoring systems location

After the installation of the systems, followed the marking of specimens from the three species: beluga sturgeon, russian sturgeon and stellate sturgeon. The marking of the specimens from the above-mentioned sturgeon species, was carried out on the basis of the developed and continuously improved procedure by INCDPM Bucharest experts (Badilita et.al., 2012; Badilita et.al., 2013; Deák et.al., 2013; Deák et.al., 2014; Danalache et al., 2017).

All data collected during the marking (size, series of the ultrasonic emitter, series of the tag, DNA sample, capture time, sex, species, etc.) were recorded in an individual catch record. A veterinarian who monitored the work of the experts was also present at the marking of the specimens. In order to record the activities, legal documents were concluded in the presence of an ANPA inspector and/or representatives of the local authorities.

RESULTS

Of the total number of ultrasonic tagged specimens, 56% of them reached the Black Sea until 31.12.2015, reaching 63% in the year 2016. In this situation, we can talk about a 56% success rate achieved in just 19 days of monitoring. Most specimens that reached the Black Sea were of the Russian sturgeon species (88%), followed by the beluga sturgeon species (40%) and the stellate sturgeon specie (39%).

If from the speciality literature we can find out that in the past the most abundant migration, with the most seizures made through commercial fishing was recorded on St. Gheorghe's branch, in this case 40% of juvenile sturgeon specimens migrated on the Chilia branch, 9% specimens on St. Gheorghe and only 7% of the specimens on Sulina branch (Fig. 6).

In fact, on this last branch, it was found that after the completion of the landscaping works, sturgeon migration has considerably decreased, most likely due to the intense maritime navigation that is taking place here and which is a cause of stress for the species in question.

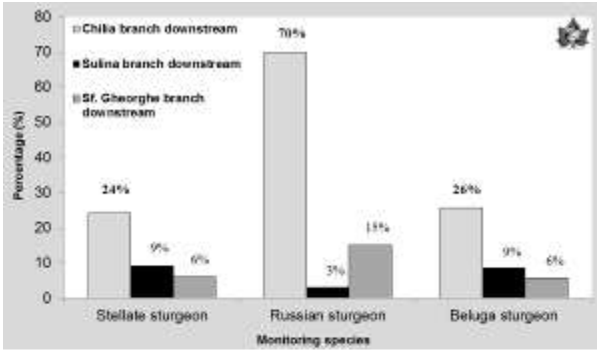

Fig. 6 - Distribution of ultrasonically tagged juvenile sturgeon on the main branches of the Danube Delta

By tracking the migration on the monitoring sectors from the release point at km 633 of the Danube and up to the Black Sea, a minimum and a maximum number of hours were calculated for when the first and last sturgeon reached one of the 16 points of interest nominated in Fig. 5.

Therefore, the fastest specimen of stellate sturgeon reached the sea through the Chilia branch after 193 hours (about 8 days) from its release, and the slowest, in 374 hours (about 16 days). On the Sulina arm, the fastest sturgeon reached the sea in 196 hours (about 8 days), and on St. Gheorghe branch after 391 hours (about 16 days) (Fig.7). The longest time interval for the first arrived at the sea on St. Gheorghe's branch, as well as the differences between the first and the last arrived in each location are caused by specimens' stops for rest and feeding. This explanation will be the same for the results of the other two species. The needs vary greatly from one individual to another.

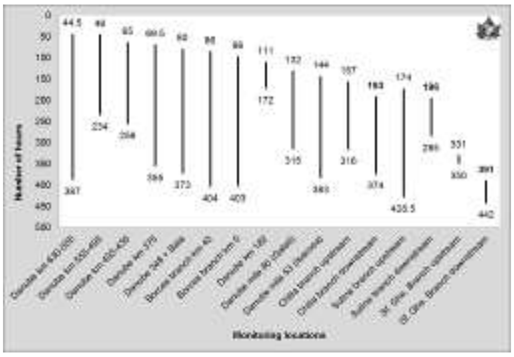

Fig. 7 - Elapsed time to track the distances between monitoring points (stellate sturgeon)

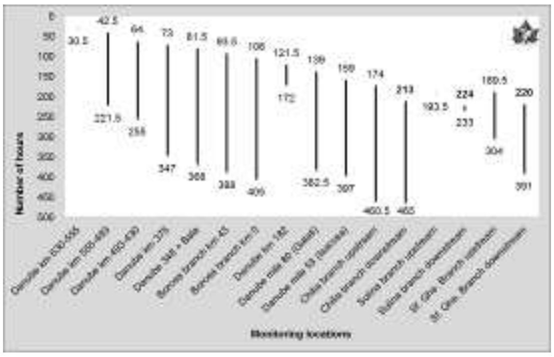

Fig. 8 - Elapsed time to track the distances between monitoring points (Russian sturgeon)

In the case of the Russian sturgeon species, it decreases the number of hours for the first arrived at the Black Sea through Sf. Gheorghe branch and it was recorded a period of only 220 hours (about 9 days), but the number of hours rises for the last arrived at the sea from Chilia, namely 465 hours (19 days). compared to only 374 hours (about 16 days) in the case of the stellate sturgeon (Fig. 8).

The fastest beluga sturgeon specimen reached the Black Sea in 224.5 hours (about 9 days), crossing the Sulina branch, and the slowest in 463.5 hours (about 19 days) on the Chilia branch (Fig. 9).

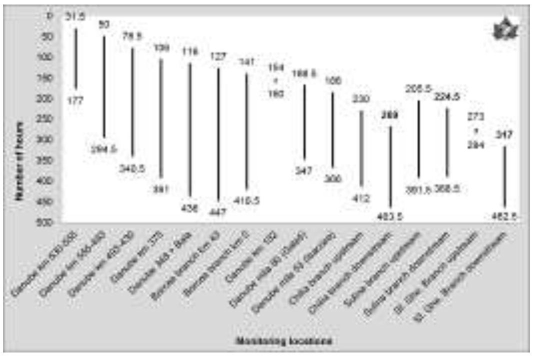

Fig. 9 - Elapsed time to track the distances between monitoring points (beluga sturgeon)

Watching the juvenile sturgeon migrate over 600 km of navigable distance, we wanted to find out if there were any differences between daytime and night-time fish swimming. Therefore, the total number of detections on the monitoring systems for each species was divided into two ranges:

- day-time period, ranging between 06:00 a.m. and 06:00 p.m.
- night-time period, ranging between 06:01 p.m. and 05:59 a.m.

It was observed that in the case of the stellate sturgeon species, of the total number of detections from the monitoring stations' area, in night-time the proportion was 57% and the daytime detections 43%. In the case of Russian sturgeon species, the difference is slightly lower, 55% in night-time and only 45% in daytime detection, and for the beluga sturgeon species the difference increases up to 58% for night-time and 42% for daytime detection (Fig.10-12).

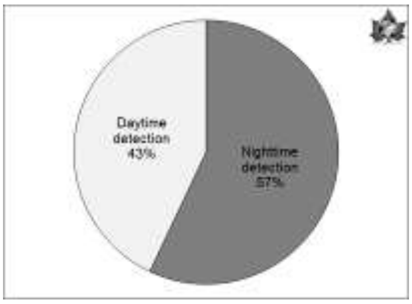

Fig. 10 – Daytime/night-time detection – stellate sturgeon

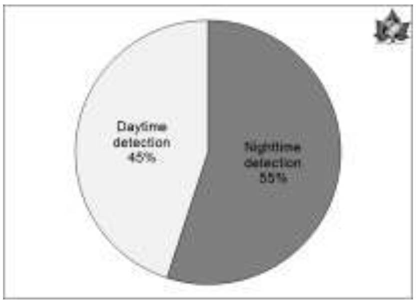

Fig. 11 - Daytime/night-time detection – russian sturgeon

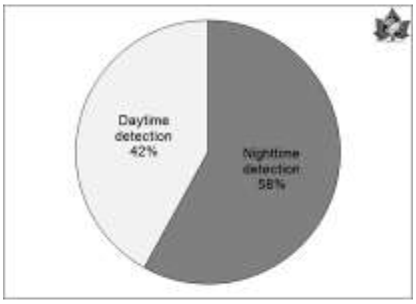

Fig. 12 - Daytime/night-time detection – beluga sturgeon

From this situation, we can see a minimum gain for night migration at the expense of daytime, but not with a significant difference that can outline an exclusive night-time behaviour. Most likely, this difference could be attributed to the sturgeon way of feeding, which can increase at night, due to a generally more intense activity of aquatic fauna during that period.

In the orientation of the juvenile sturgeon on the Danube's branches connected to the Black Sea, a particular importance with direct influence is given by the flow recorded during the migration days. From *Table 1* we can note that in the case of Chilia branch's confluence with Tulcea, the flows are relatively similar to a slightly higher distribution on Chilia between December 18-29.

Table 1

Comparison between the flows on Tulcea and Chilia branches in December

Debit (m^3/s)	18 Dec	19 Dec	20 Dec	21 Dec	22 Dec	23 Dec	24 Dec	25 Dec	26 Dec	27 Dec	28 Dec	29 Dec
Danube km 103	4860	4720	4450	4290	4120	3900	3790	3730	3640	3600	3490	3420
Tulcea	2340	2240	2150	2060	1990	1870	1820	1780	1760	1670	1620	1620
Chilia	2520	2480	2300	2230	2130	2030	1970	1950	1880	1930	1870	1800

Although the flows on the Chilia and Tulcea branches are relatively similar, we noticed that most sturgeons migrated to the Black Sea on the Chilia branch.

In this situation we exclude the theory of the shortest route, the juvenile sturgeon being at the first migration in the natural environment and the migration route on the Chilia branch is longer than in the case of Sulina and does not represent an advantage in this aspect.

CONCLUSIONS

From the migration on the three main branches of Danube that flow into the Black Sea, it was observed that most specimens migrated on the Chilia branch (40% of the specimens), followed by Sf. Gheorghe branch (9% of the specimens) and the Sulina branch (7% of the specimens).

The recorded flow on the Chilia and Tulcea branches between December 18-29 proved to be relatively similar.

The fastest juvenile sturgeon specimens reached the Black Sea after a period of about 8 days and the slowest after 19 days. The analysis of daytime migration as compared to night-time one showed that most of the detections were performed at night (approximately 55-58%), but there is no significant difference that can indicate a certain type of behaviour. This difference may also be due to the sturgeon way of feeding, perhaps more active during the night.

In 2016 there were detected approximately 24% of the tagged juvenile sturgeon, with the monitoring systems, which led to an increased success rate of 63%.

ACKNOWLEDGEMENT

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ASSESSMENT OF THE BEST TECHNIQUES FOR STURGEON MIGRATION MONITORING
/
EVALUAREA CELOR MAI BUNE TEHNICI DE MONITORIZARE A MIGRAȚIEI STURIONILOR

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ABSTRACT

Fish tagging is used to monitor ichthyofauna by providing to specialists information on fish behaviour, being able to estimate the livestock population of a species identifying thus, the amplitude of natural mortality. Before using any tagging method, the specialist should consider such issues as: species identification, to what extent tagging may affect their behavior or induce mortality, what are the chances for the tag to be lost or misidentified. The paper presents the assessment of the best techniques for sturgeon migration monitoring, the types of monitoring systems based on the use of ultrasonic tags and submersible reception stations.

REZUMAT

Marcarea peştilor este utilizată pentru monitorizarea ihtiofaunei furnizând specialiştilor informaţii cu privire la comportamentul peştilor, putându-se realiza estimări ale efectivului populaţional al unei specii identificând astfel amplitudinea mortalităţii naturale. Înainte de utilizarea oricărei metode de marcare, specialistul trebuie să ia în calcul aspecte precum: identificarea speciilor, în ce măsură marcarea poate afecta comportamentul acestora sau poate induce mortalitatea, care sunt şansele ca marca să fie pierdută sau identificată în mod greşit. Lucrarea prezintă evaluarea celor mai bune tehnici de monitorizare a migrației sturionilor, tipurile de sisteme de monitorizare ce au la bază folosirea de mărci ultrasonice și stații de recepție submersibile.

INTRODUCTION

„Knowing in detail the movements made by fish at different moments of the day or epochs of the year, especially required by the needs of developing industrial fishing in seas and seas, has led some researchers to try to unravel the enigma of the disappearance or appearance of certain species of fish for a while limited, to identify in some regions the thread of these journeys and explain the causes that determine them" (Niculescu D., 1959).

Migration studies were not limited only to understanding the periods and routes of different species of fish in order to have a high fishing yield. Over time, research has been done to determine the internal and environmental factors that determine this phenomena and have been analyzed their favorite habitats in order to better understand the necessities of fish and to take conservation measures in the context of a sustainable exploitation, which do not endanger their existence over time.

At the beginning, the methods used were rudimentary and based on observations made by courageous fishermen who put their lives in danger crossing the waters of seas and oceans to find the best fishing places. Coastal or wide agglomerations have been associated by these with wind direction, frequency and strength, water temperature or breeding and feeding periods. Accumulated data constituted a basis for the scientific traking of migrations.

The data when the first fish was tagged to be tracked is unclear. A report published in early 1653 in *"The Compleat Angler"* by Isaak Walton described the way people physically bound ribbons of Atlantic salmon tails (Salmo salar), finally establishing that this fish returns from the sea into the natal rivers (McFarlane. G.A.,1990).

At the end of the 1800s, numerous experiments based on fish tagging were carried out with an initial focus on salmonids followed shortly by successful trials on the flat fish. Pelagic species such as the Pacific herring (*Clupea harengus pallasi*) and tone (*Thunnus thynnus*) were successfully tagged in the early 1900s, while the studies with tagged elasmobranchial begin after 1930. Since 1945, large-scale tagging programs have been initiated all over the world in an effort to study the biology and ecology of fish populations (*Robert J. L., 2005*).

In general, the tagging methods applied depend on the study purpose, the species studied and size of the specimens or the number of individuals needed for the relevance of results.

MATERIAL AND METHOD

Based on the own experience accumulated from 2011 until now, the National Institute for Research and Development for Environmental Protection (INCDPM) found that the choice of the ultrasonic tag model for the monitoring studies of sturgeon and not only must be made according to several aspects: the size of the specimens to be tagged, battery life and transmission frequency of the tag.

Following the tagging of more than 300 sturgeon specimens of beluga, stellate sturgeon, Russian sturgeon and sterlet sturgeon, INDCDPM found that large specimens respond much better to the implantation of the ultrasonic tag.

The life of the batteries incorporated into the tags and their number depend on the objectives of the study. For example, in sturgeon adults, it takes a longer period (a few years) to monitor the migration routes, which can analyze at least the interval between two successive reproductions. In the case of the juvenile's sturgeon migrating downstream on Danube from hatching sites toward feeding habitats from the Black Sea, the situation is different. The study period is represented by the period when this route is crossed and may reach up to a maximum of several months.

With respect to the ratio of fish size to that of tag used to mark the specimen over time, research has been carried out which has shown that the weight of tag should not exceed 2% of the fish weight in air (Mc Cleave and Stred, 1975; Ross and Mc Cormick, 1981; Marty and Summerfelt, 1986). Therefore, taking into account this report, one of the manufacturers (Vemco, Canada) recommends for 5 models of ultrasonic tags the minimum size of fish in air (Table 1).

Table 1

Tags size in relation to fish weight recommended by Vemco

Tag model	Diameter (mm)	Size (mm)	Tag weight in air (g)	Fish weight (g)
V7	7	18-22.5	1.4-1.8	70-90
V8	8	20.5	2	100
V9	9	21-45	2.9-4.7	15-235
V13	13	36-48	11	550
V16	16	54-98	20-36	1000-1800

For tagged adults from the beluga, starlet, stellate and Russian sturgeon, INCDPM used 3 types of tags (Table 2).

Table 2

Comparative analysis on ultrasonic tags choice

Tag model	Diameter (mm)	Lenght (mm)	Tag weight in air (g)	Vemco Recommendation	INCDPM studies
				Minimum fish weight in air (g)	Minimum sturgeon weight in air (g)
V13TP-1x	13	48	13	550	2000
V16TP-4x	16	71	26	1000-1800	3000
V16TP-6x	16	98	36		4000

The three types of tags have 2 built-in sensors, one for temperature and one for pressure indicating the depth of fish swimming.

RESULTS

At national level to monitor sturgeon migration on the Lower Danube, 5 types of monitoring systems were designed and used based on the use of ultrasonic tags and submersible reception stations. For the sturgeons monitoring it has been used techniques based on ultrasonic telemetry, which was described by the INCDPM researchers and in other scientific papers (Badilita et.al., 2013; Deák et.al., 2013. 2014; Raschi et.al., 2016; Danalache et.al., 2017).

The five systems used were proposed by 3 research institutes: Danube Delta National Institute for Research and Development Tulcea (INCDDD) (Fig.4), National Institute for Marine Research and Development "Grigore Antipa"Constanta (INCDM) (Fig. 5) and National Institute for Research and Development in Environmental Protection (INCDPM) (Fig. 6. 7. 8).

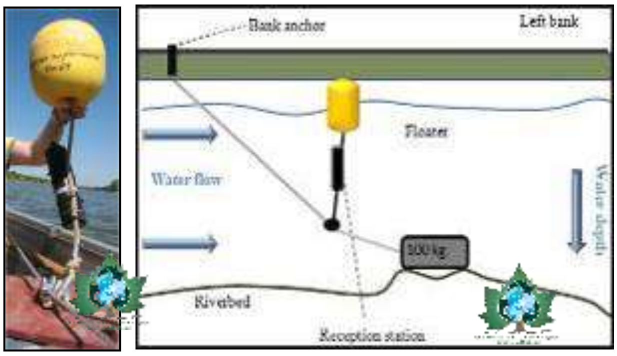

Fig. 4 - Monitoring system type INCDDD Tulcea

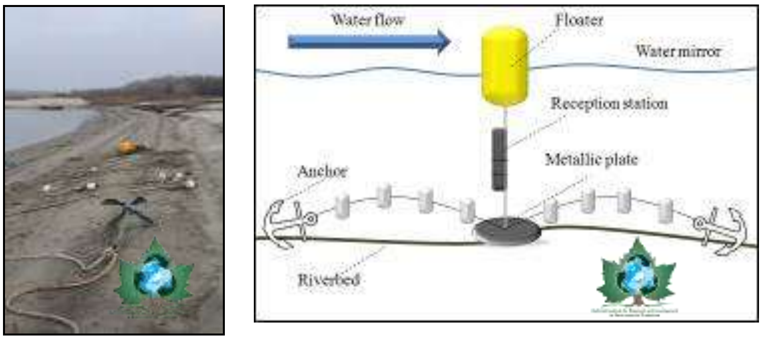

Fig. 5 - Monitoring system type INCDM Constanta

Among the advantages of the monitoring system proposed by INCDDD Tulcea are included: low confectioning costs, assembly speed at the mounting location. it can be installed anywhere in the river bed and do not mess up the navigation. The disadvantages of the system may be: high risks of hanging and clogging, difficulty in recovering the bedside station, the risk of theft and can not be placed in areas where are present the fishery tons because they can be hung.

The advantages of the second system proposed by INCDM Constanta were the following: less expensive than the previous one, complete fitting in the mounting area, reduced installation time, does not mess up the navigation and can not be stolen, and the disadvantages are similar to those of the first system.

The systems proposed and patented by INCDPM Bucharest were designed to eliminate the disadvantages of the two previous systems.

The first system is fixed - „*DKTB station to monitor the ichtyofauna, especially sturgeons, through remote sensing, with ultrasonic tags in different hydromorphological conditions*" (Fig.6).

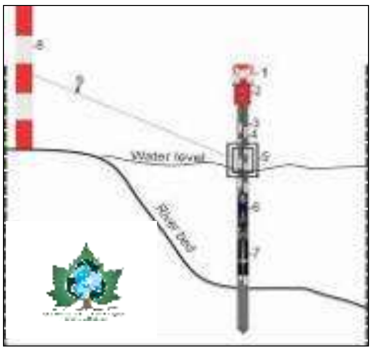

Fig. 6 - DKTB sturgeon monitoring system

(Deak et al., 2012)

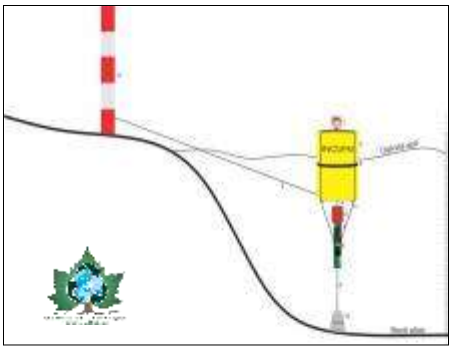

Fig.7 - DKMR-01T sturgeon monitoring system

(Deak et al., 2014)

The most important advantages of the system are: there are no risk of loss, easy installation in the shores area, can be install in the fishery areas without any influence on it, ease of data downloading, can include multiparametric water quality equipment inclusive equipment for determining the level variation.

The disadvantages of the system are the higher manufacturing costs than in the first cases and the fact that at high level of water they need to be moved or mounted extensions to provide access to the lid for recovery of the detection station.

The second system is floating and is called „*DKMR-01T mobile station for remotely sensing and monitoring of ichthyofauna, especially for sturgeon in difficult hydrological conditions*" (Patent no. 129803/2017) (Fig.7).

Among the advantages of the system are: lower production costs than the DKTB system, it can also be fitted in fishing areas without any influence on fishing, reduced fastening time. ease of loading data and may include multiparametric equipment.

The disadvantage of the system is that it can not incorporate equipment for determining the water level, presents the risk of theft and risk of breaking the anchoring system.

The third monitoring system proposed by INCDPM is used for areas where intensive monitoring is required with the possibility of determining the behavior of sturgeon specimens in detail.

The patent is called „*DK-PRB-01U Monitoring, control and alarming system".* It is composed of the floating system and the fixed type system that has a built-in multiparameter device for determining the water quality.

All 5 monitoring systems were tested in the project „*Monitoring the environmental impact of the works regarding the improvement of the navigation conditions on the Danube River between Calarasi and Braila, km 375 and km 175"* started in 2011.

The results obtained indicated irrecoverable losses of the systems in different proportions. In the case of the system developed by INCDDD Tulcea the total losses were 35%, in the case of the system developed by INCDM Constanta were 50% and in the case of the systems proposed by INCDPM Bucharest there were no irrecoverable losses.

Table 3 presents a matrix where are taken into account the most important decisional factors regarding choosing and using one of the described monitoring system models.

Table 3

Decisional matrix on the advantages and disadvantages for the implementation of sturgeon migration monitoring systems on the Lower Danube

Parameters / Systems	Location accuracy	Technological risks	Installation effort	Data download effort	Data download costs	Production and maintenance costs
System I - INCDDD Tulcea	Low	Big	Big	Big	Big	Low
System II - INCDM Constanta	Low	Big	Medium	Medium	Big	Low
System III - INCDPM	Precise	Low	Medium	Low	Small	Medium
System IV - INCDPM	Precise	Low	Low	Low	Small	Low
System V - INCDPM	Precise	Low	Big	Low	Small	Medium

After developing and implementing the best monitoring system, the most important aspect is the methods and techniques used to tag the fish.

For sturgeon tagging it was designed a tagging procedure and a system to eliminate the stress and mortality risk of the specimens subjected to the surgical implantation of tag. The system and steps of the tagging procedure are shown in Figure 9.

DOMAIN	COMPONENTS	CHARACTERISTICS	DOMAIN
a) sturgeon tagging	1. ultrasonic transmitter 2. contention tube 3. surgical kit 4. electronarcosis 5. anti-poachig gun 6. GPS to locate the fish release site	-frequency = 69 kHz -diameter = 40 cm -scalpel blade size = no. 11. surgical needle pattern G 10 -voltage = 16 - 20 V -needle length = 1 cm -stereo coordinate determination	

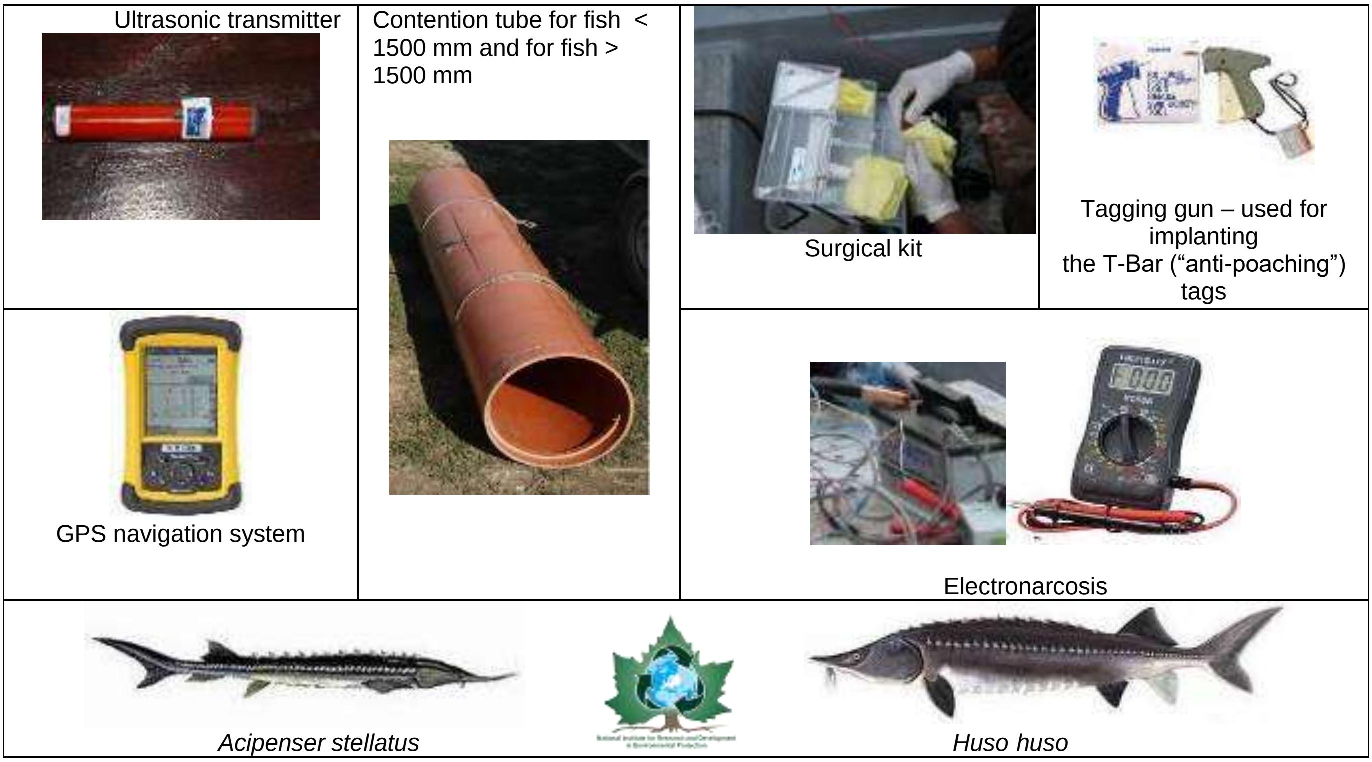

Fig. 9 - Monitoring system with ultrasonic transmitter of type_60 (Monitoring of sturgeon with size > 1500 mm)

The sturgeon tagging procedure developed and continuously improved by INCDPM Bucharest team aims at eliminating the stress during the tagging operation of individuals. Sturgeon are tagged directly in the river water using the equipment described in Fig. 9. The first operation of the tagging activity is the identification of the metric and gravimetric characters, followed by taking of the DNA sample, insertion of the ultrasonic tag by surgical incision, application of a tissue adhesive, attachment of a spaghetti tag "anti-poaching" and ultimately of releasing the individual into the natural environment. The entire operation is supervised by a veterinarian and the data of the tagged specimen is recorded in a catch record and in the report drawn up by an inspector of the National Agency of Fisheries and Aquaculture.

CONCLUSIONS

Fish species have different anatomical. physiological and behavioral characteristics, making them unique, being necessary to develop a feasibility study prior to the implementation of any tagging method, both for reasons with regard on the individual’s welfare and for results reliability.

In developing any type of study for the ichthyofauna monitoring by involving a tagging method, it is necessary to pay more attention to the choice of the tags size in relation to fish size since the excessive weight of the tag may have adverse effects on individual.

At national level for monitoring of sturgeon migration, three different research institutes have developed 5 systems since 2011. Taking into account aspects such as costs, losses, mounting speed, or download time, only the 3 systems proposed by INCDPM have proven to be effective and are still used successfully.

The ultrasonic tagging of sturgeons is a complex process, which must be done in a very short time, without stressing those endangered specimens. The use of the latest monitoring technologies for fish species can give a high yield only through integration into innovative systems developed by researchers and adapted to local environmental conditions.

ACKNOWLEDGEMENT

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Danube Galati. The authors are grateful to the National Institute for Research and Development which is the consortium leader and the responsible for environmental monitoring of the entire project.

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CONTRIBUTION TO THE STRENGTHENING OF THE BILATERAL COOPERATION BETWEEN ROMANIA AND NORWAY LINKED TO IMPROVEMENT OF KNOWLEDGE AND CAPACITY OF A NUMBER OF EXPERTS AND PROFESSIONALS IN HAZARDOUS SUBSTANCES, BY MEANS OF PROFESSIONAL TRAINING: *TARCHS PROJECT*

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CONTRIBUȚIA LA CONSOLIDAREA COOPERĂRII BILATERALE ROMÂNIA - NORVEGIA. LEGATĂ DE ÎMBUNĂTĂȚIREA CUNOȘTINȚELOR ȘI A CAPACITĂȚILOR UNUI NUMĂR DE EXPERȚI ȘI PROFESIONIȘTI PRIVIND SUBSTANȚELE PERICULOASE. PRIN FORMARE PROFESIONALĂ: PROIECT TARCHS

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ABSTRACT

Public information and awareness on the negative effects of hazardous chemicals and waste on human health and environment leads to environmental awareness and gaining knowledge, skills, motivation and commitments that people need in order to take responsibility for maintaining environmental quality. In this paper are briefly presented the main activities carried out and the results obtained within the project called "Training and awareness rising campaigns regarding the potential human health and environmental risks associated to hazardous substances and waste" (TARCHS), funded by EEA Grants within Programme RO04 – Reduction of hazardous substances. Second call – "Training and Awareness Campaigns".

REZUMAT

Informarea și conștientizarea publicului larg asupra efectelor negative ale substanţelor chimice şi deşeurilor periculoase asupra sănătăţii umane şi mediului conduce la conștientizarea problemelor de mediu și dobândirea de cunoștințe. Deprinderi, motivații și angajamente de care oamenii au nevoie pentru a-și asuma răspunderea pentru menținerea calității mediului. În această lucrare sunt prezentate succint principalele activități desfășurate și rezultatele obținute în cadrul proiectului "Campanii de formare și conștientizare cu privire la potențialele riscuri asupra mediului și sănătății populației asociate cu substanțele și deșeurile periculoase" (TARCHS), finanțat prin Granturi SEE. în cadrul Programului RO 04 – Reducerea Substanţelor Periculoase. Apelul nr. 2 – Campanii de formare și conștientizare.

INTRODUCTION

Hazardous substances and waste pose a great risk to the environment and human health and require a strict monitoring and control regime (*EEA Report no. 35. 2016; Vani et al. 2017)*. Under the REACH (*Regulation (EC) no.1907/2006*) regulation on chemicals, substances classified as carcinogenic, mutagenic or having reproductive toxic effects may need authorisation to be used or placed on the market and also measures should be developed to protect the environment from the dangerous effects of these substances. REACH is one of the most complex projects of the European Union (EU) in recent years. The purpose of this Regulation is to ensure a high level of health and environmental protection and the free circulation of substances on the internal market while ensuring increased competitiveness and innovation and establishes provisions for substances and mixtures (*https://ec.europa.eu*). Waste Framework Directive (*Directive 2008/98/EC*) underlines that hazardous waste has the potential to cause harm to the environment and human health. Waste are generated by human activities and must be managed properly so as not to create environmental risks *(Chiriac et al., 2017)*. Regardless of the source, unless proper hazardous waste disposal, health risks for people and damage to the environment can be created (*Lubomir et al. 2013*) . As a result, strict controls apply from the point of its production to its movement, management, and recovery or disposal. A lack of knowledge in this information from the EU legislation can have significant and irreversible impacts on the environment and on the human health (*Crawford et al. 2010)*. Public participation and consultation in a free, open and constructive manner is an essential, indispensable part of the work and effort to protect the environment. Improving knowledge and skills of the persons in charge with implementing EU legislation in this field will facilitate the enforcements of EU strategies and legislations on chemicals and hazardous waste preventing possible injuries and adverse health and environmental effects caused by chemicals and hazardous waste.

In this context, the paper will present the main results and activities performed within the project "*Training and awareness rising campaigns regarding the potential human health and environmental risks associated to hazardous substances and waste" (TARCHS)*, financed under the Programme RO 04 - Reduction of hazardous substances. Call for Proposals no. 2: Training and Awareness Campaings by a grant from Iceland. Liechtenstein and Norway (EEA 2009-2014), project which was implemented between July 2015 - April 2017 by the National Institute for Research and Development in Environmental Protection, Bucharest - INCDPM as a Project Promoter (PP) in partnership with the Environmental Protection Agency Vrancea – ANPM (PP1) and 3 Norwegian Partners: Boost Global Innovation (PP2), InErgeo (PP3) and Hjellnes Consult (PP4) (*TARCHS Project. 2015-2017*).

The general objective of the project was the strengthening the institutional capacity of environmental protection agencies from the South-Eastern development region and of other public entities from the same region, having environmental responsibilities for implementation and enforcement of EU legislation and policies on hazardous substances and waste in order to ensure a better monitoring of their environmental and human health potential impact.

The specific objectives were: institutional capacity building and facilitating collaboration between the Romanian governmental authorities and the Donor states; raising awareness on hazardous substances and waste at regional level and minimizing the impact of substances and hazardous waste on the environment and human health. The target groups were: Public authorities in the S-E Development Region, local Environmental Protection Agencies in the SE Development Region and the local communities and companies in the S-E Development Region.

The implementation of this project has come to support the implementation of the 2009-2014 EEA Financial Mechanism objectives by preventing the adverse environmental effects caused by dangerous substances and waste on the environment. The project has strengthened the capacity of the entities in charge with implementing and applying European legislation and strategies regarding hazardous substances and waste in the S-E Development Region, a better knowledge of this field being a necessity in order to reduce their impact on human health and environment.

To achieve effective training and awareness campaigns regarding human health and environmental risks associated to hazardous substances and waste, measures should be taken to develop tools in order to support decision-making processes (registers, databases, information exchange systems, procedures, guidelines, exposure scenarios for the environment and human health, methodologies for estimating the risks associated with hazardous substances to human health and environment, to education. etc.) to enhance the ability of public authorities responsible for implementing and supervising the implementation of EU policies and legislation related to chemicals and hazardous waste.

MATERIAL AND METHOD

The project was implemented in the South-Eastern Development Region (Romania), composed of the following counties: Vrancea, Galati, Buzau, Braila, Tulcea and Constanta (fig. 1).

Fig. 1 - Localization of the region where the project was implemented

The project was a challenge regarding the implementation management related to the thematic complexity, to the tight time schedule of the work plan and to the diversity of the end-users and stakeholders. Thus, the management structure was creaded based on the experience of the partners in other national or European projects. To ensure optimum performance within the project, the quality assurance of project management played an important role, being assured by a clear structure, precise tasks and responsibilities for all partners, decisional competencies and adequate communication (fig.2).

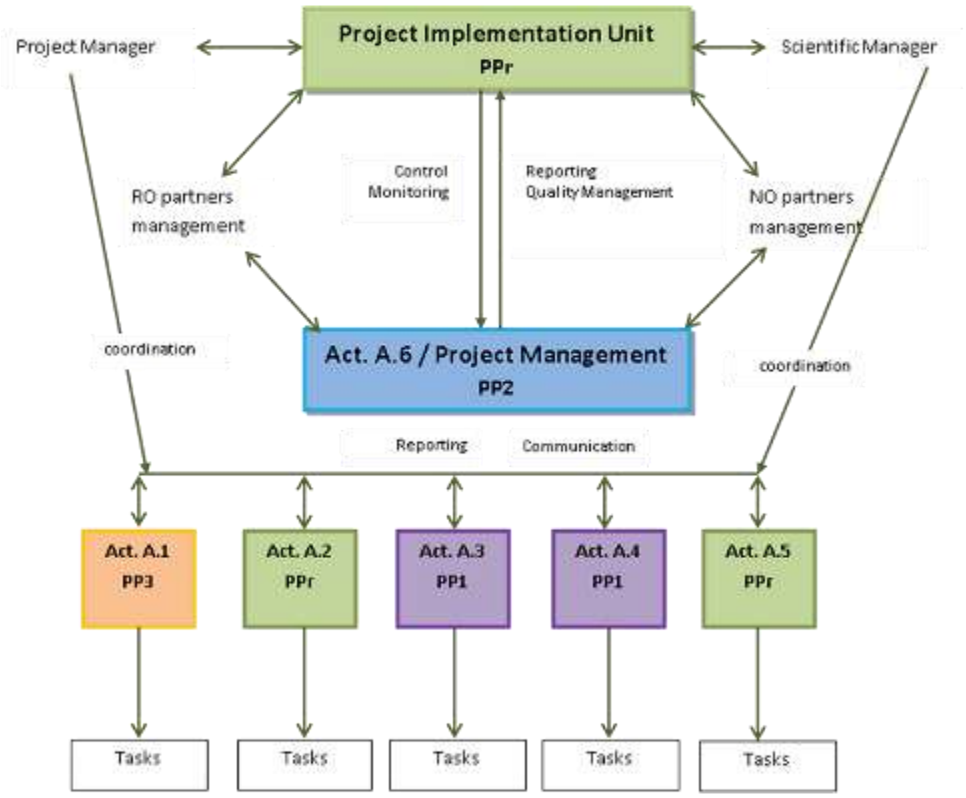

Fig. 2 - Project management structure

The TARCHS project was focused entirely on the dissemination and formation activities. The ultimate goal of the project was to use dissemination channels and demonstration efforts for training and awareness rising of public authorities obliged to implement EU legislation for hazardous substances and waste. In table 1 the main activities performed within the project are presented.

Table 1

Activities performed within the project

Activity Number	Name of activity
Act. A1	Long term training for professionals involved in hazardous substances and waste environmental behavior and health associated issues
Act. A2	Information and awareness campaign for public bodies regarding EU legislation and strategies regarding hazardous substances and waste
Act. A3	Strengthen the capability of South-Eastern development region public bodies to apply EU legislation and strategies regarding hazardous substances and waste
Act. A4	Information and awareness campaign regarding the potential effects of hazardous substances and waste
Act. A5	Project dissemination
Act. A6	Project Management

RESULTS

The long term training for professionals involved in issues related to the risk for environment and human health associated to hazardous substances and waste has a high importance for increasing knowledge and experience on hazardous substances and waste legislation.

Within **Activity 1,** a long term training for nine employees of public authorities (students) was organized at the Norwegian University of Life Sciences (NMBU) in Oslo: 5 students for toxicology training (course on Environmental Exposures and Human Health) - autumn session 2015 and 4 students for ecotoxicology training (course on Environmental Pollutants and Ecotoxicology) - winter session 2016. For the first 5 students at the long term training, a meeting with the coordinator of the course was arranged with the aim to support the sedimentation of knowledge accumulated in the course and to receive additional information in the field. All students have passed exams and graduated the courses. For the other 4 students a study visit was organized in Norway, in order to have a general idea regarding the methodology of Norwegian authorities for implementing and enforcing EU strategies and legislations on chemicals and hazardous waste and regarding the assessment of hazardous substances and waste impact on the environment and human health. Students who participated in long-term training have elaborated 2 pilot projects in the S-E Region through which they have put into practice the information accumulated within the training courses adapted to the regional conditions: *Risk Assessment for Drinking Water in S-E Region* and *Ecotoxicology of Heavy Metals in Danube Delta,* projects that were presented at the pilot workshop organized in Bucharest.

Within **Activity 2,** five round tables were organized in Focşani with representatives of public organizations with the aim of establishing the current situation of knowledge and implementation status of EU legislation and strategies regarding hazardous substances and waste among public authorities involved in environmental protection; 78 participants were from public authorities in Vrancea country. Dissemination materials have been distributed within the activity, helpful in informing the target group regarding the EU legislation updates - brochure "*Regulations on hazardous substances and waste – information for public authorities"*, elaborated within the project to enhance the information degree of public authorities in legislation on hazardous substances and waste; questionnaires were applied in order to help the consortium understand the lack of knowledge and of competitiveness regarding the subject of hazardous substances and waste and to create appropiate comunication strategies; questionnaires for evaluation of the awareness campaign have also been applied. Following the implementation of the activity actions, necessary measures to be taken have been established in order to raise the competitivity of public authorities in the field of hazardous substances and waste.

Activity 3 of TARCHS project (Strengthen the capability of S-E Development Region public bodies to apply EU legislation and strategies regarding hazardous substances and waste) was focused on training 102 professionals in public authorities during a short term course. The course was aimed to deepen and update previous knowledge in EU legislation and strategies regarding hazardous substances and waste.

Moreover, 8 persons from the whole target group together with representatives of project partners (in total 16 persons), attended an exchange visit in Norway in order to facilitate know-how transfer in hazardous substances and waste management from Norwegian specialists to professionals of Romanian public authorities. Aims of exchange visit were:

- informing on legislation for hazardous waste in Europe and in Norway;
- sorting and handling of hazardous waste at collection centers;
- handling of hazardous waste & waste in construction and demolition projects;
- risk management in companies handling hazardous waste;
- understanding the importance of communication and information to the inhabitants regarding waste in general.

The main purpose of **Activity 4, was to** raise the local communities' awareness regarding hazardous substances and waste and covered:

- establishing of the current situation of knowledge about environmental protection by investigating the local communities;
- development and spreading of informing materials (brochures, flyers, guides) for increasing the awareness of targeted groups regarding hazardous substances and waste effects and their proper management;

- organizing of informing meetings with economic operators and with agricultural associations in order to minimize the impact of chemicals used in agricultural practices on the environment and human health
- measuring the impact of the awerness campaing.

In **Activity 5**, the project results were disseminated using differerent forms of message transmissions to target gropus to facilitate distribution of results and to ensure the project promotion:

- Kick-off meeting to open the project and present activities;
- Putting in 2 press announcements;
- Distribution within the territory of 100 project flyers;
- Project website (http://tarchs.incdpm.ro);
- Newsletters with news in the project implementation, posted on website;
- Project board at the promoter's headquarters;
- The project roll-up and poster were always posted in all meetings and at promoter's headquarters;
- Drafting of a book within the project by INCDPM experts involved in the activities implementation: *"Hazardous waste: Management and risk for environment and health".* The book contains information on the management of hazardous waste and waste as a guid to their correct management and providing suport for strengthening the implementation capacity of legislation on chemicals and hazardous waste (*Chiriac et al. 2017*);
- Press conference held during the final meeting;
- Participation in the conference *"Reduction of Hazardous Substances",* organised by the Programme Operator (17-18 Jan 2017);
- Final meeting of the project took place in Bucharest, where 42 participants attended (23 Feb 2017);
- Participation in the conference *"Circular Economy in Romania"* (5 Oct 2017).
- Final conference of the Programme RO 04 *"Reducing Dangerous Substances"* funded by EEA Grants 2009 – 2014, organised by the Program Operator (6 Oct 2017).

During the implementation of the project, the estimated indicators were overcome regarding the number of target groups representatives having been trained (table 2).

Table 2

Project indicators

No.	Output	Forecasted indicators	Reached indicators
1.	Improved knowledge and skills of professionals from public authorities regarding the long-term impact of hazardous substances and waste on the environment and human health	8 employees of public authorities will be trained and certified on long term in ecotoxicology and toxicology	**9 employees**
2.	Awareness raising among public authorities regarding the necessity to implement EU legislation related to hazardous substances and waste and the necessity to perfom a monitoring of their environmental fate	1 Awareness raising campaign regarding hazardous substances and waste	**1 campaign**
3.	Improved knowledge and skills of professionals from public authorities regarding the EU legislation on hazardous substances and waste	100 public authorities employees short term trained in hazardous substances and waste EU legislation	**102 employees**
4.	Awareness raising among population regarding the associated risks of hazardous substances and waste for helping public authorities in environmental and health protection	1 Awareness and information campaign	**1 campaign**
5.	Project dissemination	Billboard and permanent plaque Press conference (Final meeting) Web page Newsletter (6)	√

CONCLUSIONS

The project aimed to improve the professional knowledge and skills of specialists in public authorities on the impact of hazardous substances and wastes on the environment and human health by organizing long-term courses in Norway, for 9 public authority employees and a training course short term in the S-E Development Region, for 102 employees. The project also aimed to raise the awareness of public authorities and local communities by organizing information and awareness campaigns that consisted of meetings and discussions, the distribution of information materials on hazardous substances and wastes and their effects on the environment and health, as well as the best practices used in Norway combined with the long-standing experience of the INCDPM, the Romanian and Norwegian experts jointly carried out the knowledge transfer activities and organized working visits to Norway.

This project demonstrates the possibility of obtaining useful results for both parties and represents the basis for the possibilities of future collaborations in the field of environmental protection in which we capitalize both Norwegian and Romanian experience through INCDPM.

ACKNOWLEDGEMENT

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The project was implemented by the National Institute for Research and Development in Environmental Protection. Bucharest - INCDPM as a Project Promoter in partnership with the Environmental Protection Agency Vrancea and 3 Norwegian Partners (Boost Global Innovation, InErgeo and Hjellnes Consult) and would like to thank its partners.

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OVERVIEW ON „HAZARDOUS WASTE – MANAGEMENT AND RISKS FOR ENVIRONMENT AND HEALTH”- GUIDE RELEASED BY TARCHS PROJECT
/
DEȘEURI PERICULOASE - MANAGEMENT ȘI RISCURI PENTRU MEDIU ȘI SĂNĂTATE" - GHID ELABORAT ȘI LANSAT ÎN CADRUL PROIECTULUI TARCHS

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Keywords: *hazardous waste, risks associated to waste, industry of waste management, environmental and health impact.*

ABSTRACT

Numerous products and materials encountered daily can become hazardous waste and their management is an international problem. Improper management of hazardous waste is a serious threat to both human health and environment. Thus, the need for proper management of hazardous waste has led to the adoption of the Resource Conservation and Recovery Act (RCRA) in 1976 and subsequent EU-wide elaboration of more specific legislation. This paper brings to the foreground the need to develop an informative material as guidelines material regarding the potential risks to the environment and to the human health associated to hazardous substances and wastes.

REZUMAT

Numeroase produse şi materiale întâlnite zilnic pot devenii deşeuri periculoase, iar gestionarea lor reprezintă o problemă internaţională. Gestionarea necorespunzătoare a deşeurilor periculoase constituie o ameninţare serioasă atât pentru sănătatea umană cât şi pentru mediu. Astfel, necesitatea gestionării adecvate a deșeurilor periculoase a condus la adoptarea legii privind Conservarea și Recuperarea Resurselor (Resource Conservation and Recovery Act - RCRA) în 1976 şi ulterior elaborarea la nivel UE a legislaţiei din ce în ce mai specifice din domeniu. Această lucrare aduce în prim plan necesitatea elaborării unui material informativ sub formă de ghid cu privire la potenţialele riscuri asupra mediului şi sănătăţii populaţiei asociate cu substanţele şi deşeurile periculoase.

INTRODUCTION

Recently, waste management has become an increasingly complex activity [Chiriac et al. 2017; INCDPM. 2001; INCDPM. 2005; INCDPM 2017]. After the drafting the EU Consolidated List of Waste (European Waste Catalogue) and more specific legislation, the methods of waste management were improved together with the knowledge of their generation [Chiriac et al. 2017].

It is well known that a hazardous waste is a waste with properties that make it dangerous or capable of having a harmful effect on human health or the environment [ASCEND. 2015; EPA; EPA. 2005]. Hazardous waste are originated from different sources, ranging from industrial manufacturing process wastes to batteries and may come in many forms as liquid, solid gas, and sludge [EPA; EPA. 2005].

In the mid-twentieth century, the United States has encountered with a solid waste management issues because of increasing solid waste generation, shrinking disposal capacity, rising disposal costs and public opposition to the siting of new disposal facilities. The challenges in this field continue today, as many communities are struggling to develop environmentally protective solutions [EPA; EPA. 2005] including the European community.

The treatment and disposal of hazardous substances, stemming from industrial activities as well as from import and daily use of chemicals have become a challenging task for Romania. Minimizing such a threat at a national level requires a special effort to strengthen the management capacity of chemical and hazardous waste. The *EEA Grants Programme* aims to help reduce the economic and social disparities in the European Economic Area and to strengthen the cooperation relations between the donor state (Norway) and the beneficiary countries through the proposed priority sectors. The *Reduction of Hazardous Substances* programme, part of the *EEA Grants,* focuses on strengthening the capacity of public entities responsible for implementing and enforcing EU strategies and legislation on chemicals and hazardous waste and also to improve the monitoring of hazardous substances in the environment. The aim is to prevent injury and adverse health and environmental effects caused by chemicals and hazardous waste [EEA Grants. org; EEA Grants. ro; SEE. 2009-2014].

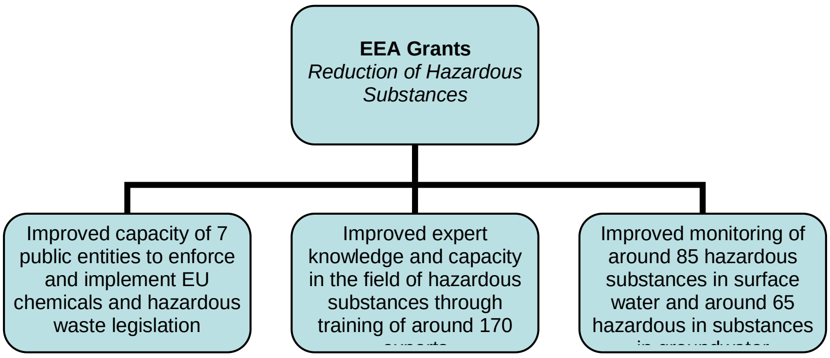

Fig. 1 - Projects results which had to be met by implementing the of Hazardous Substances programme [5]

MATERIAL AND METHOD

This informative material - the guide, generally described in this paper was developed within the project "Training and awareness rising campaigns regarding the potential human health and environmental risks associated to hazardous substances and waste" under the EEA Grants 2009-2014 Program RO04- "Reduction of Hazardous Substances".

The guide was elaborated by experts involved in the implementation of project activities. The project promoter and his partners have identified the need to develop this informative material as a result of the actions carried out within the project (meetings and discussions with public authorities and economic agents in the SE Region) and their own experience in the management of chemicals and hazardous waste. Thus, it has been proposed to carry out a guidance document for the proper management of chemicals and hazardous wastes, but also to avoid the risks that these materials may have for health and the environment. Also, with the support offered by the Norwegian partners, the material presents many examples of good practice on hazardous waste management in Norway.

RESULTS

The guidelines contain seven chapters, except for the introduction and references. First of all, the *legislation on waste at national and European level* is presented in a more captivating and easier way to understand than is found in other materials [EC. 2015; Guidelines. 2015]. The second chapter refers to *temporary storage of hazardous waste* and *waste thermal treatment to final disposal*.

The hazardous waste containing metal ions are discussed in the third chapter - *recovery and valorisation of metal compounds from industrial hazardous waste*. According to GD 856/2002, hazardous wastes containing heavy metals result from the different industrial activities (tanneries, inorganic chemical processes, thermal processes from the steel, metallurgical and non-ferrous metallurgy industry, chemical treatment of surfaces and coating of metals and other materials, treatment of residues and wastewater treatment). In this chapter, the authors present the procedures for the recovery of metals and metal salts from spent solutions and the techniques for valorisation of the galvanic sludges.

Risks for environment and health due to hazardous waste is the next chapter of the guide. The risk assessment and the effects of waste and hazardous substances on health and environment are detailed here.

Fig. 2 - Risk Management [Chiriac et al. 2017]

Household waste generated by the population is the most important part of municipal waste. So, the chapter *hazardous waste and substances in households* was introduced in the guide. In some developed countries, authorities have taken measures for household hazardous waste management. Although the quantities generated are small, the risks of their disposal in the environment are high due to their degree of hazardousness. Quantities are small (except for electrical and electronic waste), therefore it is not financially justifiable to introduce a policy of selective collection at a large scale. Also, the population cannot be considered a generator of hazardous waste. European Union legislation does not specify very clearly specific conditions for the management of hazardous wastes generated by the population and the term "household hazardous waste" is not clearly defined. However, since 1980 or 1990, some Member States have developed national initiatives for the separate collection of these types of waste [Chiriac et al. 2017].

In Norway, waste management is regulated by shared responsibility between central and local authorities. The central authority sets out the overall framework and strategy and local authorities and industry establish local waste collection and treatment solutions. The *hazardous waste management in Norway* chapter presents the today situation in Norway about their waste management system.

And the last chapter of the guide presents the reduction measures taken before materials or products become waste - *prevention and minimization of hazardous waste*. One of the forms of implementation is quantitative prevention, which is to reduce the amount of hazardous materials used in the manufacture of products and to increase the efficiency with which they are used. Also, avoidance of waste formation can be done by limiting unnecessary consumption and by designing some products that generate less waste but also by repairing and reusing products before they become waste.

Fig. 3 - „Hazardous Waste – Management and Risks for Environment and Health" guide released by TARCHS project

CONCLUSIONS

The purpose of this document is to assist operators in understanding and implementation of legislation on hazardous waste. Also, the material is useful to local authorities with responsibilities in waste management. The information contained in this document is complementary to the information in other hazardous waste guidelines.

The informative material was created to be useful to a target group represented by hazardous waste generators, urban or rural economic agents, industry or agriculture companies, population. The guide refers to issues related to the safe management of hazardous substances and wastes for the environment and the health of the population.

ACKNOWLEDGEMENT

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CONSIDERATIONS ON NONLINEAR STATIC ANALYSIS OF COUPLING DEVICES - LONGITUDINAL STRESSES
/
CONSIDERATII PRIVIND ANALIZA STATICĂ NELINIARĂ A DISPOZITIVELOR DE CUPLARE – SOLICITĂRI LONGITUDINALE

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Keywords: *aggregate, coupling, analysis, stresses, forces.*

ABSTRACT

Coupling devices are elements providing the connection between the power source (tractor) and the carried vehicle. They must be checked in terms of safety for the traffic on public roads by different methods. One of these methods is the nonlinear static analysis by longitudinal stresses, which can, in some cases replace verification by endurance testing. The present paper presents such an analysis as well as the results obtained.

REZUMAT

Dispozitivele de cuplare sunt elemente ce asigură legătura dintre sursa energetică (tractor) şi maşina tractată. acestea trebuind verificate din punct de vedere al securităţii pe care o asigură la circulaţia pe drumurile publice prin diferite medote. Una dintre aceste metode o reprezintă analiza statică neliniară prin solicitări longitudinale, analiză care poate înlocui în anumite cazuri verificarea prin testări la anduranţă. Lucrarea de faţă prezintă o astfel de analiză precum şi rezultatele obţinute în urma acestei analize.

INTRODUCTION

The paper analyzes the functioning of mobile agricultural aggregates (tractor - agricultural machine) coupling devices in order to identify an “*optimal*” coupling and to determine how it works properly, in case of normal and/or critical stresses, by tests under simulated and accelerated regime, respectively under operation on uneven lands, identifying its critical areas (Finite Element Analysis - FEA).

Based on these results, optimization of the *coupling* will be achieved, leading to optimal operation and increased service life, in safety conditions for the operator, but especially for the traffic participants.

The technical conditions for the development of new coupling systems for tractors, trailers and agricultural machinery are harmonized to European standards in order to increase the degree of interchangeability and safety in circulation, one of the main reasons for studying these devices being due to the multitude of accidents caused both in service and in traffic by using inadequate coupling systems (on tractors or trailers, respectively between tractors and agricultural machines) which are not made in accordance with certain traffic safety and security specifications [1].

We analyze the distribution of stresses and deformations in the lateral coupling bars of the tractor suspension mechanism using triangular plane finite elements of CST type [2]. This study serves to geometrically optimize the shape of the lateral coupling bar by increasing its thickness in the areas where the stresses are very big, respectively, by reducing its thickness in the areas where the stresses are too small.

At present, the most widely used are the carried agricultural machines, placed behind tractors, the coupling between the machine and the tractor being made by means of the suspension mechanism. The most common suspension mechanisms are those in three points, currently equipping all agricultural tractors.

The lateral coupling bars are basic components of the suspension mechanisms, being stressed differently depending on the type of agricultural machine carried and the work performed. Thus, in the lifting or transporting position, the main stress for the lateral coupling bars is bending and in the working position, the main stress is tensile.

Using the finite element method [3], [4], [5], [6] it is possible to study the distribution of stresses and displacements in the points on the lateral coupling bars, placing them in the category of flat plate type problem with a constant thickness, for the worst case, that of the lifting position, for which the external force was considered to be the maximum load prescribed for the mechanisms in the second category (15680 N).

MATERIAL AND METHOD

Experimental research to test the strength of a coupling device from the U650M tractor was carried out on a drawbar (Figure 1), which was previously tested in static and dynamic mode, by nonlinear static analysis, considering the situation: longitudinal stress.

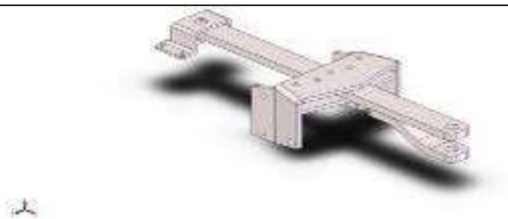
Fig. 1 – Drawbar mounted for experimentation

RESULTS

Drawbar nonlinear static analysis - *longitudinal stress*

Type of analysis: <u>Nonlinear - Static</u>

Model Information

Model Information		
 **Model name: Rel-1.0**		
Solid bodies		
The name of the reference document	Treated as:	Volumetric properties
Cut-Extrude1 	Solid body	Mass:15.1715 kg Volume:0.00197032 m^3 Density:7700 kg/ m^3 Weight:148.681 N
Cut-Extrude1 	Solid body	Mass:5.02876 kg Volume:0.000653085 m^3 Density:7700 kg/ m^3 Weight:49.2818 N
Fillet2 	Solid body	Mass:2.95203 kg Volume:0.000383381 m^3 Density:7700 kg/ m^3 Weight:28.9299 N

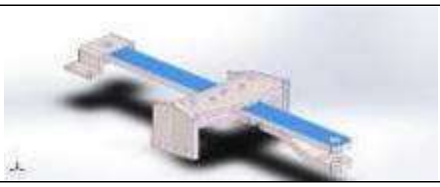
Cut-Extrude4 	Solid body	Mass:18.0411 kg Volume:0.002343 m^3 Density:7700 kg/ m^3 Weight:176.803 N

Information

Piece	Piece image	Piece properties
Contact Set-4		**Entities:** 2 faces **Friction value:** 0.5 **Advanced:** Node-to-surface

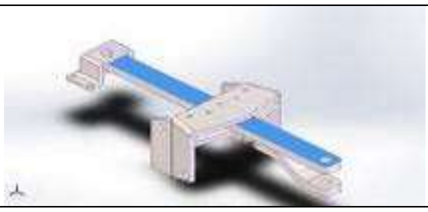
Contact/Friction force

Components	X	Y	Z	Resultant
Contact force (N)	-3.8125	2582.3	-0.015631	2582.3
Friction force (N)	-274.03	-1.0259E-015	-1.7333	274.03

Contact Set-5		**Entities:** 2 faces **Friction value:** 0.5 **Advanced:** Node-to-surface

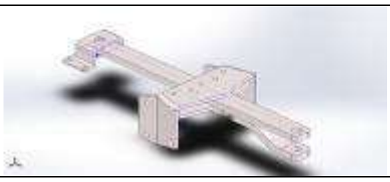
Contact/Friction force

Components	X	Y	Z	Resultant
Contact force (N)	**-0.36503**	**-629.19**	**0.0010524**	**629.19**
Friction force (N)	**-1.2346E-013**	**-1.5407E-031**	**7.8687E-015**	**1.2371E-013**

Contact Set-9		**Entities:** 2 faces **Advanced:** Node-to-surface

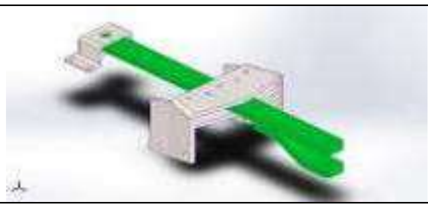
Contact/Friction force

Components	X	Y	Z	Resultant
Contact force (N)	**20.068**	**-4235.4**	**-0.0032082**	**4235.4**
Friction force (N)	**241.84**	**7.7331E-016**	**0.15619**	**241.84**

Contact Set-10		**Entities:** 2 faces **Advanced:** Node-to-surface

Contact/Friction force

Components	X	Y	Z	Resultant
Contact force (N)	**-3.8125**	**2582.3**	**-0.015631**	**2582.3**
Friction force (N)	**-274.03**	**-1.0259E-015**	**-1.7333**	**274.03**

Components **Contact-4**		**Structure:** 2 solid bodies **Options:** Compatible mesh

Properties studied

Name of the study	Nonlinear
Type of analysis	Nonlinear - Static
Mesh type	Compact / Solid
Start	0 se.
Stop	1 sec.
Increment time	Automatic
Travel formula	Yes
Thermal effect	Yes
Thermal option	Includes temperature loads
Solution type	FFEPlus
Control technique	Force
Iterative technique	NR (Newton-Raphson)
Integration method	Newmark
Result folder	SOLIDWORKS document (G:\Carlig_tractor)

Units of measurement used

Measurement system used	SI (MKS)
Length/Movement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m^2

Properties of the material used

Reference model	Properties	Components
	Material name: Alloy steel Model type: **Linear Elastic Isotropic** The implicit breaking criterion: **Tens. Max. von Mises** Average resistance: **6.20422e+008 N/m^2** Traction resistance: **7.23826e+008 N/m^2** Elastic modulus: **2.1e+011 N/m^2** Poisson Coefficient: **0.28** Density: **7700 kg/m^3** Shear modulus: **7.9e+010 N/m^2** Coefficient of thermal expansion: **1.3e-005 /Kelvin**	**Solid body 1**(Cut-Extrude1)(Rel-1.1-1) **Solid body 1**(Cut-Extrude1)(Rel-1.2-1) **Solid body 1**(Fillet2)(Rel-1.3-1) **Solid body 1**(Cut-Extrude4)(Rel-1.4-1)

Tests and fixing

Product name	**Image**	**Details**
Fixed-6		**Entities:** 6 faces **Type:** Fixed geometry

Resulting forces

Components	**X**	**Y**	**Z**	**Resultant**
Reaction force (N)	2.97274	-16.74	-0.166811	17.0027
Reaction moment (N.m)	0	0	0	0

Fixed-2		**Entities:** 6 faces **Type:** Fixed geometry

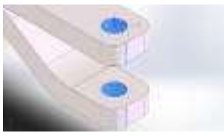
Resulting forces

Components	X	Y	Z	Resultant
Reaction force (N)	-252.973	-2.85289	0.166783	252.989
Reaction moment (N.m)	0	0	0	0

On Flat Faces-1		**Entities:** 2 faces **Type:** on flat faces **Translation:** ---. ---. -0 **Unit of measurement:** mm

Resulting forces

Components	X	Y	Z	Resultant
Reaction force (N)	0	19.4967	0	19.4967
Reaction moment (N.m)	0	0	0	0

Name	Image	Load details
BearingLoads-1		**Entities:** 2 faces **Coordinate system:** Coordinate System1 **Force value:**25000 N

Defining the connectors
Connector pin / pin / bearing

Reference model	Connector details	Force details
 Pin Connector-3	Entities: 2 faces Type: Pin Connection type: With key (no rotation) Connection type: With retaining ring (no displacement)	-

Connection forces

Type	X	Y	Z	Resultant
Axial force (N)	7.9821e-005	13.192	-1.8457e-007	13.192
Shear force (N)	-146.58	0.00088688	0.16587	146.58
Torque (N.m)	4.6033e-007	0.076079	-1.0644e-009	0.076079
Bending moment (N.m)	0.006516	1.574e-007	14.068	14.068

 Pin Connector-4	Entities: 2 faces Type: Pin Connection type: With key (no rotation) Connection type: With retaining ring (no displacement)	-

Connection forces

Type	X	Y	Z	Resultant
Axial force (N)	-6.0222e-005	-9.9703	1.7187e-007	9.9703
Shear force (N)	106.4	-0.00064265	-0.00094652	106.4
Torque (N.m)	6.1979e-007	0.10261	-1.7688e-009	-0.10261
Bending moment (N.m)	-0.0028915	1.7324e-008	-0.0082006	0.0086954

Mesh information

Mesh type	Solid / compact
Mesh used	Curvature based mesh
Jacobian points	16
Element maximum size	19.2419 mm
Element minimum size	3.84838 mm
Mesh quality	High

Resulting forces

Reaction forces

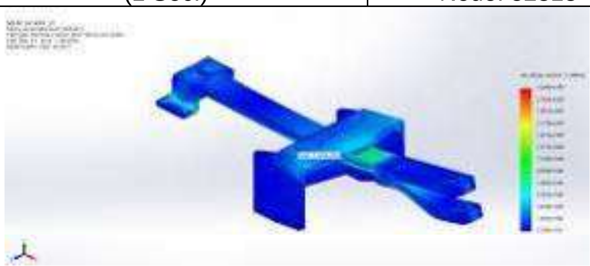
Selection mode	Unit of measurement	Sum X	Sum Y	Sum Z	Resultant
Entire model	N	-250	6.31357e-007	-2.8424e-005	250

Reaction moment

Selection mode	Unit of measurement	Sum X	Sum Y	Sum Z	Resultant
Entire model	N.m	0	0	0	0

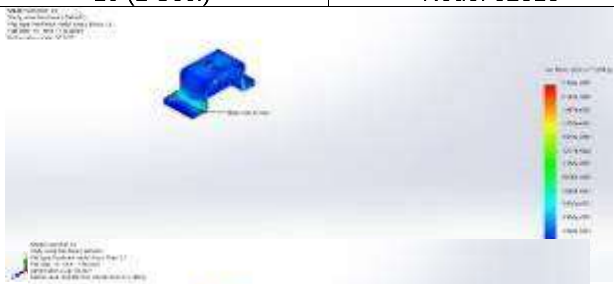
Results obtained

Name	Type	Min	Max
Stress_ Assembly	VON: von Mises stress at step: 10 (1 Sec.)	3.009e-002N/mm^2 (MPa) Node: 52818	2.360e+002N/mm^2 (MPa) Node: 48787

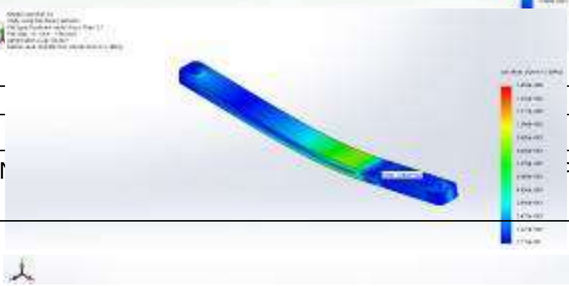


Rel-1.0-Nonlinear-Stress-Stress_Ansamblu

Name	Type	Min	Max
Stress1_3	VON: von Mises stress at step: 10 (1 Sec.)	3.009e-002N/mm^2 (MPa) Node: 52818	2.360e+002N/mm2 (MPa) Node: 48787

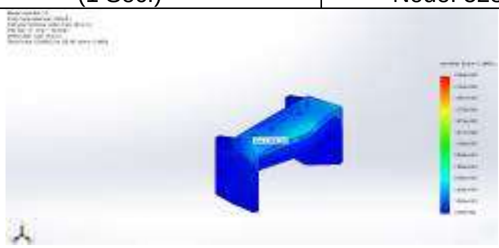


Name			Max
Stress1_1	VO	Pa)	2.360e+002N/mm^2 (MPa) Node: 48787



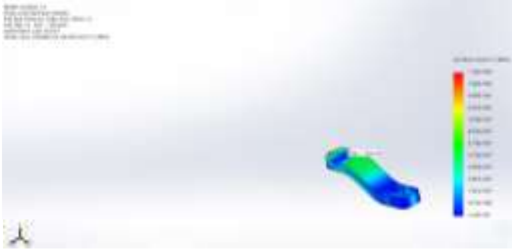
Rel-1.0-Nonlinear-Stress-Stress1_1

Name	Type	Min	Max
Stress1_4	VON: von Mises stress at step: 10 (1 Sec.)	3.009e-002N/mm^2 (MPa) Node: 52818	2.360e+002N/mm^2 (MPa) Node: 48787



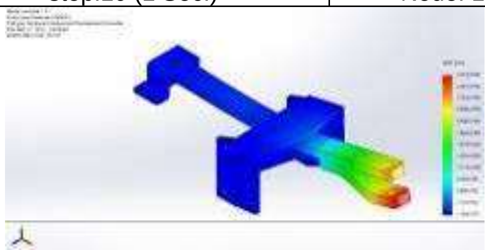
Rel-1.0-Nonlinear-Stress-Stress1_4

Name	Type	Min	Max
Stress1_2	VON: von Mises stress at step:10 (1 Sec.)	3.009e-002N/mm^2 (MPa) Node: 52818	2.360e+002N/mm^2 (MPa) Node: 48787



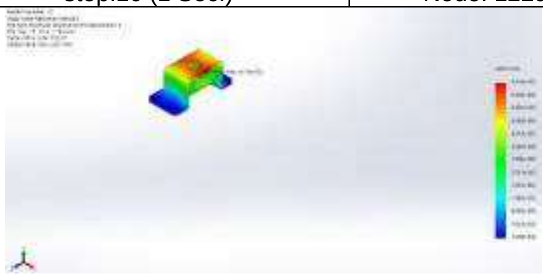
Rel-1.0-Nonlinear-Stress-Stress1_2

Name	Type	Min	Max
Displacement_Ansamblu	URES: Displacement resultant at step:10 (1 Sec.)	0.000e+000mm Node: 12293	3.340e+000mm Node: 8276



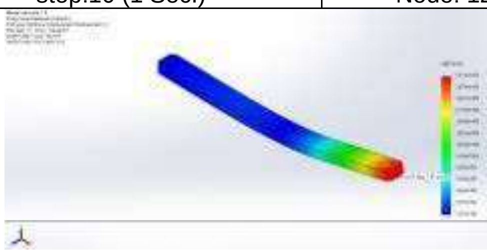
Rel-1.0-Nonlinear-Displacement-Displacement_Assembly

Name	Type	Min	Max
Displacement1_3	URES: Displacement resultant at step:10 (1 Sec.)	0.000e+000mm Node: 12293	3.340e+000mm Node: 8276



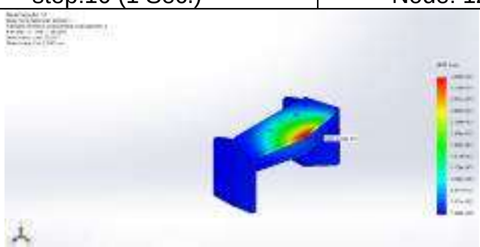
Rel-1.0-Nonlinear-Displacement-Displacement1_3

Name	Type	Min	Max
Displacement1_1	URES: Displacement resultant at step:10 (1 Sec.)	0.000e+000mm Node: 12293	3.340e+000mm Node: 8276

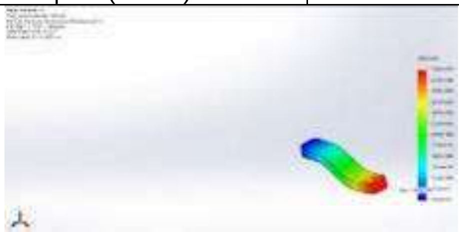


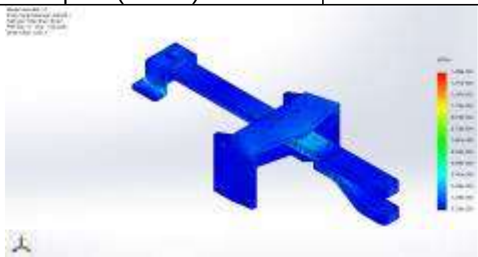
Rel-1.0-Nonlinear-Displacement-Displacement1_1

Name	Type	Min	Max
Displacement1_4	URES: Displacement resultant at step:10 (1 Sec.)	0.000e+000mm Node: 12293	3.340e+000mm Node: 8276



Rel-1.0-Nonlinear-Displacement-Displacement1_4

Name	Type	Min	Max
Displacement1_2	URES: Displacement resultant at step:10 (1 Sec.)	0.000e+000mm Node: 12293	3.340e+000mm Node: 8276
 Rel-1.0-Nonlinear-Displacement-Displacement1_2			

Name	Type	Min	Max
Strain1	ESTRN: Equivalent voltage at step:10 (1 Sec.)	9.236e-008 Element: 56359	1.496e-003 Element: 24502
 Rel-1.0-Nonlinear-Strain-Strain1			

CONCLUSIONS

The biggest stresses occur in the bar hitching area in the two clamping elements on the engine chassis and the coupling pin between the tractor and the trailer, which is why they must be optimized, namely we must choose a quality material with a good coefficient of elasticity to allow taking over some shocks that may occur when passing over holes, etc. and which can cause shearing of the pin or of the articulation elements.

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TUTA ABSOLUTA (LEPIDOPTERA: GELECHIIDAE) - WHAT IMPACT FOR BIODIVERSITY?
/
TUTA ABSOLUTA (LEPIDOPTERA: GELECHIIDAE) – IMPACTUL ASUPRA BIODIVERSITĂȚII?

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Keywords: *Tuta absoluta, invasive pest, biodiversity implications.*

ABSTRACT
The introduction of an invasive species on a new territory is likely to cause an economic and/or environmental harm or harm to human health. Tuta absoluta is considered as one of the worst arthropod invasive pests due to the economic losses in tomato crop, which can reach 100% very often. The aim of the current review is to illustrate the implications of the rapid spread of tomato leafminer on the biodiversity.

REZUMAT
Introducerea unei specii invazive pe un teritoriu nou este susceptibilă să provoace daune economice și de mediu sau să dăuneze sănătății umane. Tuta absoluta este considerat ca fiind unul dintre cei mai periculoși dăunători invazivi datorită pierderilor economice din culturile de tomate. care pot ajunge chiar la 100%. Scopul prezentei sinteze de literatură este ilustrarea implicațiilor răspândirii rapide a minierului frunzelor tomate asupra biodiversității.

INTRODUCTION
Tuta absoluta (Meyrick. 1917) (Lepidoptera: Gelechiidae) is acknowledged as one of the main tomato crop pests and one of the worst invasive arthropod in the world. Centuries ago, exotic plants and animal species were considered beneficial for economic growth and great efforts have been made to introduce and cultivate a wide range of foreign species (*Mack. 2000*). Today, the globalization and intensive trade exchanges lead to undesirable alien species introductions which have negative implications, both on biodiversity and economy. The pest was reported first time in 1914 in Peru and currently is a common pest for South America countries (Jham et al. 2001). *Tuta absoluta* is such a devastating tomato pests because it feeds on all aerial parts, causing losses of 80–100% (*Desneux et al. 2010; Urbaneja et al. 2012*) and it is even more problematic, as the pest can use alternative plants as secondary hosts *(Zlof and Suffert, 2012)*, fact that allows the continuous presence of the pest in diverse habitats, even when the tomato crops are avoided, as part of an IPM plan. Since 2006, when the first specimens where found in Spain, *T. absoluta* managed to spread in around 30 European countries (*EPPO. 2017*), although the pest was included in the EPPO A1 List since 2005 (EPPO 2005). In some of them the pest is under eradication, but the majority of the states are now fighting to find the most suitable control measures, which may include subsidies offered to growers to monitor the pest (e.g. distribution of pheromone traps) and to prevent infestations in greenhouses via the use of insect-proof screens and nets, double doors and insect-free planting material *(Zlof and Suffert, 2012).* Despite of these measures, *Tuta absoluta* has increased its range radius by 800 km each year in the last ten years, infesting almost 60% of the tomato cultivated area worldwide (*Campos et al., 2017*). In the still unaffected areas, various phytosanitary measures, quarantine restrictions and early warning actions are taken while in the areas where the pest is present, various non-chemical control solution are tested in order to avoid massive applications with broad-spectrum insecticides (*Campos et al., 2017*). According to Zlof and Suffert, 2012, in some countries where tomatoes can be planted four to five times per year, growers have been spraying intensively with up to 25 sprays per season, and there is an urgent need to develop effective IPM programmes.

In Romania, the tomato leafminer was first time identified in Botoșani county, in 2009 (Leaotă, 2009). and then started its spread in neiboughring counties: Maramureş (2009), Bihor (2010), Arad (2010), Ilfov

(2010) and Mureş (2010) (Cean and Dobrin, 2009). In 2013, the pest was found again in Arad and Ilfov counties, damaging eggplants and tomatoes, but also in Hunedoara county. The pest was found only indoor on tomatoes crops (*Lycopersicon lycopersicum*). Also, in the period 2009-2010 the pest was intercepted in Cluj, Covasna and Vaslui on fruits imported from Spain and Turkey. In 2017, the pest could be found in all the major vegetable producing areas of Romania. New pesticides were approved and can be legally used today for the control of this pest and there is a high interest of the Romanian farmers for the integrated control, more and more citizens offering for sale traps and pheromons on the free market (https://www.olx.ro).

In our conditions, *Tuta absoluta* might survive over the winter only indoor, but in the Mediterranean. African or some Asian countries, this destructive invasive pest can survive also outdoor. In India, a recent study states that the pest can cause up to 90% loss of yield and fruit quality under greenhouses and field conditions (Madhubala et al., 2017). The recent changes induced by the climate alterations also affect the behavioral patterns of insects and increase their adaptation range, which might raise the threat on biodiversity represented by *T. absoluta*. Our study aims to summarize the implications and threats of the rapid spread of *T. absoluta* on biodiversity.

MATERIAL AND METHOD

A throughout literature review of the major scientific publications was conducted without ignoring the official and unofficial information which could be found on internet, on the specialized websites for plant protection and food safety, including CABI, EPPO, IPPC, EFSA, MADR (Romanian Ministry of Agriculture and Rural development, ANF (Romanian Phytosanitary Authority), ANSVSA (National Sanitary Veterinary and Food Safety Authority).

RESULTS

Impact on plants

Tuta absoluta is recognized as a specific pest for tomatoes, but actually its plant hosts range gathers plants from many different genera and families. It includes until the present moment at least 26 species belonging of 18 genera and nine different families. In Algeria, during studies carried out in the oasis of Ziban (Biskra region) from August 2009 to July 2011. *Tuta absoluta* was found for the first time on beet (*Beta vulgaris*) and spinach (*Spinacia oleracea*), as well as on the weed species *Chenopodium bonus-henricus* and *C. rubrum* (*Drouai et al*.. 2016). The pest has been reported from other economically important Solanaceous plants including *Solanum tuberosum* (L.) (Potato), *Solanum melongena* (eggplant) and weed plants like *Solanum nigrum* (European black nightshade), L.. *Atropa belladonna* L (belladonna), *Datura ferox* (L.) (Fierce thorn–apple), *Nicotiana longiflora* Cav. (longflower tobacco), *Nicotiana glauca* Graham (tree tobacco), *Salpichroa origanifolia* (Lam.) Baill, (Lily of the valley vine)., *Solanum americanum* Mill. (American black nightshade), *Solanum sisymbriifolium* Lam. (sticky nightshade), *Brugmansia arborea* (L.) (Angel's trumpets), *Solanum chenopodioides* Lam. (goosefoot nightshade), *Solanum sarrachoides* Sendtner (hoe nightshade), *Solanum pygmaeum* and *Datura stramonium* (L.) (Jimson weed) (Bawin et al. 2015. Salas Gervassio et al. 2016). Some studies in Sudan, in outdoor vegetable production sites revealed that *T. absoluta* can infest, besides tomatoes, potato and eggplants, weeds as *Datura stramonium* et *S. dubium*, *Vicia faba* (broad bean), *Medicago sativa* (alfalfa) of the Fabaceae family, Citrullus *lanatus* (watermelon) of the Cucurbitaceae family, *Jatropha curcas* of the Euphorbiaceae family, *Amaranthus spinosus* (spiny amaranth) from the Amaranthaceae family and *Xanthium brasilicum* from the Asteraceae family. Many of these weeds are also present in Romania.

Impact on arthropods

In its native environment, the tomato leafminer lives in a natural balance with many parasitoids and predators species. Collections conducted in twelve countries, in open-field crops, protected susceptible crops, wild flora and using infested sentinel plants leaded to a list including more than 70 arthropod species which attack *T. absoluta*. 20 % predators and 80 % parasitoids (Zappala et al.. 2013). The lists of Zappala and colab. (2013) are not complete. as researchers all over the world are trying to find the best options for biologic control in theirs specific area conditions, without being tempted to import the predators/parasitoids from other countries. Their list could be enlarged with native predators (e.g. Macrolophus caliginosus, Nesidiocorus tenuis) and the search for more effective egg parasites worldwide continues.

Impact on environment

The extensive use of synthetic pesticides to control a single target organism often leads to the development of resistance phenomena, which have a negative impact on the environment. particularly on non-target arthropods and soil composition. Only one year **a**fter its first mention in Spain, there were necessary more than 15 chemical treatments/season while in Romania more than 10 chemical treatments were recommended by crop protection specialists.

Plant-derived active compounds, such as essential oils (EOs) are one of the alternative solution. The results of a test with Citrus peel essential oil nanoformulations showed an overall good insecticidal activity with a higher mortality through contact on eggs and larvae by EO emulsions and through ingestion on larvae by EO-NPs, while the nanoformulation significantly reduced the visible toxic effects on the plants (Campolo et al.. 2017). In a study performed by El-Samahy et al.. 2014, silica nanoparticles were effective in the control of *T. absoluta* under field condition with high yield in tomato, with the same efficacy as the imidacloprid, but more studies are necessary to evaluate the side effects on natural ennemies. The same authors also showed a significant increase in the weight and size of tomato fruits as a result of the silica nanoparticles treatment, fact which might be as well appreciated by the farmers.

In Romania, at the Research and Development Institute for Vegetables and flowers in one ADER programme done in the period 2011-2014, *Tuta absoluta* attack started at the begining of July (05.07) in low tunnels and begining of September (10.09) in high plastic tunnels, in tomato crops. The organic preparations OLEORGAN, QUAMAR and KONFLIC, all used at 0.3% concentration, showed promising results in controlling *T. absoluta* populations.

Biological control agents

In some studies, the biological insecticides were more effective in the control of *T. absoluta* than the selected chemical insecticides. Application of bio-insecticides (as Spinetoram, Spinosad and Emamectin) at different doses caused a higher reduction of pest infestation and loses (Gebremariam. 2015). According to Gacemi and Guenaoui (2012), three times foliar application of Emamectin benzoate at seven days interval in a tomato greenhouse caused 87% mortality of tomato leaf miner larvae.

CONCLUSIONS

Tuta absoluta is a threatening pest that can cause great losses in the future not only to the tomato crop but to others crops. The implication on biodiversity should be continuously monitored, as the list of host plants is extending each year.

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EVALUATION OF THE POTENTIAL RISKS OF SEWAGE SLUDGE COMPOST ON THE SOIL-PLANTS SYSTEM
/
EVALUAREA POTENŢIALELOR RISCURI ALE NĂMOLURILOR DE EPURARE COMPOSTATE ASUPRA SUBSTRATULUI DE CULTURĂ

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Keywords: *sewage sludge, cereal straw, shredded paper, compost, Lactuca sativa L., ATR-FTIR analysis.*

ABSTRACT
The composting process is considered as an economically and environmentally viable alternative to hygienization and stabilization sewage sludge from small sewage treatment plants, from non-industrialized cities.The main purpose of the paper is to determine the degree of phytotoxicity as well as the quality parameters of the two compost mixes obtained from sewage sludge with cereal straw (CSSS), sewage sludge with shredded paper (SPSS) and a compost derived from household waste (HW). Normalized germination index values (NGI) for two dilutions (1:10 v/w and 1:20v/w) indicate low compost toxicity (SPSS) as demonstrated by the ATR-FTIR analysis, demonstrating the presence of polyethylene (PELD and PET) with decreased degradation level due to plastic paper. We note that for all three calculated quality indices (RSI, EI and DQI). significant values (p-value <0.001) are obtained when using the sewage sludge with cereal straw compost (CSSS) as the substrate.

REZUMAT
Procesul de compostare este considerat o alternativă viabilă economic și ambientală pentru igienizarea și stabilizarea nămolurilor de epurare rezultate de la stațiile mici de tratare a apelor uzate de la orașele neindustrializate. Scopul principal al lucrării este de a determina gradul de fitotoxicitate precum și indicii de calitate a două amestecuri de compost obținute din nămoluri de epurare cu paie (CSSS).,nămoluri de epurare cu hârtie (SPSS) și un compost obținut din reziduuri menajere (HW). Valorile indicelui de germinare normalizată (NGI) în cazul a două diluții (1:10 v/w și 1:20 v/w) indică o toxicitate redusă pentru compostul (SPSS), fapt demonstrat și prin analiza ATR-FTIR. demonstrând prezența polietilenei (PELD și PET) cu grad scăzut de degradare datorită hârtiei plastificate. Remarcăm faptul că pentru toți cei trei indici de calitate calculați (RSI, EI și DQI). valori semnificative (p-value<0.001) se obțin în cazul utilizării ca substrat a amestecului de compost obținut din nămoluri de epurare cu paie (CSSS).

INTRODUCTION
Sustainable agriculture becomes more present in farmers, input producers and consumers vocabulary. It is a term which causes agriculture and the beneficiaries of this system to think very hard about the environment, so that this exists to produce, being fertile and friendly also for next generations. Our capacities to reduce the quantities of waste and residues from agriculture make us think about of transforming these wastes in soilborn with fertile properties for next agricultural and horticultural crop. We have to learn from the experience of the developed country that have tradition in treatment of wastewater. Romania is a country with great problems over waste selection, recycling of plant debris, sewage sludge, organic waste, respectively, for transforming them in diferent products.

The present paper makes a comparative assessing for five different seedlings of lettuce (*Lactuca sativa* L.) and garden cress (*Lepidium sativum* L.) crops, over the quality of the sewage sludge compost.

The results obtained by Iranzo et al. (2004) on sewage sludge and rice straw compost, following physical, chemical and microbiological analyses have noticed that certain mixture can be usefull for the fertilization of agricultural land. In addition, they have calculated a C/N ratio ranging from 16 to 24, optimal for development of soil microorganisms. Thermophilic composting of the mix at 62°C for 48 hours resulted in a free pathogenic mix. In 2007, Ostos et al.. substituted a comercial peat with municipal waste and sewage sludge on the soil of the mastic tree in nurseries, that proved to be suitable for obtaining a suitable substrate. The peat and sewage sludge compost were more efficient than municipal solid waste and peat compost after 72h. The value of the germination index after 48 h of the peat was practically twice as great as the distilled water test and after 72 h the values were almost the same, while the composts made up of municipal sewage sludge and peat waste had significance. Similarly in 2012, Rios et al.. concluded that paper sludge has a potential use for improving soil use.

MATERIAL AND METHOD

The materials used are: cereal straw and sewage sludge compost (CSSS); shredded paper and sewage sludge compost (SPSS); household waste compost (HW) and comercial peat as control (P). The provenience of this materials are from the Otopeni wastewater treatment plant for sewage sludge, resulting from the biological wastewater treatment step and the peat purchased by Marcoser S.R.L. from Matca, Galați country.

To achieve the experience, alveolar fixed seed trays were used. Experimental substrates were comprised of three types of compost in different ratios: 25%, 50%, 75% and 100%. respectively. The sowing of the salad was carried out on February 28, 2017. The same measured volume was used for the seed substrate reports in relation to the apparent density of the substrate constituent materials. The three composts and the pea,. red preluvosol soil, respectively, were sieved through a metal screen with a hole diameter of 4.0 mm. Four variants of substrates were tested (Table 1).

Table 1

Elements of single-factor experimentation

Sewage sludge + shredded paper (SPSS)	25% SPSS + 75% P	50% SPSS + 50% P	75% SPSS + 25% P	100% SPSS
Sewage sludge + cereal straw (CSSS)	25% CSSS + 75% P	50% CSSS + 50% P	75% CSSS + 25% P	100% CSSS
Household waste compost (HW)	25% HW + 75% P	50% HW + 50% P	75% HW + 25% P	100% HW
Commercial peat (P)				100% P

Control on plant evolution was made daily, until the end of the experiment and biometric measurements were made on plants. This coincided with the period of pricking out of the salad plant, ranging between 45 and 60 days after sowing. During the experiment. watering was applied to plants.

Preliminary operations of the assays were performed according to Zucconi et al. 1981. The germination index (GI) was determined as follows: 17 garden cress seeds (*Lepidium sativum* L.) were placed on three paper filters (Whatman 1) in a 9.0 cm diameter Petri dish, over the paper filter that was humidified (5 ml) with the compost solution in two dilutions ratio (DL1 and DL2) 1:10 w/w. respectively 1:20 w/w. Five grams of compost were used in the achivement of the dilutions (50 ml of distilled water DL1 and 100 ml of distilled water DL2), as follows: shredded paper and sewage sludge compost, cereal straw and sewage sludge compost, household waste compost and the distilled water was control. Suspensions from the Erlenmeyer flask were placed on the IKA Vortex Genius 3 shaker for one hour. After the shaking process was completed and solutions were obtained, they were let to rest to decant and then filtered using filter paper (Whatman 1). To determine the germination index, the seeds were incubated (BF 240 model) in the dark at 25°C for 72 hours. Each dilution is done in three repetitions.

In the case of the use of compost as a culture substrate during the vegetation (*Lactuca sativa* L.), the following biometric measurements were performed: the date of rise, the germination deflection, the number of leaves of the plants, the colet diameter, the epigeous plant height, the root elongation, total plant height, both root and stem green weight and total green weight of plants. Subsequently, the plants were dried in the oven and the root and the stem dry were weight. For this purpose. twenty-four plants from each alveolar fixed seed trays of experience were marked. At the palant maturation, samples were taken and determinations were made on their development: the number of leaves of the plants, the colet diameter, the epigeous plant height, the root elongation, total plant height.

In order to achieve the proposed objectives, some of the index may lead to conclusions on the quality of sewage sludge composts and the rural household waste compost used have been followed in the experiments: the elongation index (EI) (Schmidt-Vogt. 1981); root-stem index (RSI) (Iverson. 1984); Dickson quality index (Dickson et al.. 1960).

In order to make comparisons between the compost solutions from the experience of *Lepidium sativum* L. seeds, the relative seed germination percentage (RGP), the relative root elongation rate (RRE), germination index (GI), (Hoekstra et al.. 2002 and Walter et al.. 2006), normal residual germination index (NGI) and normal residual elongation index (NEI), respectively. (Bagur-Gonzáles et al.. 2002)

Both indices, NGI and NEI establish toxicity of the solutions for negative values and values can be interpreted as follows: for values between 0 and -0.25 the degree of toxicity is low; values between -0.25 and -0.50 are considered to be of medium toxicity; values ranging from -0.50 to -0.75 show high toxicity and values ranging from -0.75 to 1.0 show very high toxicity. Positive values of these indices indicate normal growth of the root or hormesis effect. (Bagur-Gonzáles et al.. 2011)

Statistical analysis was performed using Microsoft Excel 2010.

Spectroscopic analysis in IR was performed using the ATR (Attenuated Total Reflectance) method using the Thermo Scientific Nicolet ™ iS ™ 50S spectroscope with a spectral range of 400-4000 cm^{-1} with 32 scans. (Sánchez-Báscones et al.. 2016). The ATR accessory is a horizontal diamond (the angle of incidence of 45°) and the absorption of IR radiation of the molecules is determined when it starts vibrating. This technique was used to observe the functional groups of humic and fulvic acids of compost mixtures analyzed. An FTIR spectrum is a fingerprint of the functional group and for this reason it is important to know in which region of the spectrum we meet the characteristics of the studied material. The fund is determined in the atmosphere without material.

RESULTS

1. Experimental results on degree of phytotoxicity on *Lepidium sativum* L. seeds of composts dilutions (DL1 and DL2) resulting from sewage sludge with shredded paper, sewage sludge with cereal straw (SPSS and CSSS) and household waste (HW).

The experimental data characterizing the composts taken into account for the two dilutions (DL1 and DL2) (Matei et al.. 2016 and Rodriguez Romero et al.. 2014) are shown in Table 2. For both (DL1) and (DL2) the percentage of relative germination (RGP) for all composts with an average of 102.7% for (DL1) exceeding the transgression value of 5% and 100.7% for (DL2), respectively. The germination index (Hoekstra et al.. 2002 and Walter et al.. 2006) showed significant values for both composting sewage sludge mixed with shredded paper (409.9 ± 71.4%) and the one made up of sewage sludge with cereal straw (434.1 ± 31.9%), the lowest values being recorded for household waste compost (120.1 ± 22.8%). The values obtained for relative root elongation (RRE) revealed sewage sludge mixed with cereal straw with distinctly significant values (425.4 ± 44.4%).

Table 2

Biological response on *Lepidium sativum* L. crops for two compost dilutions (DL1) and (DL2)

Response	SPSS		CSSS		HW		DW	
	DL1	DL2	DL1	DL2	DL1	DL2	DL1	DL2
RGP	104.1	98.0	102.0	102.0	102.0	104.1	100.0	100.0
RE	393.8	382.3	425.4	401.5	117.7	105.0	100.0	100.0
GI	409.9	374.5	434.1	409.7	120.1	109.3	100.0	100.0
RE	3.4	3.3	3.7	3.5	1.0	0.9	0.9	0.9
NGI	0.041	-0.020	0.020	0.020	0.020	0.041	0.000	0.000
NEI	2.938	2.823	3.254	3.015	0.177	0.050	0.000	0.000

SPSS (sewage sludge with shredded paper); CSSS (sewage sludge with cereal straw); HW (household waste compost); DW (distilled water); RGP (relative germination percent); RRE (relative root elongation); GI (germination index); RE (root elongation); NGI (normal residual germination index); NEI (normal residual root elongation index).

In Table 2 we also observe the values of normalized germination index (NGI) and normalized residual root elongation index (NEI), both indices set values of dillution toxicity for negative values. Only the normalized germination index (NGI) values showed reduced toxicity for sewage sludge with shredded compost (SPSS) (-0.020) (DL2), according to Bagur-Gonzáles (2011) dilutions for values ranging from 0 to -0.25. The positive values of these indices obtained for the dilutions used in the other composts indicate a normal growth of the root without phytotoxic effect. As we can see, the sewage sludge with cereal straw compost (CSSS) results most well for its use as a crop substrate and the highest root elongation (RE) values following seed germination (DL1 = 3.7 cm. DL2 = 3.5 cm).

2. Experimental results on the quality of composts from sewage sludge with cereal straw and sewage sludge with shredded paper (CSSS and SPSS) and household waste (HW) used as a substrate for *Lactuca sativa* L. plants.

In the greenhouse of U.A.S.M.V. in Bucharest, the percentage of emergence in the experience regarding the quality of the composts obtained from the sewage sludge (CSSS and SPSS) and household waste (HW) as the substrate for the *Lactuca sativa* L. plants was the first factor. The obtained results were recorded daily over the 21 days for each substrate. For each compost one was sown in the three replications, a total of 48 seeds corresponding to the maximum percentage of 100% (Figure 1). The results recorded the following: the highest number of seeds was found in the 25% CSSS mixture with 43 seeds, corresponding to 89.6%, followed by 25% SPSS substrate with 42 seeds seeded, 87.5% and 50% SPSS and 100% P substrates with 41 seeded seeds.

Fig. 1 - Analysis of the percentage of emergence in *Lactuca sativa* L. using as a crop substrate mixtures of compost (SPSS. CSSS and HW) with peat (P) in different percentages (25. 50. 75 and 100%).

In the greenhouse conditions in which the analysis was carried out, we noted the 100% CSSS substrate with the highest value of 9.4 leaves per plant, 25% CSSS and 50% SPSS for the largest colet diameter value 4.0 ± 1.5 mm, 4.0 ± 1.2 mm (Table 3). respectively. As far as the root elongation is concerned, we note that once again 25% CSSS with a value of 11.7 ± 5.0 cm and the height of the epigeal area (13.0 ± 4.7 cm) are obtained, resulting in this substrate the highest height of the plant 24.7 ± 8.9 cm (Table 3).

Table 3

Morphological characters of *Lactuca sativa* L. cultivated on the substrate obtained from the compost mixture (SPSS. CSSS and HW) with peat (P) in different percentages (25. 50. 75 and 100%).

Compost substrates		Leafs number	Colet diameter (mm)	Root elongation (cm)	Elongation of epigeal zone (cm)	Total length plant (cm)
CSSS	25%	8.2±4.3	4.0±1.5***	11.7±5.0***	13.0±4.7***	24.7±8.9***
	50%	7.7±1.2	3.4±0.7	10.4±1.4	12.3±1.9***	22.8±2.2***
	75%	8.4±3.8	3.5±1.6	9.3±4.0	12.8±5.3***	22.1±9.3***
	100%	9.4±5.2***	3.4±1.8	9.1±4.7	9.1±4.9	18.2±9.4
SPSS	25%	8.7±2.0***	3.9±1.1***	9.0±2.5	9.9±2.5	18.9±4.5
	50%	8.0±2.4	4.0±1.2***	9.0±2.4	11.4±2.6***	20.4±4.8
	75%	7.9±3.7	3.9±1.7***	9.0±4.2	9.8±4.4	18.7±8.3
	100%	8.5±4.0***	3.3±1.6	8.9±4.2	8.0±3.8	16.9±7.9
HW	25%	8.0±2.8	3.2±1.3	9.8±3.1	6.8±2.3	16.5±5.1
	50%	7.5±2.9	3.2±1.3	10.7±3.9	6.6±2.6	17.3±6.0
	75%	7.8±1.5	3.1±0.7	9.9±1.5	6.2±1.4	16.1±2.1
	100%	7.5±2.4	3.1±1.0	8.9±2.7	7.3±2.4	16.2±4.8
P	100%	7.3±1.9	3.0±0.8	10.5±2.8	6.0±1.6	16.5±3.9
AVERAGE		8.1±0.6	3.5±0.4	9.7±0.9	9.2±2.6	18.9±2.8

DL5%	0.49	0.30	0.75	2.18	2.38

Standard deviation(±) ; *** p< 0.001

In Table 4 we can see the determinations of the quality indices (RSI. EI and DQI) of compost mixtures (SPSS, CSSS and HW) with peat (P) in different percentages (25, 50, 75 and 100%).

Table 4

Means quality characters of *Lactuca sativa* L. cultivated on the substrate obtained from the compost mixture (SPSS. CSSS and HW) with peat (P) in different percentages (25. 50. 75 and 100%).

Compost substrates		Dry plants ratio (g)	RSI	EI	DQI
CSSS	25%	0.104	3.245***	3.213***	0.66*
	50%	0.076	2.725***	3.613***	0.46***
	75%	0.065	3.486***	3.625***	0.40***
	100%	0.061	3.648***	2.716**	0.32***
SPSS	25%	0.095	2.467**	2.565*	0.65*
	50%	0.100	2.382**	2.847**	0.75
	75%	0.095	2.383**	2.514*	0.67
	100%	0.085	2.567**	2.411	0.50***
HW	25%	0.119	1.911	2.085	0.64*
	50%	0.126	1.725	2.058	0.77
	75%	0.131	1.741	1.975	0.72
	100%	0.107	1.983	2.316	0.56**
P	100%	0.162	1.551	1.979	0.79
AVERAGE		0.102	2.447	2.609	0.61
p < 0.05		0.024	0.578	0.488	0.013

RSI (Root-Stem Index); EI (Elongation Index); DQI (Dickson Quality Index); *** *p-value*<0.001

We note that for all three calculated quality indices (RSI, EI and DQI), significant values (p-value <0.001) are obtained when using the sewage sludge with cereal straw compost (CSSS) as substrate. Also, when using the sewage sludge with shredded paper compost (SPSS) significant values were obtained but with a (p-value <0.01), respectively (p-value <0.5).

In terms of (RSI) (Iverson. 1984), are significant (p-value<0.001) for (CSSS) values for all percentages of peat mixtures (P), while for SPSS (p-value <0.01) are significant and for the mixture (HW), the values obtained are not significant. The root-stem index indicates that a plant has a better quality when its aerial side is relatively smaller than the root, which can guarantee better development due to the fact that the transpiration is no greater than the absorption power of the plant (May , 1984).

A second important index in the evaluation of seedliness quality is the elongation index (EI) (Schmidt-Vogt. 1981), on the basis of which it can be appreciated that a high positive value determines a good seedling quality in the case of pricking out plants (Toral. 1997). The data from Table 4 show that significant distict values (p-value <0.001) are also obtained in the case of the mixture (CSSS), demonstrating the quality of this compost mixture as a substrate for obtaining quality seedlings. This index correlates the plant's resistance with its photosynthetic capability.

The Dickson Quality Index (DQI) (Dickson et al.. 1960) combines the influence of the two previous indices (RSI and EI), resulting in a qualitative interpretation of the seedlings composts (Oliet. 2000). It is highlighted in Table 4 that for this index the best substrate is peat (P) with the value of 0.79. and compost with the lowest behavior (DQI 0.32) against the control (P) is 100% CSSS. This issue demonstrates the importance of peat in the nutrient mixture for the substrates. (Herrera et al.. 2009)

3. Characterization using ATR-FTIR (Attenuated Total Reflection - Fourier Transform Infrared spectroscopy) spectrophotometry of composts from sewage sludge (CSSS and SPSS) and household waste (HW).

One of the objectives of this study was the identification by ATR-FTIR of the presence of cellulose, hemicellulose, lignin, humic and fulvic acids in sewage sludge composts (CSSS and SPSS), household waste compost (HW). It has been able to isolate low-grade plasticized paper from sewage sludge compost materials. consisting of low-density polyethylene (LDPE) and polyethylene terephthalate (PET), a widely used plastic for packaging. In Figure 2 and Table 5 the totality of the FTIR spectra, the spectral bands respectively, characteristic of the analyzed samples are found.

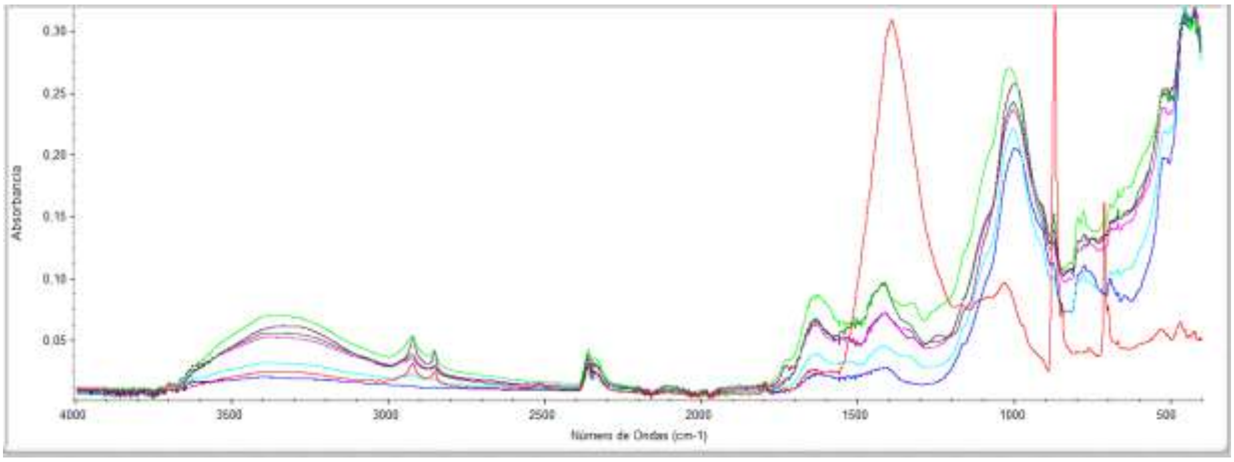

Fig. 2 – FTIR spectrum for cereal straws with sewage sludge compost (CSSS – blue light color), shredded paper with sewage sludge compost (SPSS – dark green color) and householder waste (HW – violet color). We also find the spectra for materials identified in non-degraded compost, namely straw (light green color) and plasticized paper (red color)

Table 5

The main ATR-FTIR spectral bands obtained for compost samples analyzed as well as uncompacted materials visible in compost. Wavelength (cm-1) (in brackets the absorbance values are found).

Sample	**Wavelength** (cm^{-1})										
Straw residue	3350 (0.05)	2927 (0.043)	2857 (0.030)	1634 (0.056)	1422 (0.086)	1324 (0.052)	1164 (0.080)	1020 (0.18)	878 (0.11)	784 (0.10)	524 (0.2)
Household waste (HW)	3350 (0.04)	2927 (0.043)	2857 (0.03)	1640 (0.053)	1419 (0.058)	1327 (0.041)	1156 (0.063)	1000 (0.22)	878 (0.12)	751 (0.11)	524 (0.2)
Sewage sludge with shredded paper (SPSS)	3362 (0.04)	2930 (0.03)	2860 (0.024)	1643 (0.05)	1422 (0.068)	1350 (0.09)	1094 (0.12)	1002 (0.17)	878 (0.2)	778 (0.19)	529 (0.3)
Sewage sludge	3262 (0.04)	2930 (0.03)	2860 (0.024)	1643 (0.05)	1424 (0.060)	1347 (0.05)	1094 (0.12)	1011 (0.20)	878 (0.1)	778 (0.19)	526 (0.3)
Sewage sludge with cereal straw (CSSS)	3362 (0.025)	2930 (0.03)	2860 (0.028)	1640 (0.05)	1412 (0.06)	1342 (0.05)	1091 (0.17)	1002 (0.3)	872 (0.15)	775 (0.15)	515 (0.3)
Plastic paper residue	3371 (0.024)	2928 (0.03)	2854 (0.02)	1646 (0.02)	1392 (0.30)		1035 (0.1)		875 (0.4)	713 (0.15)	

Table 5 shows the characteristic peaks of the 872 cm-1 band corresponding to the cellulose-C-H group in the case of sewage sludge with cereal straw (CSSS) composts. The characteristic peaks in the range 1091 cm-1 and 1164 cm-1 can be assigned to β-1.4-glycosidic –C–O–C– bending vibrations demonstrating the presence of straw in compost (CSSS). The band 1000-1020 cm-1 is the band of the highest intensity and corresponds to the vibrations for the C–C. C–O alcohol groups and Si–O–Si. Si–O–C silicate groups (Rojas-Morales et al. 2016), encountered in all analyzed samples. Due to water absorption. a band between 1634 cm-1 and 1640 cm-1 can also be identified for all analyzed samples. We can conclude that all compost samples are contained in cellulose and lignocellulosic material and / or silicates.

With regard to the ATR-FTIR spectral study for sewage sludge compost (CSSS and SPSS), it can be observed that they are very similar (figure 2) with a high organic content due to the presence of cellulose peaks (Ziaul Karim et al.. 2014) hemicellulose and lignin as well as humic and fulvic acids present in compost biomass.

Also, comparing the values of the wavelengths for the paper residue (SPSS) (Table 5) with the low density polyethylene (LDPE) values (Figure 2) represented in the bibliography (Sierra et al. 2010), we demonstrate the presence of polyethylene (PE) in sewage sludge with shredded paper compost (SPSS). We identify typical bands of the –CH2 groups appearing in our study at wavelengths 2928 cm-1. 2854 cm-1 and 1392 cm-1 in correspondence with the PE-specific wavelengths in the bibliography (2911 cm-1. 2843 cm-1 and for the range 1357-1460 cm-1).

It is very important to assume that the presence of polyethylene terephthalate (PET), specific to the peak at the wavelength of 870 cm-1 is assigned to outside the chart vibrations (Sierra et al.. 2010).

CONCLUSIONS

The results obtained with the percentage germination of *Lepidium sativum* L. seeds using compost dillutions (1:20 v/w) in the case of sewage sludge with shredded paper compost (104.08%) show significance *p-value* to control. Regarding the root length obtained by germination of seeds of *Lepidium sativum* L. using two compost dilutions (1:10 v/w and 1:20 v/w). significant levels was for sewage sludge compost (CSSS and SPSS). Germination index (GI) in both dilutions showed positive values for sewage sludge composts. All three calculated quality indices (RSI. EI and DQI) demonstrated significant values (*p-value* <0.001) are obtained when using the sewage sludge with cereal straw compost (CSSS) as the substrate. Low phytotoxicity (NGI=-0.02) was recorded for sewage sludge with shredded paper compost (SPSS). Comparing the percentage of *Lactuca sativa* L. emergence in peat compost mixtures analyzed to distinguish from 25% CSSS sewage sludge with cereal straw compost with the highest value (89.6%). Sewage sludge from wastewater treatment plant of non-industrialized cities does not pose any risk to plant quality. Highest values of biometric assays on *Lactuca sativa* L. demonstrated high quality of sewage sludge with cereal straw compost (25% CSSS). As a conclusion on the characterization of sewage sludge composting by the ATR-FTIR spectrophotometric method, the paper residue from sewage sludge compost (SPSS) is a poorly degradable polyethylene (LDPE), possibly evidence of low phytotoxicity. It is important to note that the presence of polyethylene terephthalate (PET), specific to the peak at the wavelength of 870 cm-1, was also observed in sewage sludge with shredded paper composts.

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THE RESEARCH ON THE PHENOTYPING OF NATIVE VARIETIES OF APPLE / *CERCETARI PRIVIND FENOTIPAJUL UNOR SOIURI AUTOHTONE DE MAR*

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Keywords: symptoms, *varieties, infection, scab, resistance.*

ABSTRACT

As for plant diseases, the amelioratin designed to increase natural genetic resistance is one of the effective measures for protection. The resistance of older apple varieties of Romanian origin is usually quantitatively determined. Simultaneously with the development of apple resistance to scab, new races of Venturia inaequalis were also found.

The main objective in this work is to identify a new sources of resistance to scab in to the old Romanian varieties of apple and involved them in the Romanian breeding program in order to induce a partially or total resistance to scab using this new source to resistance. The first step was to discover and evaluate the new sources to resistance of scab and therefore, were chosen the varieties "Călugărești", "Moți", "Ouțe", "Mere Tari", "Tare de Ghindă". For the second step, the research was continued with fenotyping them after artificial infections with Venturia inaequalis.

REZUMAT

In ceea ce priveşte bolile plantelor, ameliorarea pentru rezistență genetică naturală este una dintre măsurile eficiente pentru o protecție. Rezistența soiurilor de mere mai vechi de origine română este de obicei determinată cantitativ. Simultan cu dezvoltarea rezistenței la rapăn a soiurilor de măr,au fost găsite și noi rase de Venturia inaequalis.

Obiectivul principal al acestei lucrări este de a identifica noi surse de rezistență la rapăn în rândul vechilor soiuri de mere românești și a implicării acestora în programul de ameliorare din România pentru a induce o rezistență parțială sau totală la rapăn folosind această nouă sursă de rezistență. Primul pas a fost identificarea și evaluarea noilor surse la rezistența la rapăn iar pentru aceasta au fost alese soiurile "Călugărești", "Moți", "Ouțe", "Mere Tari". "Tare de Ghindă". Pentru a doua etapă. cercetarea a continuat cu fenotyparea acestora după infecții artificiale cu Venturia inaequalis.

INTRODUCTION

Apple scab is one of the most widespread diseases of apple trees. Breeding for resistance to diseases is targeted when developing varieties resistant to scab.(Bowen JK et all. [1])

This disease is caused by *Venturia inaequalis* (*Ascomycetes*) (Tenzer and Gessler. [15]). Leaves attacked by scab have a lower assimilation rate. They are falling off earlier, fruits do not develop to normal size and do not have the full taste quality (Dvořák et al. [6]). Breeding for resistance is one of the effective measures for a protection against this disease. Of the old genotypes known to exist in the Carpathian Basin, almost 200 local cultivars have been collected in the germoplasm collection over the last years. Some of the cultivars found in the germoplasm collection could be used not only in breeding, but also in organic farming, so there is a great need for the re-evaluation of the old apple cultivars. Some of the old apple varieties have become well adapted to the soil and climatic conditions of the Carpathian Basin producing good yields and highly appreciated fruit quality (Mitre I.et all. [13])

The implement of resistance of older apple varieties of Romanian origin could be a promising way for a viable breeding program in Romania. First step in this work was the identification and collection (from different parts of the country) and evaluation an important number of old local varieties. (Ion L. and colab.[9])

Using DNA markers of resistance to *V. inaequalis* will be based on the polymerase chain reaction (PCR).

Recovery in the Romanian breeding program the old local varieties, best suited to the climatic conditions of Romania was used like a natural source of resistance to pathogen attacks.

MATERIALS AND METHODS

Plant material evaluated included the five apple old varieties like “Călugărești”, “Moți”, “Ouțe”, “Mere Tari”, “Tare de Ghinda”.

Methods of work were the phenotyping tests.

Infection tests in greenhouse conditions according to Chevalier et al. (1991) were used for selection of resistant plants. Mixtures of isolates were used for plantlet inoculation. Seedlings were sprayed with a conidial suspension of *Venturia inaequalis* CKE. Seedlings were incubated for 48 hours at 18°C and 100% relative humidity. Disease symptoms were evaluated macroscopically after 21 days of cultivation in a greenhouse. Seedlings were divided into 5 classes. Plants in class 0 were without symptoms of infection. Plants of class 4 had lesions with full sporulation. For PCR analyses only pre-selected seedlings without symptoms of apple scab on the leaves – class 0 to 3 were used.(fig. 1 and 2).

The reading of simptoms was performed 14 days after infection, where each young plant according to the symptoms presented was classified on classes of resistance starting from class 0 through class 4 with subunits 3a, 3b and 3c. (Chevalier 1991) (Figure 1).

Fig. 1 - Aspects from artificial infections in the greenhouse and lecture of symptoms

RESULTS AND DISCUSSIONS

In order to plan an efficient breeding program to obtain cultivars resistant to scab, it is important to know the genetic control of this resistance. Although there is controversy about the genetic control of the resistance to *Vf* in apple, all authors consider that resistance could be transmitted from resistant progenitors to offspring. However, Dayton et al. (1970) found that descendants from crosses between susceptible and resistant cultivars segregated in a complex way. The old romanian apple varieties after artificial infection by *Venturia inaequalis,* were evaluated by phenotyping.

Table 1

Results on the phenotyping tests of apples old varieties

Nr. Crt	Variety of apple	Number of stratified seeds	Number of replanting plants	Number of plants at 10 days	Number of plants at 20 days	% of the plants grown
1	Călugărești	46	36	28	21	45.6
2	Moți	40	30	19	9	22.5
3	Ouțe	70	59	36	26	37.1
4	Mere Tari	60	39	31	23	38.3
5	Tari de Ghindă	80	60	57	38	47.5

The apple varieties taken in the study "Călugăreşti", "Moţi", "Ouţe", "Mere Tari", "Tari de Ghindă" were stratified at 4⁰C and after rising and replanting the highest percentage of raised plants were observed at "Tari de Ghindă" variety with 47.5% followed by "Călugăreşti" variety with 45.6%. The lowest percentage was registered in the "Moţi" variety, with 22.5%

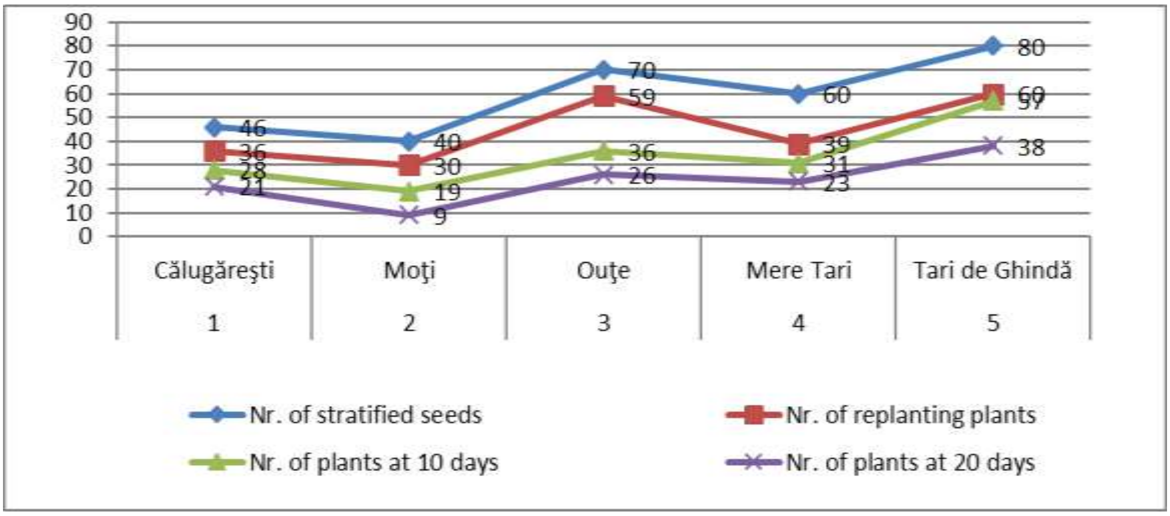

Fig. 3 - Phenotyping tests of apples old varieties

As a result of artificial infections with *Venturia inaequalis*, the highest percentage of plants resistant to infection was recorded in the ”Călugăreşti” variety with 88.0%, followed by the “Tari de Ghindă” variety with 73.6%, followed by the “Moţi“ variety with 68.6%. Among the studied varieties, the worst resistant is the variety “Ouţe” with a percentage of 53.8%. (Table 2)

Table 2.

Results of phenotyping tests, the resistant plants

Nr. Crt	Variety of apple	Parameters			
		Total plants	Number of inoculated plants	Number of resistant plants	% of resistant plants
1	Călugăreşti	25	25	22	88,0
2	Moţi	16	16	11	68,7
3	Ouţe	26	26	14	53,8
4	Mere Tari	23	23	14	60,8
5	Tari de Ghindă	38	38	28	73,6

As a result of artificial infections with *Venturia inaequalis*, the plants were classified in Class 0 resistance classes, meaning no symptoms, and 26.6% were followed by Class 2 with mild forms of infection of 29.8%. (Figure 3) Class 1. as well as the class with important drag resistance, registered 9.6%. Of the 124 young plants, 12.9% died. (Table 3)

Fig. 3 - Aspects from lecture of Venturia inaequalis symptoms

Table 3

Results on the lecture of *Venturia inaequalis* infected plants to establish the resistant classes

Nr. Crt	Variety of apple	Classes of resistant (nr. of plants)							
		0	1	2	4	3A	3B	Died	Total
1	Călugăreşti	9	1	7	0	5	0	3	25
2	Moţi	4	1	1	0	3	2	5	16
3	Ouţe	5	1	8	0	5	4	3	26
4	Mere Tari	6	2	6	0	5	3	1	23
5	Tari de Ghindă	9	6	13	0	5	1	4	34
	Total	33	12	37	0	23	10	16	124
	Values in %	26.6%	9.6%	29.8%	0	18.5%	8.0%	12.9%	100%

CONCLUSIONS

The mentioned contradictory results obtained by different authors (Yang H.et all. 1996), (Korban S.S. 1996), (Tenzer I.et all. 1997), (Gessler C. (1997), (Parisi L et all. 1993), (Lespinasse Y et all. 1990), (Guilford P. 1997), (Crosby J.A.. 1992) concerning the inheritance of scab resistance in apple, are also present in our results and could be a consequence of several factors, including the authenticity of the genotypes assayed (cultivars and descendants) or the method applied. In this sense, the races of scab, the inoculation method, the environmental and culture conditions and the definition of the trait have not been the same in all the studies.

Using the phenotyping methods on the old Romanian varieties of apple, we observed that the varieties “Călugăreşti”,“Tari de Ghindă” and “Mere Tari” show resistance to scab not total resistance but could be a good wey to the new breeding program. This varieties that are well adapted to the climate of Romania can be an interesting premise on the induction of natural genetic resistance to *Venturia inaequalis*.

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ASPECTS REGARDING THE CONSTRUCTION AND OPERATION OF AGRICULTURAL CULTIVATORS WITH VIBRATORY WORKING TOOLS
/
ASPECTE PRIVIND CONSTRUCȚIA ȘI FUNCȚIONAREA CULTIVATOARELOR AGRICOLE PREVĂZUTE CU ORGANE DE LUCRU VIBRATOARE

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Keywords: *agricultural cultivators, vibrating tillage tools, agricultural soil, tillage energy.*

ABSTRACT
In relation to the volume of tests carried out in different domains, it results that it was prioritized to carry out working processes with the application of vibrations especially to the agricultural operations with high energy consumption. Consequently, most researches as well as the most significant results were registered in the field of soil operations. The paper presents the results of some theoretical researches on the construction and operation of cultivators with active vibratory working tools.

REZUMAT
In raport cu volumul incercarilor efectuate in diferite domenii. rezulta ca s-a urmarit cu prioritate realizarea unor procese de lucru cu aplicarea vibratiilor indeosebi la lucrarile agricole cu consumuri energetice mari.In consecinta, cele mai multe cercetari precum si rezultatele cele mai semnificative s-au inregistrat in domeniul lucrarilor solului. În lucrare sunt prezentate rezultatele unor cercetări teoretice privind construcția și funcționarea cultivatoarelor cu organe active de lucru vibratoare.

INTRODUCTION
Soil is a granular material that varies in composition from organic peat to gravel and may contain varying amounts of water. The dynamics properties of soil are properties made manifest by the action of forces creating movement of the soil. Soil dynamics is defined as the relation between forces applied and the resultant soil reaction. (*William R. , Glen E. Vanden Berg*)

Active working tools with elastic supports vibrate during work in the longitudinal direction and sometimes in the transverse direction, having a more active effect on soil work. These cultivators are also called vibrators.In some cultivators, the parts are mounted on the frame by means of a mechanical or hydraulic safety device that avoids deformation of the support, the working part passing over the obstacle.[9]

Vibratory tillage better sustains the soil productivity because it leaves residues on the surface that protect the soil against the processes of erosion. This residue cover also impedes the formation of surface crusts that could cause reduced crop emergence.(*Manual on integrated soil management and conservation practices*,2000)

Studies over the past 50 years have revealed that oscillation of a tillage tool can be very effective in decreasing draft force and improving the transfer of engine power to soil loosening. Gunn and Tramontini (1955) reported that when the ratio of oscillatory velocity of the soil engaging tool tip to the tractor's forward velocity is more than 1, the tool moves backward relative to the soil for a period of time in each oscillation cycle. For a given tractor velocity, the velocity ratio can be increased by increasing amplitude and/or frequency[1]

High drawbar force of tillage tools is the main causes of soil compaction and wheel slip. So, a reduction in the draught force is one of the most important parameters in the design and application of these implements.(*Razzaghi. E.. Sohrabi. Y.. 2016*)

MATERIALS AND METHODS
Rolled convex steel used in the production of vibratory working tools is designed to provide a maximum lifetime. Unlike standard flat steel, special rounded corners prevent cracks. Using this special steel profile, active working tools are able to vibrate faster and more powerfully. High quality alloy steel ensures long lifetime of both active tools and wearing parts.Some of the tools are subjected to a special shot peen bombardment process (as illustrated above).

This ensures that any potential fatigue cracks from the shaping process are closed up, thereby increasing the tine's lifetime.[*Genuine tines and shares.2016*]

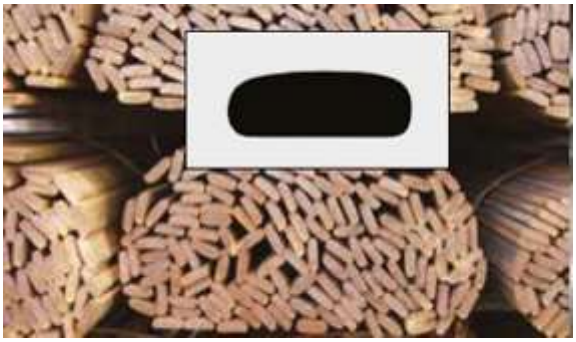

Fig.1 - Rolled convex steel used in the production of vibratory working tools

The first category of vibratory working bodies are the ones in which the spring is part of the working body shape (Figure2). These have the advantage that they vibrate and have a lower draught requirement. The vibrating movement also means that material is broken up and graded effectively. Since this type of tine also has a natural stone release force that is limited by the spring, it is most suitable for slightly shallower cultivation up to a working depth of 20 cm. [5]

Fig.2 - Vibratory working bodies in which the spring is part of the working body shape [5]

The system with pressure spring not only protects the tine from obstacles in the subsoil, but the effect of the vibrations causes an easier crumbling of the soil. The presence of the spring transmits a strong oscillating or vibratory type of action allowing for penetration even in extremely dry of difficult conditions. In figure 5 are presented a few types of active working tools equipped with this king of elastic support[8]

Fig.3 - Elastic support with pressure spring [8]

A levelling unit is designed to produce a uniform surface behind the machine and to draw the weed roots to the surface so that it can dry. The depth of the unit is controlled by two hydraulic cylinders connected in series. Raise the levelling units to the maximum height and gradually descend during operation using the hydraulic controls in the cabin until a good result is obtained. Levelling units usually produce the best work results if they are set to start rotating.[Catalog Vaderstad – Swift Cultivator. 2016]

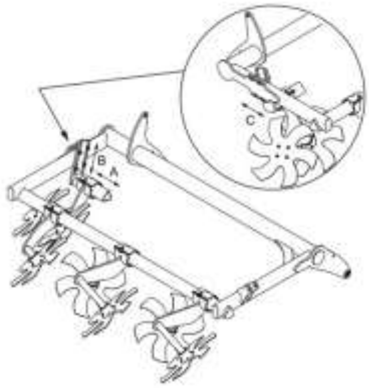

Fig.4 - Levelling unit

The cultivators can also be fitted with a following harrow or Tiller tines to further improve the working result. The connecting drawbar adds the possibility to attach a roller, for increased reconsolidation, levelling and clod crushing.[6]

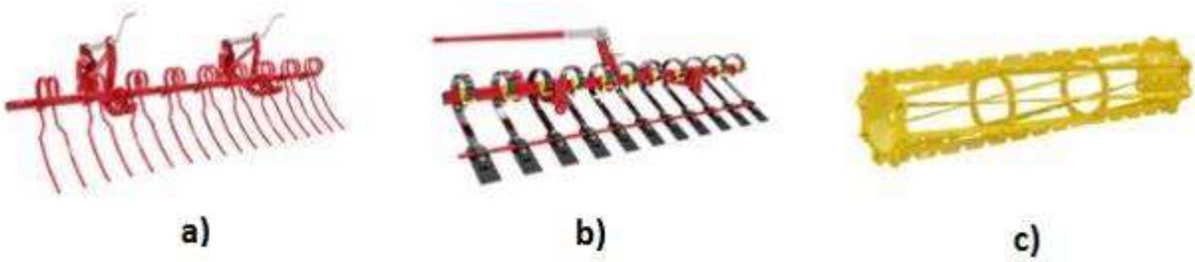

Fig.5 - Various implements for achieving a better working result
a)following harrow; b) rear crossboard; c)crumble roller

RESULTS

The basic construction of an agricultural machine that performs a certain working process by using vibrations, presents in relation to a classic car the following specific elements:
active parts that are themselves or only parts of them, vibrating elements;
- type of vibration source corresponding to the process to be performed;
-device (preferably automatic) for adjusting the vibration regime depending on the variation of the physical-mechanical properties of the processed material;
- vibration damping elements transmitted to other components of the machine in order not to impair their reliability.

Figure 5 shows the diagram of a cultivator worn for total processing, equipped with working tools with elastic support. On the frame of the cultivator made in the form of a flat surface provided on the front with a clamping triangle are mounted the working tools (claws or arrows). Adjustment of working depth can be achieved by changing the position of the support wheels. [Catalog Vaderstad products, 2015]

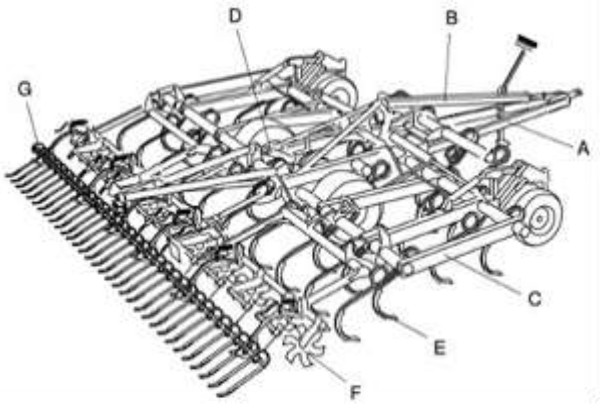

Fig.5 - Cultivator for total processing, equipped with working tools with elastic support[5]
A -Drawbar; B-Push rod; C-Frame; D-Wheel mounting; E-Cultivator vibratory tools; F-Levelling unit; G-Tiller (accessory);

A spring-tined cultivator such as the Vibro-cultivator (Figure 5) is recommended for secondary tillage. This replaces the lightweight disc harrow and has several other advantages for seedbed preparation. It has flexible and vibrating spring tines, spaced at about 10 cm and mounted on four crossbeams. In case there are heavy residues or weeds, it is recommended to increase the spacing to 15 cm to reduce the risk of blockages.

Working depth should be between 8 and 10 cm. It is very important to maintain a working speed of 8-12 km/h to optimise the vibrations, which shake the weeds and break up the clods. The vibratory action leaves the larger clods on the surface, which better resist to the formation of crusts and leave the smaller aggregates in the lower levels, so enabling seed germination.[*Manual on integrated soil management and conservation practices*.2000]

Because vibratory cultivators do not invert the soil, there is less decomposition of the organic matter and less loss of moisture, which is very important before sowing. In Table 1 is shown an example of the effects on the soil moisture content and residue cover, as compared with the conventional tillage.

Table 1

Moisture content and residue cover for three tillage systems in Oxford, North Carolina, USA, in 1985

Tillage system	**Moisture content (W/W. %)**	**Residue cover (%)**
Zero Tillage	13	90
Conventional tillage	6	3
Vibratory tillage	12	33

The different positions of the cultivator make the tools have a different wear. The first row and especially those on the trajectory of the wheels, have a considerably larger wear than the back row.(*Genuine parts.2015*)

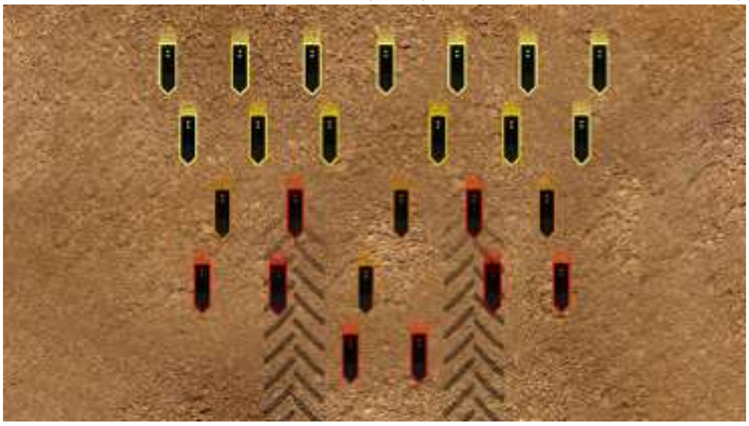

Fig.6 - Position of cultivator vibratory tools[7]

CONCLUSIONS

In relation to the volume of tests carried out in different domains, it results that priority has been given to the achievement of working processes with the application of vibrations especially to the agricultural works with high energy consumption.

From the analysis of the documentary materials, it is possible to use the vibrations in carrying out the working processes of the agricultural machinery in order to fulfill one or more of the following aspects: the reduction of the energy consumption in the execution of the agricultural works, the qualitative improvement of the agricultural technological processes, the increase of the agricultural machinery productivity, of agricultural machinery, the universalization of certain assemblies or subassemblies of agricultural machinery.

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RESEARCHES ON EVOLUTION OF CERTAIN CHARACTERISTICS RELATED TO MISCANTHUS SP. CROP SPRINGING, SIZE AND STRESS RESISTANCE
/
CERCETĂRI ASUPRA EVOLUŢIEI UNOR CARACTERISTICI PRIVIND RĂSĂRIREA. TALIA ŞI REZISTENŢA LA FACTORII DE STRES A CULTURII DE MISCANTHUS SP.

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***Keywords:* renewable** *energy, phenological observations, Miscanthus sp.*

ABSTRACT

Directive 2009/28/EC regarding the Renewable Energy by 20 % for 2020 recommends to pass from a society based on fossil fuel to a renewable energy society. Bioenergy is a forefront component for achieving the objectives of Directive above by 2020. In the paper, some phenological observations are made, emphasizing the morphological and anatomic aspects based on Miscanthus sp. vegetative organs microscopic analysis. Role of presented researches is to participate in vegetal production increase by capitalizing the knowledge on the whole Miscanthus sp plant biological potential.

REZUMAT

Directiva 2009/28/EC privind Energia Regenerabilă cu obiectivul 20 % pentru 2020. susțin nevoia în creștere de a trece de la o societate bazată pe combustibili-fosili la o societate bazată mai mult pe energie regenerabilă. Bioenergia este o componentă esențială pentru îndeplinirea obiectivelor Directivei până în 2020. În lucrare sunt făcute observații fenologice cu evidențierea unor caractere morfologice și anatomice prin analiză microscopică a organelor vegetative ale plantei Miscanthus sp. Rolul cercetărilor prezentate în lucrare este de a participa la procesul de sporire a producției vegetale prin valorificarea cunoștințelor privind întregul potențial biologic al plantelor de Miscanthus sp.

INTRODUCTION

As a plant with photosynthetic cycle C_4 with CO_2 modified fixation, *Miscanthus sp.* has high productivity and a more efficient use of resources at which are added the reduced agronomy practice requirements; therefore, it is better adapted to biomass designed to produce energy (Plant Physiology 132, 2003). It has minimal nutritive demands- efficiently use nitrogen, so it is able to grow in dry land, without fertilization. *Miscanthussp.* is a sterile hybrid, so it can be multiplied by its rhizomes (*Lewandowski et al.. 2000*).

Studies in course of development in Great Britain, United States and Ireland have boosted *Miscanthussp.growth* as a biomass source producing energy for direct burning or by cellulosic ethanol or biofuel producing. (*National Non-FoodCrops Centre, 2008*).

Miscanthus sp. is being cultivated in Europe, especially for energy cogeneration (producing both electricity and heat within an integrated installation) and could supply up to12% out of the UE energy by 2050 (*Dondini et al.. 2009*).

During 2008-2010, within INMA was developed the project "*Technology for promoting in Romania the miscanthus energetic plant as renewable source for increasing energetic competitiveness and safety*" that aimed to promote Miscanthus in Romania by partnership industrial research, within a specific regional, pedo-climatic and economic context for being afterwards extended to Romanian agricultural farms (*Sorică et al.. 2009*).

MATERIAL AND METHOD

Material to be studied was *Miscanthus sp. Plant*, which has an interesting biomass potential for Romania, taking into account the large surfaces of available agricultural land (not entirely exploited).

During vegetation stage,m some phenological observations were made, emphasizing the morphological and anatomic characteristics through vegetative organs microscopic analysis.

Within the paper, the *Miscanthus sp.*plant behaviour was studied in existing weather conditions in respective area (temperature, humidity, light intensity) and the physiological processes (photosynthesis, transpiration and absorption) and physical processes (humidity and ash content) were analyzed.

The experimental areas, working variants and observation areas were randomly chosen being made on experimental plot planted with *Miscanthus sp.* at INMA Bucharest(figure1).

Fig. 1 - Aspect of a *Miscanthus sp.* crop established at INMA Bucharest

Miscanthus variety belongs to subphylum Magnoliophita, class Liliopsida, Poales order, Poaceae family, subfamily Panicoideae and comprises 15 species of perennial herbs coming from tropical and sub-tropical regions from Africa and Southern Asia, only one species (Miscanthussinensis) being found in temperate area of Eastern Asia. The type of biofuel used in Europe in early ’80s is a sterile triploid hybrid between Miscanthussinensis (diploid species. figure 2) and Miscanthussacchariflorus (tetraploid species) and is called Miscanthusgiganteus or "E-grass" ().

Fig. 2 – *Miscanthussinensis (*Hitchcock. A.S. (rev. A. Chase). 1950. Manual of the grasses of the United States. http://plants.usda.gov)*

Miscanthus sinensis grows in warm season and has extremely thin leaves. Above the leaves the rosy flowers are shaped in bobbles and in autumn they turn to a white-creamy colour.(figure 3).

Fig. 3 - Miscanthus sinensis – inflorescence (*Steve Hurst. Providedby ARS SystematicBotanyandMycologyLaboratory. Japan. Sapporo. http://plants.usda.gov)*

Miscanthus sacchariflorus(Amur silver grass, Silver banner grass) is a perennial grass with green and white flowers in early autumn or late summer. It grows very well in sun light having approximately 2.4 m height and about1. width and low tolerance to floods. Flowers of Miscanthus sacchariflorus are arranged in inflorescences named panicle (figure 4).

Fig. 4 – Miscanthuss acchariflorus

(Maximowicz) Hackel. 1. Part of stem. rhizomes and panicle. 2. Spikelet pair. 3. Lower glume. 4. Upper glume. 5. Lowerlemma. 6. Upperlemma. 7. Upperpalea (FOC 582. FPRS 10(2):26. pl. 5. 1997. ShiWeiqing)

At the end of summer, Miscanthus sacchariflorus produces panicles with soft silver white inflorescences (figure 5). Although in warm areas, the flowering can appear in the first year of growing, it is only in the second and next years that the plant will develop more vigorously.

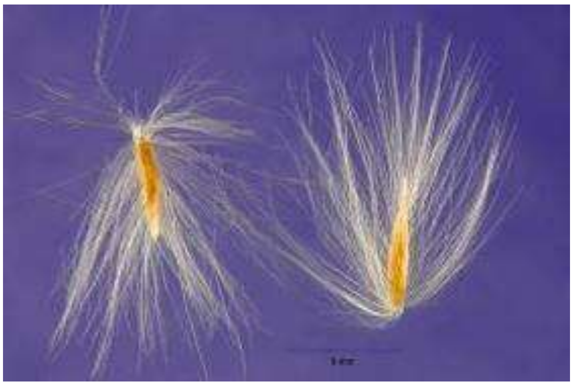

Fig. 5 -Miscanthus sacchariflorus – inflorescence

Jose Hernandez. Providedby ARS SystematicBotanyandMycologyLaboratory. China. Manchuria. http://plants.usda.gov

The soil and climate conditions were determined with a digital system for microclimate monitoring (professional weather station of Delta-T Weather Stations-WS-STD1 type).

For determining the physiological processes, there were used measuring cylinders, glass rod, light source, filter paper, analytical balance, water cristalliser and other consumables.

In order to determine the physical processes there were used: hygrometer, ceramic crucibles, dessicator, analytical balance Shimadzu AW 220M, universal kiln MEMMERT UFE 500 and calcinations oven Nabertherm model P320.

During the plant growth, phenological observations were made related to:

- spring moment;
- appearance of first leaves;
- number of leaves per plant;
- diameter and height of stem.

In order to perform the microscopic analysis of vegetative organs, the material collected was brought in laboratory, where it was conserved. Transverse sections were made in the *Miscanthus sp*. plant aerial organs (stem, leaves). Descriptions were accompanied by photos performed at microscope ML–4M IOR. with PANASONIC LUMIX DMC – LS60 camera (6MPX, optical zoom 3X).

One aspect during soil sampling in experimental field is shown in figure 6.

Fig. 6 - Aspect during soil sampling in experimental field

RESULTS

Hygroscopic (inner colloidal) **humidity** is the water quantity that remains after the soaking moistening is removed. In order to determine the hygroscopic humidity of *Miscanthus sp.* , the oven heating at 105°C was used. Therefore, the following activities were performed:

- ceramic crucible was weighted(m_0);
- by means of a spatula, the sample was introduced into the ceramic crucible, homogenized and the weighted (m_1) twice by means of analytical balance, 5±0.0002 g out of *Miscanthus sp.plant.*
- the crucible with sample was introduced into the universal oven heated at 105°C, where it remained for two hours, after which it was taken out and introduced into the dessicator till reaching the ambient temperature;
- the sample was weighed again (m_2) and hygroscopic humidity was calculated with formula (1):

$$W_h^u = \left(\frac{m_1 - m_2}{m_1 - m_0} \right) \times 100, [\%] \tag{1}$$

Result of determinations of *Miscanthus sp.* hygroscopic humidity is shown in table 1.

Table 1

Sample	Average hygroscopic humidity of *Miscanthus sp.* plant. %
1	54.46

Determination of ash **content was made through the following stages**:

- the empty crucible was calcined up to constant mass, after which it was cooled and weighed (m_1);
- the analysis sample was homogenized (stirring for 1 minute);
- 1...2 grams of fuel were taken and introduced into the crucible, levelled uniformly, by a light impact;
- the fuel crucible was weighed (m_2) with ±0.0002 g precision and it was introduced in calcination oven at ambient temperature;
- the oven temperature was increased step by step to 600±25°C, so that it could be reached in minimum 60 minutes;
- after reaching the temperature desired, the crucible remained in the oven for other 60 minutes;
- the sample was taken out the stove, put on an asbestos plate for 5 minutes and after cooling, it was weighed (m_3).

The ash content out of the sample is expressed in percentages and was calculated by relation (2):

$$A^a = \left(\frac{m_3 - m_1}{m_2 - m_1} \right) \cdot 100, \quad \% \tag{2}$$

Result of determinations of ash content is shown in table 2.

Table 2

Sample	Ash content of *Miscanthus sp.*. %
1	4.193

Morphological characteristics of species of *Miscanthus sp.:*

- Rhizomes are plagiotrope (horizontal) on each bud that is forming every year (figure 7).

Fig. 7 - Rhizomes of *Miscanthus sp.*

- Leaves are alternatively placed, are sessile, made only of sheath and limb. The limb base in its crossing point with sheath presents its foliar parts- ligula and ears, that are hairy (figure 8)

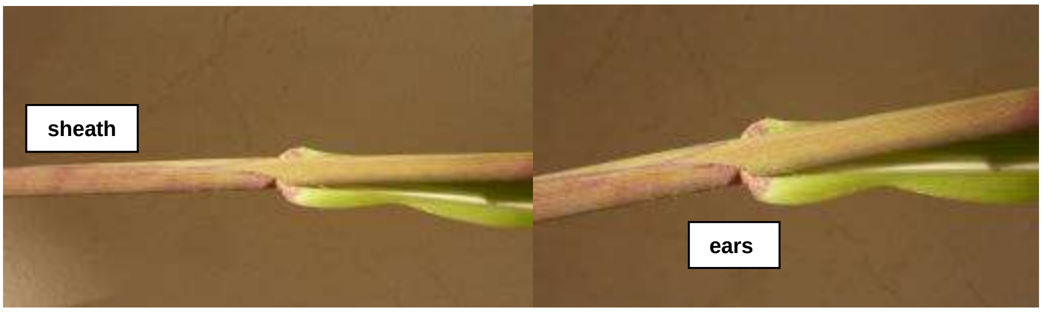

Fig. 8 - Leaves of *Miscanthus sp.*

Inflorescence is the panicle. The main axle is without hair ending with one little ear. The panicle branches are not hairy, being disposed on 6-9 levels (figure 9).

Fig. 9 - Inflorescence of *Miscanthus sp.*

- Small ears have 2-3 flowers. Fruit is of caryopsis type (dry without unique seed)(figure10).

Fig. 10 - Flowers of *Miscanthus sp.*

Anatomic characteristics of species of *Miscanthussp.*:

Making a transverse section in the adventive roo, one may differentiate the following layers: *rhizodermis, bark and central cylinder* (figure 11).

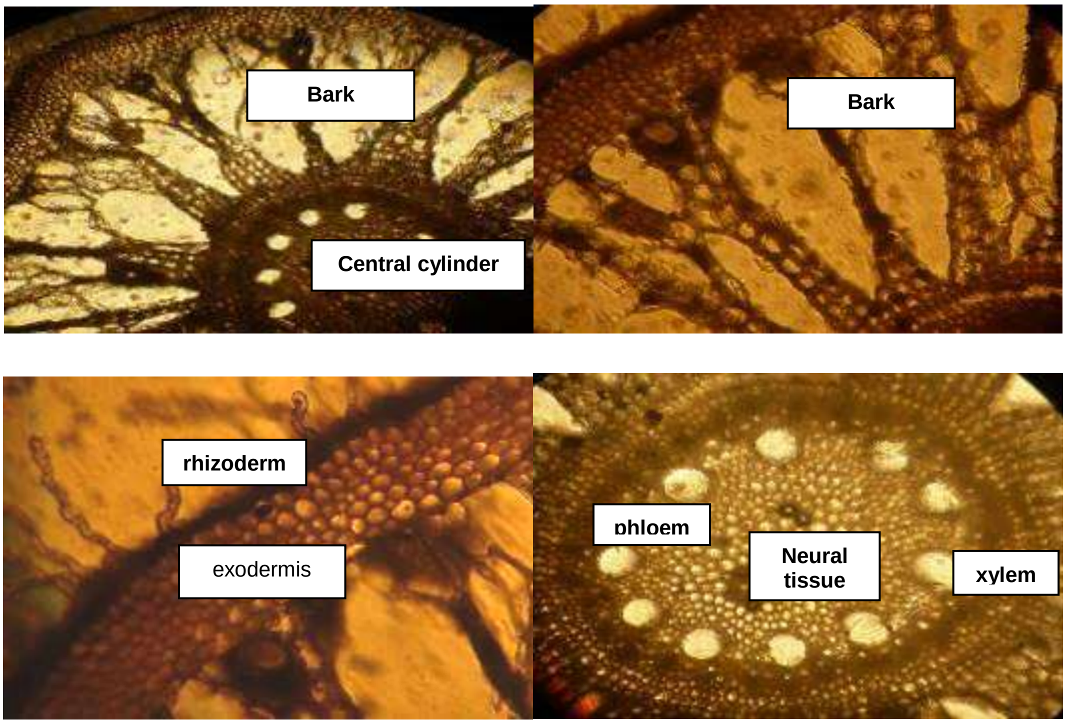

Fig. 11 - Transverse section in the adventive root of *Miscanthus sp*

CONCLUSIONS

- Researches have brought important information to specialists for helping them to boost vegetal production by capitalizing the knowledge related to the whole biological potential of *Miscanthussp plants*;
- Researches can be extended to other types of energetic plants found in Romania, such as the energetic willow (SalixViminalix).

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EXPERIMENTAL RESEARCH ON COUPLING DEVICES
/
CERCETĂRI EXPERIMENTALE PRIVIND DISPOZITIVELE DE CUPLARE

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Keywords: *simulated, device, platform, testing, regime.*

ABSTRACT

The paper presents the experimental researches carried out in a simulated and accelerated regime. which have been performed on a Hidropuls-type installation, on a lower coupling device, in a static and dynamic regime, in order to check its breaking resistance in case of extreme stresses.

REZUMAT

Lucrarea prezintă cercetările experimentale realizate în regim simulat şi accelerat. s-au realizat pe o instalaţie tip Hidropuls, asupra unui dispozitiv de cuplare inferior. în regim static şi dynamic, în vederea verificării dacă aceasta rezistă la rupere în cazul unor solicitări extreme.

INTRODUCTION

The coupling devices used between the tractor unit - agricultural machine/trailer are made as different design variants, depending on the towing/towing mass, the type of machine/towed gear, the angle under which it engages, etc.

The analysis of the operation of the coupling devices of agricultural aggregates (tractor-agricultural machine) aims to identify an optimal coupling and to determine how it works properly, in case of normal and/or critical stresses, by simulated tests and accelerated, respectively in exploitation on uneven lands, identifying its critical areas (Finite Element Analysis - MEF).

Based on these results, optimization of the coupling will be achieved, which will lead to optimal operation and increase of the service life in safety conditions for the operator, but especially for the traffic participants.

Tractors, trailers and their couplings (traction / coupling devices) must comply with certain technical and mechanical strengths in the safety of public road transport in Romania and its admission into circulation.

The technical conditions for the development of new coupling systems for tractors, trailers and agricultural vehicles are harmonized to European standards in order to increase the degree of interchangeability and safety in circulation, one of the main reasons for studying these devices due to the multitude of accidents caused by inadequate coupling systems (on tractors or tractors, respectively between tractors and farm tractors), which are not carried out in accordance with certain safety and traffic safety specifications [1].

Referring specifically to the coupling systems of tractors, trailer trucks intended for working in the agricultural or forestry sector, the condition which implies that they be carried out and meet the same rules is based on the need of coupling between them to all machinery of the same type existing on the European and Romanian market and, on the other hand, to the fact that these coupling systems are safety features in service but especially in road traffic.

If for most machinery and equipment used in agriculture and forestry there is some freedom of expression in terms of their achievement (constructive, functional, etc.), for the coupling systems, elements that contribute to safety in operation and circulation, strict conditions are imposed by internal and European building regulations, functional parameters, mounting conditions, etc.,which must be respected.

In Romania as well as in other European countries, road traffic, in particular, changes year-to-year and country-by-country depending on the increasing of the motoring index, the state of the road network, the economic development of the country in general and in particular the car transport.

With all measures to organize and improve road traffic, road safety is particularly far from being satisfactory, with a large number of road accidents resulting in significant material damage and loss of life.

An important role in these accidents is represented by the agricultural and forestry transport represented by the tractor–trailer systems or agricultural machine, although their participation in public traffic is occasional [2].

Most of these accidents result from inappropriate general technical conditions or failures in the safety components, including the coupling systems, the agricultural or forestry machinery involved.

An important source that can cause incidents and road accidents is also the fact that some tractors and machinery do not have the appropriate coupling systems.

Coupling systems are devices mounted on the trailer and used for coupling and towing various trailers or agricultural machines with towing eyebolts, coupling forks. etc.

Fig. 1 - The coupling hook-type system of the lower coupling bolt

MATERIALS AND METHODS

The verification of the coupling devices (static and dynamic) shall be carried out on specialized simulation and acceleration tests on Hydropulse- type installation (fig.1), where they are mounted in the same position in which they are used; the determination of the forces and loads of the devices coupling must take into account the shape, dimensions and technical conditions imposed on their aggregation devices, for each type of coupling system that is provided in the legislation (directives, regulations, standards, etc.).

Fig. 2 - Hydropulse-type test facility under simulated and accelerated regime

RESULTS

Data processing - static tests

Static tests were carried out at INMA Bucharest on a special installation (Hydropulse), with the towing device and any tractor coupling component attached to a rigid structure by means of the same components used for mounting on the tractor body (Figure 2).

Fig. 3 - Installation on the Hydropulse plant for the static test of the draw bar

The measuring and control equipment used to record loads and applied moments shall be of high precision: applied loads ± 50 daN; moments ± 0.01 mm.

The test procedure

a) The coupling device has first subjected to a pre-charge load not exceeding 15% of the traction load as defined in point b);
   - the operation described in point b) has been repeated twice, starting at zero load, increasing gradually until the value specified in point a) has been reached and then decreasing to 500 daN, maintaining the force for at least 60 seconds.

b) The data recorded for tracing the deformation curve under the traction load or the graph related to this curve was based only on the application of increasing loads starting from 500 daN, depending on the reference center of the coupling device..
   - It was verifyed if there are no breaks for values equal to or lower than the traction load tests, which have been established as 1.5 times the technically permissible towed mass; also the deformation curve under the load pursued a regular progression without irregularities in the range between 500 daN and 1/3 of the maximum traction load.
   - Permanent deformation was recorded on the load /deflection curve for the load of 500 daN after the test load was brought back to this value..

c) The test referred to in point b) was preceded by a test in which an initial load of 3 times of the maximum load recommended by the manufacturer was applied in the reference center of the coupling device, starting at from a load of 500 daN.

During the test, the deformation of the coupling device did not have to exceed 10% of the maximum elastic deformation observed.

Verification was performed after removal of the load and return to the initial load of 500 daN.

MT = 1.450 kg = 1.422.45 daN;
MR = 1.500 kg = 1.471.50 daN;
D = 25 kN = 2.500 daN;
S = 7 kN = 700 daN.

where:

MT = total permissible tractor mass, technically;
MR = the total permissible mass of the towed vehicle, from a technical point of view;
g = 9.81 m / s2;
D - mathematically determined force (the components of the horizontal force on the longitudinal axis of the vehicle);
S - the static load of the drawbar (component of the vertical forces on the road).

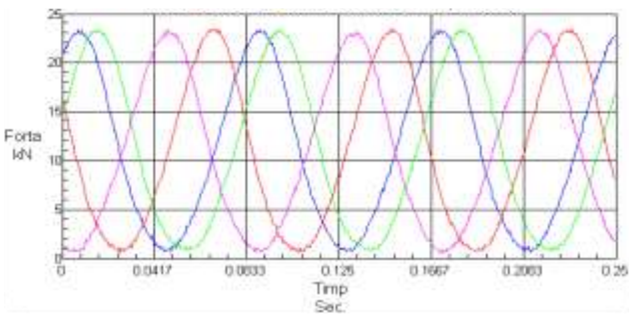

Fig. 4 - Force-time diagram for the static test of the drawbar on the Hidropuls plant

Data processing - dynamic tests

In the case of dynamic tests, the strength of the mechanical coupling system (drawbar) was established by alternating traction at a specialized stand (Hydropulse installation).

This dynamic method describes the fatigue test which applies to the entire drawbar, respectively, when the drawbar equipped with all the components required for installation is mounted and tested on the Hydropulse.

Alternate forces have been applied sinusoidly from a distance from as long as possible (by alternate towing and / or lifting) to a load cycle determined by the material involved, during which no cracks or wear must occur.

The horizontal force components on the longitudinal axis of the vehicle together with the components of the vertical force formed the basis of the load to be subjected to the test. Because they are of secondary importance, the components of the horizontal force at right angles to the longitudinal axis of the vehicle, as well as those moments, have not been considered.

The horizontal force components on the longitudinal axis of the vehicle are represented by a mathematically determined force. D.

$$D = g \cdot (M_T \cdot M_R) / (M_T + M_R)$$

where:

MT = total permissible tractor mass, technically;
MR = the total permissible mass of the towed vehicle, from a technical point of view;
g = 9.81 m / s2;
D - the mathematically determined force (the components of the horizontal force on the longitudinal axis of the vehicle);
S - Vertical loading (vertical force components at right angles to the wheel axle).

The technically acceptable load masses specified by the manufacturer on this traction unit are:

MT = 1.450 kg = 1.422.45 daN;
M_T = 1.450 kg = 1.422.45 daN;
M_R = 1.500 kg = 1.471.50 daN;
D = 25 kN = 2.500 daN;
S = 7 kN = 700 daN.

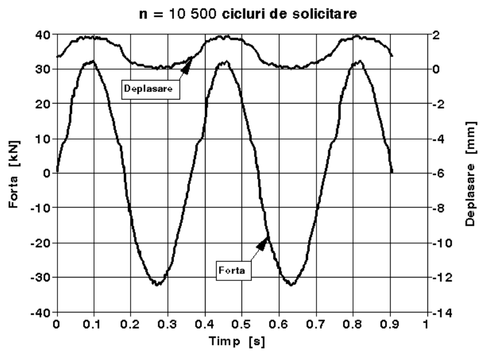

Fig. 5 - Diagram force-time and movement-time (in the horizontal direction)

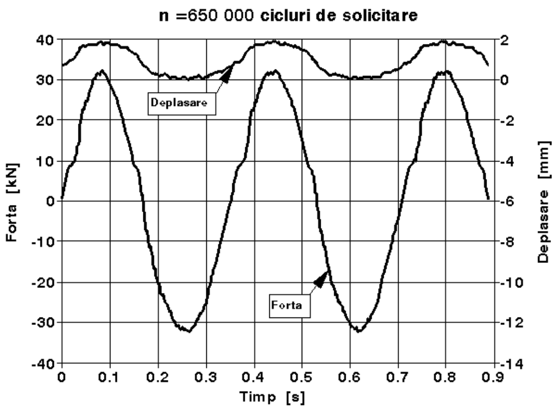

Fig. 6 - Diagram force-time and movement-time (in the horizontal direction)

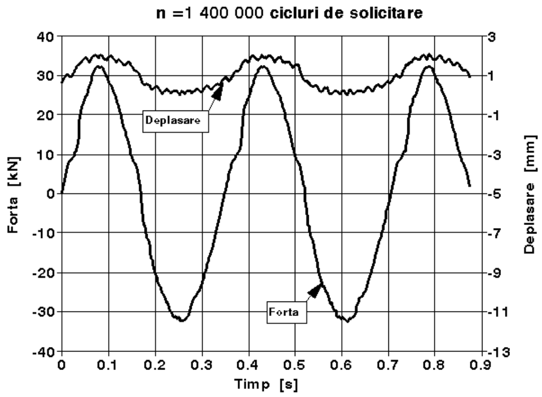

Fig. 7 - Diagram force-time and movement-time (in the horizontal direction)

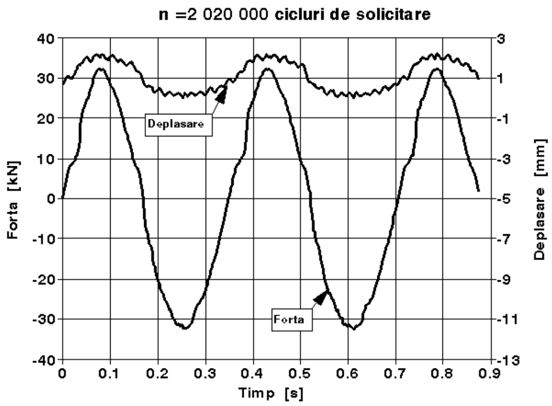

Fig. 8 - Diagram force-time and movement-time (in the horizontal direction)

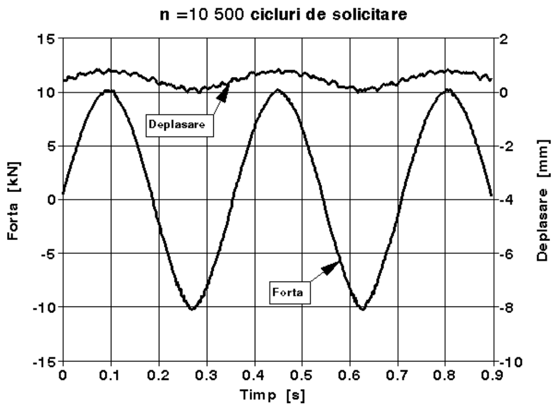

Fig. 9 - Diagram force-time and movement-time (in the horizontal direction)

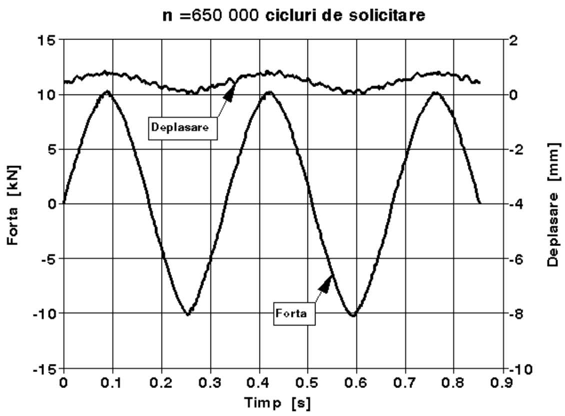

Fig. 10 - Diagram force-time and movement-time (in the horizontal direction)

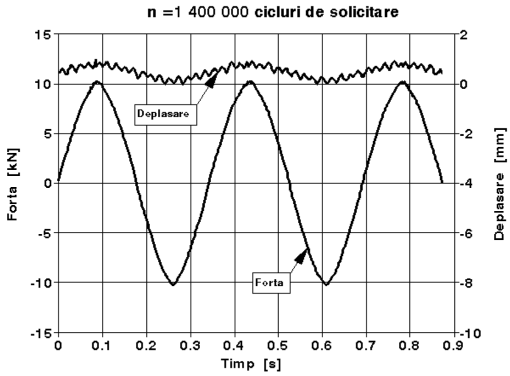

Fig. 11 - Diagram force-time and movement-time (in the horizontal direction)

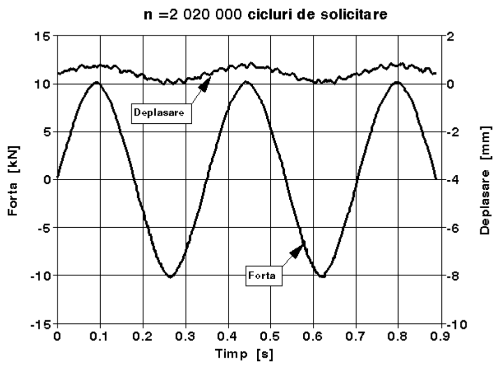

Fig. 12 - Diagram force-time and movement-time (in the horizontal direction)

CONCLUSIONS

From the data obtained and processed after the experimentation in static and dinemical regime, it resulted that the traction bar did not break when more than 2,000,000 cycles (2,020,000 cycles) of stress - in a dynamic regime were applyed with a maximum displacement at a horizontal plane of ± 1.12 mm which corresponded to a force of ± 32.27 kN and a maximum displacement at the vertical plane of ± 0.48 mm which corresponded to a force of ± 10.19 kN, respectively at a force equal to 1.5 times the permitted towable mass in the case of static load, without any visible deformation, rupture or other visible damage.

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OPTIMIZATION OF MICROWAVE ASSISTED EXTRACTION OF PHYTOCOMPONENTS FROM HELIANTHUS TUBEROSUS AND APIUM GRAVEOLENS VAR. SECALINUM
/
OPTIMIZAREA PROCESULUI DE EXTRACTIE ASISTAT DE MICROUNDE A FITOCOMPONENTELOR DIN HELIANTHUS TUBEROSUS L. ŞI APIUM GRAVEOLENS VAR. SECALINUM

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Keywords: *microwave extraction, phyto components, optimum operating conditions, e*xtraction yield.

ABSTRACT
Microwave-assisted extraction (MAE) is widely employed in the analysis and the extraction of active compounds from plants. Helianthus tuberosus L. and Apium graveolens var. secalinumis are very important species for popular medicine and industry due to numerous phytocomponents with large implications in health improvement. Extractions of these compounds require new techniques with optimized parameters. This paper shows the influence of solvent composition in polyphenols extraction from dried plant samples. It has been found that solvent mixtures with higher concentration in EtOH provide better efficiency in the extraction process.

REZUMAT
Extracția asistată cu microunde (MAE) este utilizată pe scară largă în analiza și extracția compușilor activi din plante. Helianthus tuberosus L. și Apium graveolens var. secalinumis sunt specii foarte importante pentru medicina populară și industrie datorită numeroaselor fitocomponente cu implicații mari în îmbunătățirea sănătății. Extracția acestor compuși necesită noi tehnici cu parametri optimizați. Această lucrare prezintă influența compoziției solvenților în extracția polifenolilor din probele de plante uscate. Sa constatat că amestecurile de solvent cu o concentratie ridicata de etanol prezinta randamente de extractie ridicate.

INTRODUCTION
Phytochemicals such as phenolic compounds from plants and vegetables are known to have several health-benefitting properties, including reducing the risks of certain types of cancer, cardiovascular, heart and neurodegenerative diseases (Barboni. T.. 2010). These health-promoting compounds are found in the roots, barks, stems, leaves, fruits and flowers of numerous plants (Camel. V. I. 2000). The target plants used in this work were Helianthus tuberosus L. (Jerusalem artichoke) and Apium graveolens var. secalinumis which are known that contain a large range of useful phytocomponents. Hence, some parts of this plant (stalks and leaves) possess antioxidant, antimicrobial, antifungal and anticancer activities (Dahmoune. F.. 2013; Gallo. M.. 2010). In tubercle of H tuberosus L. compounds like coumarins, unsaturated fatty acids, polyacetylenic derivatives, phenolic compounds and sesquiterpenes, can be found. Some studies shown that H. tuberosus phenolic compounds improve the pharmacological characteristics. The other plant (Apium graveolens var. secalinumis) also is rich in polyphenols and coumarins that show curative disease preventive and nutritive effects (Chen. W.. 2012).

Isolation and purification of some phytochemicals is required in most cases in order to obtain improved or standardized formulations. Extraction of bioactive compounds from different plant is based on solid–liquid extraction in presence of wide range of solvents. Earlier extraction methods, such maceration. soxhlet extraction and heat reflux extraction (HRE) are well established procedures, but also time and solvent consuming approaches (Ahmad. J.. 2010; Hayat. K.. 2009; Hossain. M. B.. 2012). Extraction process evolved toward high pressure/temperature based methods like: pressurized liquid extraction (PLE), microwave assisted extraction (MAE), ultrasound assisted extraction and supercritical fluid extraction. Between these techniques MAE is a relatively new method with different type of equipment adapted to specific needs (Dudonne. S.. 2009). The most common type of apparatus use for these processes is based on closed vessels where temperature and pressure can build up and extraction took place in presence of different mixtures of polar solvents (Huang. D.. 2002). With this procedure extraction of various compounds is enhanced, is more rapid and allows reduced costs. Nevertheless, some factors influence the amount of phytochemicals extracted therefore optimization of these parameters. (Li. H..2012). One of the most important aspect of extraction process is solvent composition since this parameter can significantly alter the partition compounds of interest between the sample and the solvent minimizing both extraction time and amount of solvent used. In the present study, influence of ethanol concentration to obtain maximum yield of total phenolic compounds, was assessed.

MATERIAL AND METHOD

2.1. Plant materials

The leaves of Apium graveolens var. secalinumis and tubercle of H. tuberosus L. were collected from HOFIGAL SA. Plant samples were dried in a forced-air oven at 50 ^oC to constant weight and then ground using an electric grinder. The ground powder was passed through a standard 100 lm sieve and was collected and stored at 4 ^oC in airtight bags until further use.

2.2. Reagents

Standards for HPLC such as gallic acid, ferulic acid, caffeic acid, p-coumaric acid, chlorogenic acid, rutin, quercetin, catechin and epigalocatechin were purchased from Sigma Aldrich. All the solvents used for HPLC analysis were HPLC grade (Sigma Aldrich).

2.3. Microwave-assisted extraction

Phenolic compounds from plant samples powders were extracted using an ETHOS EASY (Milestone – Italy) microwave system. The apparatus was equipped with a digital control system for irradiation time and microwave power (the latter was linearly adjustable from 0 to 1000 W). Plant samples (5 g) and solvent mixtures (50 ml) with different compositions (30:70, 50:50, 90:10 (water:EtOH v/v)) were introduced in sealed closed vessels. The MAE extraction program was: 30 min extraction time and 40 ^oC. After MAE treatment, the extract was filtered through a Whatman No. 2 filter paper using a Büchner funnel and the supernatant was collected in a volumetric flask. The extract was stored at 4 ^oC until further use.

2.4. HPLC-DAD analysis

Chromatographic analysis was carried out at 20 ^oC using simultaneous monitoring of extracts performed at 280 and 370 nm using an Agilent 1200 system equipped with a Zorbax C18 eclipse plus column (5 μm. 4.60 mm x 250 mm). The mobile phase A was a mixture of 1% (v/v) acetic acid in distilled water, whereas mobile phase B consisted of 100% HPLC grade acetonitrile. The solvent gradient in volume ratios was as follows: 0–40 min. 5–100% B. Phenolic compounds were identified by the retention time and quantified from peak area. Identified phenolic compounds (phenolic acid and flavonoids) were quantified using external standards. The standard response curve was a linear regression fitted to values obtained at each concentration within the range of 20–200 μg/mL for phenolic acid (Gallic acid, Ferulic acid and Chlorogenic acid) and 40– 250 μg/mL for other compounds (Rutin, Quercetin, Apigenine, Bergapten, Carvacrol, Eugenol methyl ether).

RESULTS

The identification and quantification of individual extract compounds in all samples of studied plants rely on a combination of retention times and calibration curve of external standards and from chromatograms (figures 1-2). All identified compounds were also verified comparing obtained chromatograms with data reported in literatures under similar conditions. Effects of solvent concentration in phytocomponents amount found in extract are presented in table 1.

In this table it can be observed that regardless the operating conditions, MAE technique is capable to extract all considered compounds from both types of samples. Nevertheless, the extraction yields are better for solvents with higher EtOH concentration. Even in case of rutin which is the major flavonoid in this plant the concentration decrease until extinction for w: EtOH = 90/10 solvent.

Table 1

Amount of phytocompounds extracted from solid samples using different concentration of solvents

Sample / solvent	mg/g								
Sample / solvent	gallic	chlorogenic	ferulic	apigenine	bergapten	carvacrol	eme	quercetin	rutin
Celery / w: EtOH = 30/70	0.054	1.052	2.919	0.020	0.237	0.261	0.596	0.076	5.047
Celery / w: EtOH =50/50	0.104	0.967	2.564	0.017	0.183	0.208	0.509	0.072	4.339
Celery / w: EtOH = 90/10	0.171	0.893	0.076	0.021	0.000	0.024	0.139	0.080	0.090
Tuberosus/ w: EtOH = 30/70	0.015	0.600	0.189	0.005	0.000	0.035	0.011	0.028	0.309
Tuberosus/ w: EtOH = 50/50	0.033	1.198	0.058	0.010	0.000	0.020	0.009	0.384	0.077
Tuberosus/ w: EtOH = 90/10	0.080	0.036	0.000	0.000	0.000	0.000	0.000	0.024	0.000

Apium graveolens var. secalinumis sapmples are richer in phytocompounds comparing with tubercle of H. tuberosus L which probably contain large amount of other bio compounds like inulin and can not be evaluated in this study. Another aspect is that differences in extraction process for w: EtOH =50/50 and w: EtOH =50/50 are very small, hence ethanol consumption can be reduced. Gallic acid shows a reversed behavior hence higher yields are obtained in case of w: EtOH =90/10.

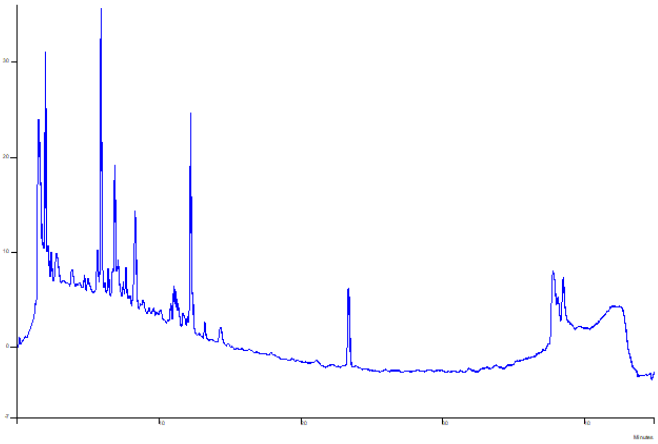

Fig. 1. Chromatogram of phytocomponents in 30:70 water:EtOH (v/v) extract from Apium graveolens var. secalinumis samples

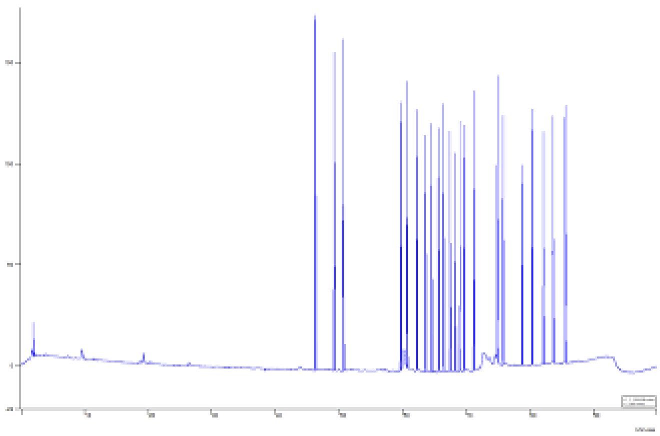

Fig. 2 - Chromatogram of phytocomponents in 30:70 water:EtOH (v/v) extract from Apium graveolens var. secalinumis samples

CONCLUSIONS

Helianthus tuberosus L. and Apium graveolens var. secalinumis are rich in phytochemicals with high antioxidant activity. Nevertheless, from biomass valorisation point of view, application of MAE for extraction of bioactive compounds from plant material requires thorough optimisation in order to substitute other the older extraction methods. The present work established an improved and optimised procedure for extracting polyphenols by using solvent mixture with higher EtOH content. Further studies for extraction process optimisation are required before large scale utilisation is used.

ACKNOWLEDGEMENT

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RESEARCH ON FREEZING BEHAVIOUR OF SOME STRAWBERRY FRUIT GROWN IN ROMANIA
/
CERCETĂRI PRIVIND CONGELAREA UNOR FRUCTE DE CĂPȘUN CULTIVATE ÎN ROMÂNIA

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Keywords: *freezing, strawberry, sicon, process, ice crystals.*

ABSTRACT
Due to the development of cold-making equipment and its accessible price, the food's conserving by freezing has become a widely used method in the food industry. Considering this fact, the research performed at the Horting Institute followed the behaviour of Mira and Magic variety of strawberry fruits. During the experiments were examined the variation of the ascorbic acid content and water crystallization mode by microscopic view.

REZUMAT
Datorită dezvoltării echipamentelor de realizarea a frigului și a prețului accesibil al acestora, conservarea alimentelor prin congelare a devenit o metodă utilizată pe scară largă în industria alimentară. Ținând cont de acest fapt cercetările edectuate la institutul Horting au urmărit comportarea la congelarea a fructelor soiului de căpșun Mira și Magic. Pe parcursul experimentărilor, s-au urmărit variația conținutului de vitamiă C și modul de cristalizare a apei prin vizualizare microscopică.

INTRODUCTION
The globalized system for exchange of goods, especially the alimentary goods, allows now a continuous exchange between all continents of the Earth. Fresh and frozen fruit's trade has known an ascending trend in global chains of retailer stores, in recent years.

High-quality frozen products are obtained by controlling the freezing process, both in the pre-frozen and freezing stages (George. 1993). Therefore, the theory of the freezing process and the involved parameters must be clearly understood and well known and managed by the processors. A succession of thermodynamic and kinetic factors influences a certain moment of the freezing process (Franks. 1985). A first critical point of freezing is represented by nucleation, the beginning of the initial freezing process, which has as result in a complete change of phase (Sahagian and Goff. 1996). Depending on the moisture's content, in the literature of speciality exist empirical equations for the calculation of the initial freezing temperature of some alimentary goods.

The basis for the freezing process has been established through the research conducted at the International Institute of Refrigeration (IIR), which has offered definitions and has established the theory regarding the freezing process, divided in three stages and based on the major temperature changes, which are taking place in the product, as is shown in the Figure 1 for a food product.

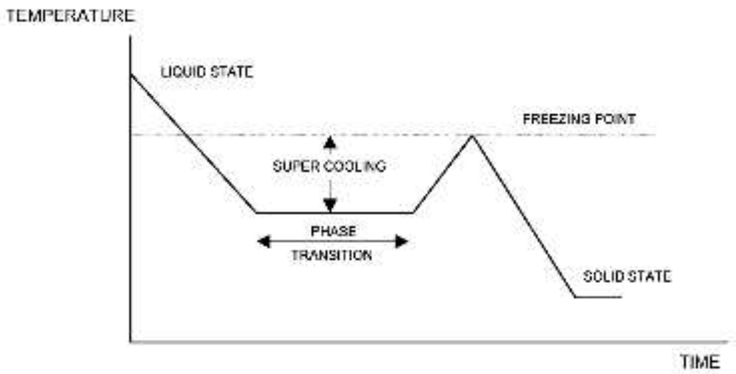

Fig.1- Freezing process for the food product (Mallett, 1993)

The freezing rate influences the quality of the frozen fruit and the freezing time is calculated accordingly to this freezing rate.

The freezing time is influenced by the initial and final temperatures of the fruit and the amount of heat released, the size and shape of the fruit, the heat transfer process and the storage temperature. In this context, the research developed followed the behaviour at freezing for two primary variants of freezing of a variety of strawberry cultivated in Romania.

MATERIAL AND METHOD

The Magic and Mira varieties of strawberry are obtained at the Research Institute for Fruit Growing Pitesti - Maracineni and the fruits used in the experiments come from their crops. Figures 2 and 3 show aspects of these varieties culture.

Fig. 2 – Magic variety

Fig. 3 – Mira variety

In Table 1 are presented the main characteristics (fruit's weight, fruit's content in soluble dry substance, pulp's firmness and fruit's colour) of these two cultivars.

Table 1

Maturation period and fruit's characteristics

No.	Variety	Beginning of fruit's maturation	Fruit's weight (g)	Dry substance content (%)	pH	Pulp's firmness (Units HPE)
1	Mira	28 May	26.0	6.9	3.40	13.00
2	Magic	29 May	17.0	8.8	3.75	21.87

A major importance for consumers in choosing the fruits is represented by colour, the ones coloured in bright light-red being preferred. The colorimetric characteristics of the fruits are presented in Table 2.

Table 2

Fruit's colour at strawberry varieties

Variety	Color characterization				
	Brightness Index (L*)	Green-Red Coordinate (a*)	Blue-Yellow Coordinate (b*)	The angle of color (Redness)	Chromatographic index (C*)
Magic	30.06	26.52	10.80	24.32	28.14
Mira	29.64	24.86	10.56	23.00	27.01

The freezing system used was Bosch GSN36AI31 Freezer, No Frost. 237 L Capacity and 7 drawers, is provided with Multi Airflow systems (uniform air distribution) and Super Freezing (frozen food protection,. freezing temperature [-18^{0}C. - 20^{0}C].

The linear average freezing speed given by the relation (1) is a criterion that characterizes a freezing process in terms of cooling intensity.

$$w_m = \frac{\delta_0}{\tau_0}, \text{ [cm/h]} \quad (1)$$

where: δ_0 is the smallest distance between the thermic center and the surface of the product [cm];
τ_0 - the freezing time from a uniform initial temperature of 0°C to the temperature intended to be reached in the thermic center. [hours].

Depending on the linear average freezing speed, w_m. the International Institute of Refrigeration recommends the following classification of freezing methods:

- slow freezing $w_m < 0.5$ cm/h;
- fast freezing $w_m = 0.5 \ldots 3$ cm/h;
- very fast freezing $w_m = 3 \ldots 10$ cm/h;
- ultrafast freezing $w_m = 10 \ldots 100$ cm/h.

For the visualization of the fruit's structure and ice crystals formed by freezing was used a digital microscope type Supereyes B008 500X USB Digital 5.0 MP Portable.

RESULTS

After six mounts of freezing was analyzed the ascorbic acid content for the two variety of strawberry, Mira and Magic. The values obtained are shown in Table 3.

Table 3

Variation of Ascorbic Acid content in strawberry varieties

No.	Variety	Number of samples	Ascorbic Acid content (mg/100g) as average -Initial-	Ascorbic Acid content (mg/100g) as average - After 6 mounts-
1	Mira	10	43.001	39.180
2	Magic	10	41.217	38.255

Crystallization type of water in the fruits are shown in the Figures 4 - 7

Fig. 4 – Magic variety (in section)

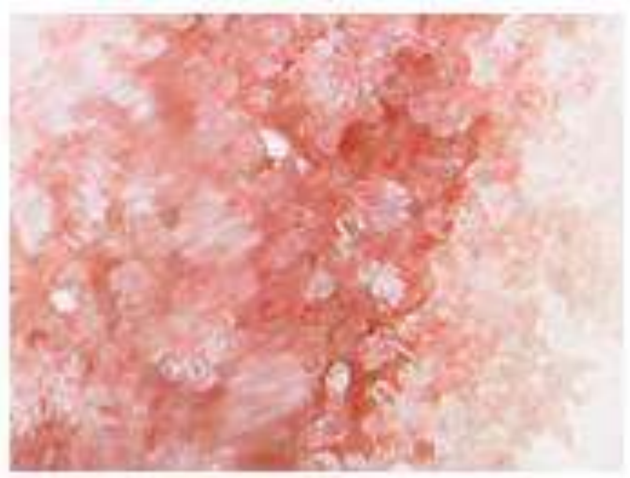

Fig. 5 – Mira variety (in section)

Fig. 6 – Magic variety (external aspect)

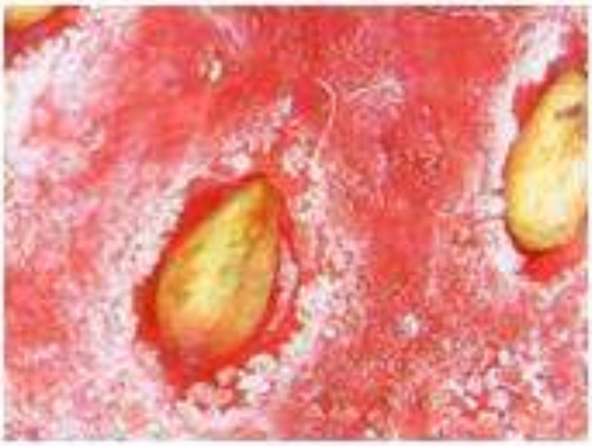

Fig. 7 – Mira variety (external aspect)

CONCLUSION

Regarding the variation of ascorbic acid content during the six mounts of storing, the values presented in Table 3 show insignificant differences for the both varieties. We can say that the storing by freezing does not affect the ascorbic acid content.

Regarding the microscopic evaluation was established that the large dimension of ice crystals is characterized as a slow freezing.

It was observed differences between the two varieties, mainly in internal structure, the cells in Mira variety having larger dimensions, the water content of each variety having an influence on crystallization.

These researches achieved are the beginning of new studies regarding very fast and ultrafast freezing for other varieties of fruits.

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AQUAPONICS. AN INNOVATIVE TECHNOLOGY FOR FOOD PRODUCTION AND A NEW RESEARCH DIRECTION IN ROMANIA IN THE FIELD OF HORTICULTURE AND MASS AND HEAT TRANSFER
/
ACVAPONIA. O TEHNOLOGIE INOVATIVÃ PENTRU PRODUCEREA HRANEI ȘI O DIRECTIE NOUÃ DE CERCETARE ÎN DOMENIILE HORTICOL ȘI AL TRANSFERULUI DE MASÃ ȘI CALDURÃ

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***Keywords**: aquaponics; nutrient mass balance; energy balance; dynamic modeling; biogas.*

ABSTRACT

Aquaponics is an innovative agricultural technology that combines into a loop aquaculture (fish farming) with hydroponics (growing plants without soil) to create a sustainable, low-impact food production unit.

The fish, plant and bacteria (which play an important role in the system) each constitute a heterotrophic and homeostasis system. By bringing together several individuals of the same species, a community or system is formed that preserves the characteristics of the individual, but introduces new criteria for functioning, imposed by coexistence and a new way of dealing with the environment.

By introducing the aquaponic system into a greenhouse, a series of transfer functions are created between the aquaponic system and the environment.

In view of these issues, a pilot plant was built at ICDIMPH Horting, where three types of aquaponics systems and several heating systems are installed, which constitute the infrastructure for a research program that has the following objectives:

- identifying the system variables that characterize the behaviour of the system and can be measured, the functional relations and the elaboration of dynamic models that allow to anticipate the behaviour of the aquaponic system depending on the evolution of the respective variables.

- defining the thermal characteristics of greenhouses and unconventional heating systems;

- wide dissemination of the results;

In this paper are presented the first results obtained.

REZUMAT

Acvaponia este o tehnologie de producție agricolã inovativã care cupleazã în circuit închis acvacultura (cresterea peștilot în scopul comercializãrii) cu hidroponia (cultura plantelor fãrã sol) pentru a crea un sistem de producție agricolã sustenabil, eficient energetic și nepoluant.

Peștele, planta și bacteria (care capãtã un rol important în sistem) constituie fiecare un sistem heterotrof și homeostazic. Prin punerea la un loc a mai multor indivizi din aceeași specie se formeazã o colectivitate sau system, care pãstreazã caracteristicile individului, dar introduce criterii de funcționare noi, impuse de conviețuirea în comun și un nou mod de relaționare cu mediul înconjurãtor.

Introducând sistemul acvaponic într-o sera, se creazã o serie de funcții de transfer intre sistemul acvaponic și mediul inconjurãtor.

Avand in vedere aceste aspect, la ICDIMPH Horting a fost realizata o statie pilot in care sunt instalate trei tipuri de sisteme aquaponics si mai multe sisteme de incalzire care constituie infrastructura pentru un program de cercetare, care are urmatoarele obiective:

- identificarea variabilelor de sistem care caracterizeazã comportamentul sistemului si pot fi masurate, a relatiilor funcționale și elaborare unor modele dinamice care sã permitã anticiparea comportamentului sistemului acvaponic în functie de evoluția variabilelor respective.

- definirea caracteristicilor termice serelor si a sistemelor de incalzire neconventionale

- diseminarea pe scara larga a rezultatelor obtinute

In aceasta lucrare sunt prezentate primele rezultate obtinute.

INTRODUCTION

The aquaponics technology was created in the US in the 1980s and has spread throughout the world due to the benefits it has:

- is an alternative to cheap, efficient and sustainable traditional production technology;
- the daily water consumption in the system represents 10% of the water consumption of each crop taken separately and 5% of the system water volume;
- no pesticides, insecticides or other chemicals are used;
- the occupancy rate of the land is several times smaller than the traditional crops;
- aquaponic systems can be located in any geographic region regardless of their pedoclimatic conditions, can be located in cities as well;
- plant yields are 3-8 times higher than similar crops produced in the field;
- system management is simple;
- plant production is almost free.

In Romania, the first small, medium and commercial aquaponic systems were developed at ICDIMPH Horting, between 2006 and 2010. Also at ICDIMPH Horting, in 2015 the project titled "IMPLEMENTATION OF AQUAPONIC TECHNOLOGY IN ROMANIA TO BENEFIT HEALTH AND SUSTAINABLE LIVELIHOOD IN DEPRIVED AREAS **(AQUA-ROM)**" was implemented. The project is co-funded by a grant from Switzerland through the Swiss Contribution to the Enlarged European Union. Based on this funding, ICDIMPH Horting has set up a pilot plant, where the three types of aquaponics systems (media bed, raft culture and NTF) are installed, in which aquaponics production research has begun. The first researches are presented in this paper.

Regardless of the constructive type, the basic components of an aquaponics system are:

- Tanks for fish breeding. They must be constructed in such a way as to allow the discharge of waste as much as possible into the solid filter;
- Fish waste processor - is a mechanical separator of solid particles (fish feces, algae, undigested food, etc.) that are suspended in water;
- Biofilter - is the site where the cultures of nitrous bacteria develop, that convert ammonia into nitrates;
- Beds for hydroponic plant cultivation - are of different types and sizes and are the place where plants absorb water from nitrates and other substances that are toxic to fish. The water released by the toxic chemicals for the fish returns to the fish tanks, clean.

By creating an aquaponics system, three populations are involved: fish, plants and bacteria that have different nutritional requirements and environmental quality and, different relationships. Each of these populations, when evolving independently, can be considered a heterotrophic and homeostasis syste,. which is characterized by a number of specific state variables. The variation range of status variables of each system (fish, bacteria, and plants) shows areas where the variables have the same values. This feature makes it possible to couple the three systems into a new system and transform them into subsystems of the artificially created system.

For the same type of fish and plant species, the quantitative ratio between plant biomass and fish biomass directly influences the filtering capacity of the system. This ratio is converted into the ratio between the amount of feed given and the hydroponic culture area. If this ratio is too high, the mineral salts, ammonia, nitrite and nitrate content in the system will increase, exceed the absorption capacity of the plants; when the water is not properly treated it becomes toxic to fish and plants. If the ratio is too low, the plants will have fewer nutrients available, so the growth rate will drop. It follows that, in order to achieve good production of plants and fish, in the context of efficient water treatment, this ratio should be maintained between optimal limits. In other words, a steady state (and monitored) must be achieved.

In order to determine these limits, it becomes necessary to develop mathematical models that establish the functional links between the system variables. Once the mathematical model has been established, experimental research is geared to studying the evolution of these variables and calibrating the model so that it can be used later in the design and management of these systems.

In the climatic conditions in our country, for an aquaponics system to reach its maximum production, it has to work for the whole year. For this reason, the aquaponics systems at the Horting pilot station were placed in two heated hot houses. To reduce as much as possible the heat loss, one of the greenhouses is built semi - buried. At the same time, in order to avoid the destruction of the greenhouses under the action of wind or snow, but also because the shape of the greenhouse contributes to the reduction of the heat loss, two greenhouses are of the geodetic type (the first built in Romania) and the third is of the Gothic type. Figure 1.

Fig.1 – Greenhouses at ICDIMPH Horting in the winter

MATERIAL AND METHOD

Aquaponics systems have been built to allow measurements to be made and extrapolated to systems of other dimensions. Three types of heating systems were built: a biomealer, a "masset heater" and a biogas generator. The greenhouses where the aquaponics systems are made of wood, covered with PVC anti-UV film. A greenhouse is of the Gothic type and is partially buried and the other two greenhouses are geodomes.

The modeling of aquaponics and other technological objects is done using the "STELLA" software. For modeling the behavior of the plant culture in a hydroponic system, the scheme of the model was elaborated. fig. 2.

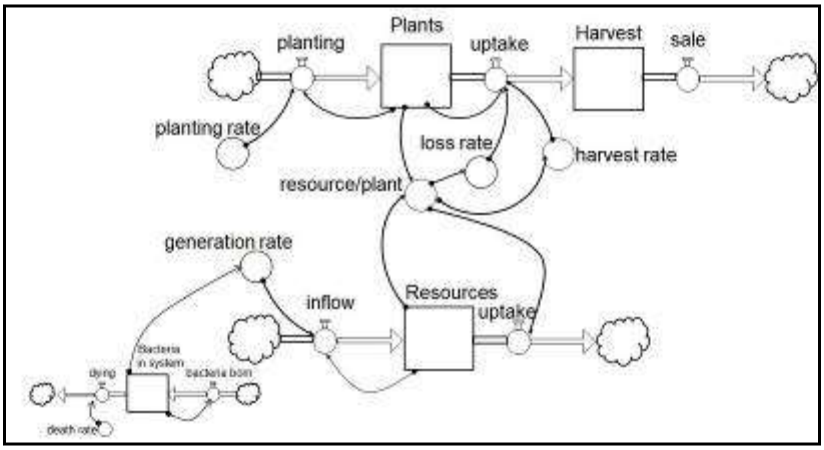

Fig.2 – Hydroponic culture model

The fate of fish feed has been well quantified [1, 2, 3, 4, 5], and the fate of nutrients, solids and carbonaceous wastes resulting from feed application, can be predicted.

Since the sludge accumulated in the mechanical separator and the biofilter, vegetal biomass is periodically evacuated from the system, we have made an anaerobic fermentation plant producing methane. It is used for water heating.

Regularly evacuated air with high enthalpy is used in an air / air heat exchanger for preheating the introduced air.
The Rocket Mass Heater was designed to work with both wood and pellets. The biomimeter will be tested this winter to determine the operating parameters.

RESULTS

The first researches revealed the following aspects in the functioning of aquaponic systems:
1. Plants cultivated in hydroponic systems have not developed the same. The analysis of the causes that determined these differences has highlighted the fact that water circulation in different constructive types favors plants that are near the water inlet area.

2. Plant technology in RAFT, NFT and Media Bed systems has been designed and built as recommended in the literature. All aquaponic systems of this type all over the world are built according to these recommendations.

3. The analysis of the causes that led to the differential plant development revealed the following:
- In the RAFT system culture boxes, the water is inserted through one end of the box and the outlet is made in the middle of the box or at the opposite end of the input. The flow of water is laminar with very low 'w' values. Plant roots create a dense mesh in the liquid layer and prevent the uniform distribution of nutrients throughout the volume. The retention time of water in the boxes, calculated according to the rule, does not ensure that all plants take up the nutrients in the water.

- In the tubes in the NTF system, the roots occupy almost the whole section of the tube. For this reason, the water that reaches the plants at the opposite end of the water inlet receives fewer nutrients than the plants that are in the first third of the tube 4, the amount of waste generated from the aquaponic system being able to potentially supply (through biogas) the energy requirements to run the off-grid system.

CONCLUSIONS

The first research has highlighted the need to find a solution for the uniform distribution of nutrients in the technological objects that make up the hydroponic system.

Modeling with the "STELLA" software provides enough precision to extrapolate by similarity the results obtained on the aquaponic systems of the Horting pilot station.

The analysis of biogas production by anaerobic fermentation of waste from aquaponic systems in the pilot plant revealed that the quantity produced is sufficient to heat for a few days the water in the system. The following researches and experiments will define the issues presented.

ACKNOWLEDGEMENT

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EXPERIMENTAL RESEARCHES CONCERNING THE WORKING PROCESS OF A GERMINAL BED PREPARATION EQUIPMENT FOR HEAVY SOILS
/
CERCETĂRI EXPERIMENTALE PRIVIND PROCESUL DE LUCRU AL UNUI ECHIPAMENT DE PREGĂTIT PATUL GERMINATIV PENTRU SOLURI GRELE

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Keywords: *soil, tillage, chisel, force, penetration, humidity.*

ABSTRACT
The paper presents the results obtained from experimental researches carried out in exploitation conditions in order to determinate the qualitative working indices of an equipment used for the processing of the germination bed for heavy soils: the vegetal debris coverage degree and the soil crushing degree, as well as the energy indices: slipping, traction and fuel consumption, depending on the depth, soil moisture and working speed.

REZUMAT
Lucrarea prezintă rezultatele obţinute ca urmare a cercetărilor experimentale realizate în condiţîi de exploatare pentru determinarea indicilor calitativi de lucru ai unui echipament de pregătit patul germinative pentru soluri grele: gradul de acoperire cu resturi vegetale şi gradul de mărunţire a solului, precum şî a indicilor energetici: patinarea. forţa de tracţiune şi consumul de combustibil. funcţie de depth. umiditatea solului şi speed de lucru.

INTRODUCTION
Conservative soil cultivation works are an alternative to classical soil processing (plowing) in the context of current drought-induced climate change. The use of the equipment for processing the germinating bed for heavy soils is an alternative, this equipment being able to process the soils up to depths of 25-30 cm (Budoi and Penescu, 1996; Constantin et al., 2008).

Under the need to apply conservative tillage, it became widely used the combiner, an equipment for conservative processing of soil that can also perform soil crumbling in a single pass (*Koloszvary, 2008*).

The combiner can be fitted with active bodies, type notched disks, chisel and leveling. Among these types, the chisel type active bodies are subjected to an intense wear due to the shape that comes directly in contact with the soi, resulting in a high wear. Such equipment for conservative processing of soil (Fig. 1) is designed as a complex aggregate, consisting of 4 modules with different active bodies, mounted one after another so that in a single pass to perform several operations which will ultimately lead to a high quality of soil processing.

Fig. 1 - Equipment for soil processing in conservative system

MATERIALS AND METHODS
The experimental researches for the determination of the qualitative and energetic indices with the soil processing equipment (preparation of the germinating bed) in a conservative system, were made in the

Zerind locality, Arad County, about 12 km away from Chisinau Cris, on an area of about 30 ha., using a tractor of 250 HP. For the determination of the experimental data, a National Instruments acquisition system, tensiometric marks, humidity meter, penetrometer, stopwatch, fuel consumption meter, furrow metering system, metric frame, 100 kg scale, bags and milestones were used (Uceanu et al. 2008; et al.. 2008; Vlăduţ et al. 2012).

Fig. 1 - Plot 1 used for experiments (Zerind locality. Arad county)

Fig. 2 - Soil processing equipment working in a conservative system during experiments

REZULTS

- ***Soil moisture determination***

According to the working depth set for the experiments: 5/10/15/20/25/30 cm., the relative humidity of the soil (Figure 3) was determined for these 6 horizons: 0 – 5 / 5 – 10 / 10 – 15 / 15 – 20 / 20 - 25 / 25 - 30 cm (tabel 1).

Fig. 3 - Aspects during soil determination in the plot used for experimentation

Table 1

Soil humidity depending on the depth of the horizons

SOIL HUMIDITY [%]											
Depth [cm]	**Sample**										***Mediate***
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
0 – 5	17.4	19.6	18.2	17.7	18.4	20.3	20	19	18.1	18.3	*18.7*
5 – 10	25.3	28.8	22.9	27.6	25.8	26.7	29.4	27	28.7	25.8	*26.8*
10 – 15	37.2	38.9	36.9	34.5	36.8	35.9	34.4	32.8	33.7	31.9	*35.3*
15 – 20	21.8	40.8	42.2	39.9	41.7	42.6	43.1	40.5	41.3	42.1	*39.6*
20 - 25	38.6	42.3	40.9	41.5	41.9	40.7	42.2	41.6	42.2	42.1	*41.4*

25 - 30	39.1	43	41.2	42.8	42.7	42.7	44.1	40.9	41.3	41.2	*41.9*

- ***Soil compactness determination (resistance to penetration)***

The soil compactness was determined for the working depth of the equipment set between: 0 ÷ 30 cm. (Figure 4). Table 2

Fig. 4 - ***Soil compactness determination (resistance to penetration)*** **in plot 1**

Table 2

Compactness of the soil corresponding to the working depth of the equipment

Depth. [cm]	COMPACTITATE SOL [kPa]				
	Sample I	**Sample II**	**Sample III**	**Sample IV**	***MEAN***
2.5	1088	3054	1860	3025	*2256.75*
5.0	1369	2036	2212	2011	*1907.00*
7.5	1193	3265	1931	3210	*2399.75*
10.0	1334	4318	1966	4290	*2977.00*
12.5	2247	4213	1896	4280	*3159.00*
15.0	2387	3581	1899	3560	*2856.75*
17.5	1931	3511	1860	3480	*2695.5*
20.0	2071	3195	1755	3090	*2527.75*
22.5	1966	3300	1931	3281	*2619.5*
25.0	1755	2738	2001	2711	*2301.25*
27.5	1746	2685	1995	2657	*2270.75*
30	1723	2611	1952	2613	*2224.75*

<u>Determination of qualitative and energy indices</u>

- ***Determination of the vegetal debris coverage degree***

This step has been done in order to identify the average values of the existing vegetal mass present on the soil surface per 1m^2, before (Figure 5) and after the passing of the aggregate, and in order to check how the combiner incorporates as much as possible of the vegetal debris into the soil (Table 3).

The existing vegetal mass on the soil surface (per 1m^2) before the passing of the aggregate

Existing soil mass on the soil surface (per 1m^2) after the combiner-tractor aggregate has passed

Fig. 5 - Aspects on how to determine the degree of vegetal debris coverage

Table 3

Determination of vegetal debris coverage degree

A. BEFORE THE PASSING OF THE AGGREGATE						
Repetition 1 (kg/mp)	**Repetition 2** (kg/mp)	**Repetition 3** (kg/mp)	**Repetition 4** (kg/mp)	**Repetition 5** (kg/mp)	**Repetition 6** (kg/mp)	***MEAN*** (kg/mp)
0.445	0.494	0.364	0.612	0.533	0.481	*0.488*
B: AFTER THE PASSING OF THE AGGREGATE						
Repetition 1 (kg/m2)	**Repetition 2** (kg/m2)	**Repetition 3** (kg/m2)	**Repetition 4** (kg/m2)	**Repetition 5** (kg/m2)	**Repetition 6** (kg/m2)	***MEAN*** (kg/m2)
0.034	0.038	0.028	0.048	0.042	0.037	*0.0378*
Incorporation of plant residues degree						
92.36	92.31	92.31	92.16	92.12	92.31	**92.25**

- ***Determination of soil compactness***

This step was done in order to determine how the working parts of the combiner dislodge and crush the soil (Figure 6) in order to make a germinating bed, as uniform as possible, with the smallest bulges (Table 4).

Fig. 6 - Aspects on how to determine the degree of soil shredding

Table 4

Determination of soil compactness

Particle size [mm]	**The grading degree by size [%]**					
	Sample 1	**Sample 2**	**Sample 3**	**Sample 4**	**Sample 5**	***MEAn***
>100	8.20	5.90	6.93	8.54	6.23	*7.160*
>50	66.63	71.64	68.69	72.64	71.88	*70.296*
>20	22.66	21.02	23.01	23.15	22.88	*22.544*

- ***Determination of tractor slipping and fuel consumption***

The tractor slipping (table 5) that occurs when the tractor is towing the combine while working, is necessary to be calculated related to the traction power requirement of the power source used (tractor). The average fuel consumption of the tractor, obtained by processing the 80 ha of scarified land (including double crossings at the ends of the plot and for turning at the end of the furrow. etc.). correlated with the working width of the equipment, speed and working depth, allows to determine combiner productivity which varies depending on working conditions: humidity, soil compactness, depth of work, etc.

Table 5

Slipping of the tractor during the working process with the DRACULA combiner

Slipping[50m]											
Sample 1		**Sample 2**		**Sample 3**		**Sample 4**		**Sample 5**		**MEAN**	
left	right	left	right	left	right	left	right	left	right	left	right
9.50	9.50	9.75	9.50	10.0	10.0	10.25	10.50	10.50	10.50	-	-
6.31%		7.54%		11.21%		14.22%		15.23%		*10.9%*	

- *Average fuel consumption: 25.81 l / ha.*

In order to highlight the energy indices according to the variation of the main working parameters: depth, speed and soil humidity, experiments were carried out following their variation: traction, slipping and fuel consumption (Table 6).

Table 6

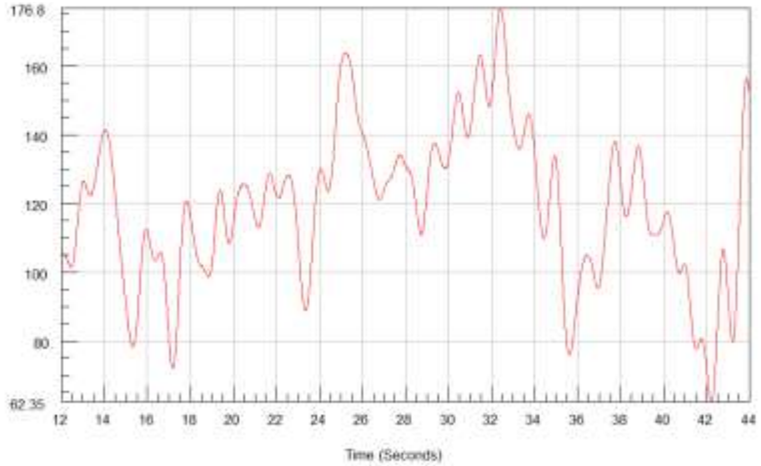
Variation of the energy indices depending on: depth and working speed, respectively soil humidity

Parameters		a_1 [5 cm]; u = 18.7%				a_2 [10 cm]; u = 26.8%				a_3 [15 cm]; u = 35.3%			
		R1	R2	R3	*Media*	R1	R2	R3	*Media*	R1	R2	R3	*Media*
$v_1 = 2$ [m/s] 7.2 [km/h]	Slipping[%]	6.15	6.15	6.18	*6.16*	7.42	7.43	7.47	*7.44*	9.43	9.42	9.38	*9.41*
	Tractive force [daN]	100.3	100.8	100.1	*100.4*	108.9	101.2	105.8	*105.3*	119.2	114.3	116.7	*116.73*
	Fuel consumption[l/ha]	5.98	6.02	6.03	*6.01*	10.44	10.42	10.4	*10.42*	13.13	12.9	12.73	*12.92*
v_2=2.5 [m/s] 9 [km/h]	Skid [%]	6.26	6.26	6.23	*6.25*	7.49	7.49	7.49	*7.49*	9.51	9.49	9.5	*9.5*
	Tractive force [daN]	102.48	102.89	101.96	*102.44*	110.22	105.77	107.46	*107.82*	118.95	121.35	119.24	*119.85*
	Fuel consumption[l/ha]	6.12	6.12	6.18	*6.14*	10.35	10.31	10.33	*10.33*	12.72	12.81	12.9	*12.81*
$v_3 = 3$ [m/s] 10.8 [km/h]	Slipping[%]	6.36	6.32	6.34	*6.34*	7.58	7.58	7.55	*7.57*	9.5	9.51	9.55	*9.52*
	Tractive force [daN]	103.95	104.12	103.98	*104.02*	112.87	111.56	111.21	*111.88*	122.33	124.01	121.89	*122.74*
	Fuel consumption[l/ha]	6.26	6.26	6.23	*6.25*	10.24	10.22	10.26	*10.24*	12.73	12.74	12.72	*12.73*
v_4=3.5 [m/s] 12.6 [km/h]	Skid [%]	6.48	6.49	6.5	*6.49*	7.67	7.67	7.64	*7.66*	9.52	9.53	9.51	*9.52*
	Tractive force [daN]	105.21	106.03	104.32	*105.19*	114.34	114.88	113.98	*114.40*	122.33	124.01	121.89	*122.74*
	Fuel consumption[l/ha]	6.36	6.37	6.35	*6.36*	10.13	10.13	10.07	*10.11*	12.61	12.71	12.51	*12.61*

Parameters		a_4 [20 cm]; u = 39.6%				a_5 [25 cm]; u = 41.4%				a_6 [30 cm]; u = 41.9%			
		R1	R2	R3	*Media*	R1	R2	R3	*Media*	R1	R2	R3	*Media*
$v_1 = 2$ [m/s] 7.2 [km/h]	Slipping[%]	11.07	11.09	11.08	*11.08*	14.3	14.1	13.9	*14.1*	15.07	15.08	15.12	*15.09*
	Tractive force [daN]	118.72	121.21	124.54	*121.49*	123.51	126.17	127.32	*125.67*	128.85	129.04	129.65	*129.18*
	Fuel consumption[l/ha]	25.42	25.44	25.4	*25.42*	21.67	21.67	21.64	*21.66*	26.1	26.1	26.1	*26.1*
v_2=2.5 [m/s] 9 [km/h]	Skid [%]	11.16	11.16	11.16	*11.16*	14.19	14.19	14.16	*14.18*	15.19	15.21	15.2	*15.2*
	Tractive force [daN]	120.75	124.33	125.04	*123.37*	131.52	130.26	132.2	*131.33*	139.12	138.62	137.52	*138.42*
	Fuel consumption[l/ha]	17.6	17.52	17.56	*17.56*	21.42	21.42	21.45	*21.43*	25.81	25.83	25.82	*25.82*
$v_3 = 3$ [m/s] 10.8 [km/h]	Slipping[%]	12.27	11.27	11.24	*11.26*	14.25	14.27	14.29	*14.27*	15.28	15.27	15.29	*15.28*
	Tractive force [daN]	127.55	126.89	128.19	*127.54*	136.95	137.53	135.88	*136.79*	143.62	145.52	146.06	*145.07*
	Fuel consumption[l/ha]	17.49	17.5	17.45	*17.48*	21.33	21.32	21.34	*21.33*	25.69	25.69	25.72	*25.7*
v_4=3.5	Slipping[%]	11.35	11.35	11.32	*11.34*	14.33	14.33	14.33	*14.33*	15.36	15.36	15.33	*15.35*

Parameters		a_4 [20 cm]; u = 39.6%				a_5 [25 cm]; u = 41.4%				a_6 [30 cm]; u = 41.9%			
		R1	R2	R3	*Media*	R1	R2	R3	*Media*	R1	R2	R3	*Media*
[m/s] 12.6 [km/h]	Tractive force [daN]	130.14	131.56	130.61	*130.77*	140.56	142.06	141.32	*141.31*	151.69	154.32	152.54	*152.85*
	Fuel consumption[l/ha]	14.4	14.41	14.45	*14.42*	21.28	21.27	21.223	*21.26*	25.6	25.63	25.63	*25.62*

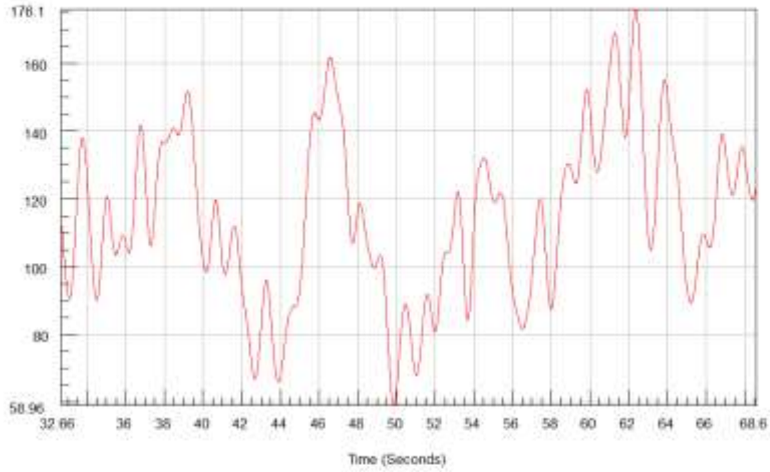
Tf [daN] speed: 7.2 km/h; depth: 15 cm; sample 1



speed: 7.2 km/h; depth: 15 cm; sample 2

Marker	Y Max	Y Min	Y Mean
	176.8	62.35	119.2

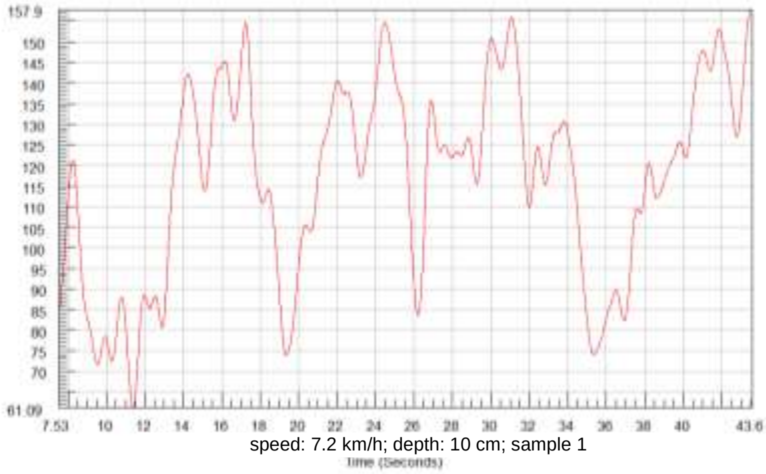
Tf [daN] speed: 7.2 km/h; depth: 15 cm; sample 1



speed: 7.2 km/h; depth: 15 cm; sample 2

Marker	Y Max	Y Min	Y Mean
	176.1	58.96	114.3

Tf [daN] speed: 7.2 km/h; depth: 15 cm; sample 3

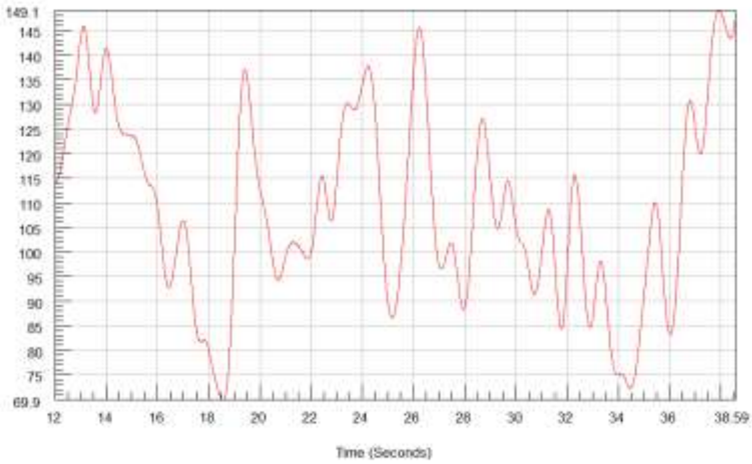


speed: 7.2 km/h; depth: 10 cm; sample 1

viteza - 7,5km/h, adancime- 15cm, nr proba - 3

Marker	Y Max	Y Min	Y Mean
	157.9	61.09	116.7

Tf [daN] speed: 7.2 km/h; depth: 15 cm; sample 3



speed: 7,2 km/h; depth: 10 cm; sample 1

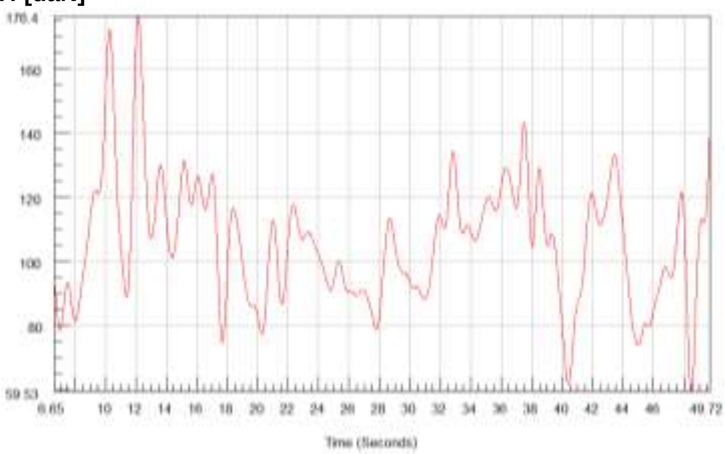
Marker	Y Max	Y Min	Y Mean
	149.1	69.9	108.9

Tf [daN] speed: 7.2 km/h; depth: 10 cm; sample 2

speed: 7.2 km/h; depth: 10 cm; sample 2

Marker	Y Max	Y Min	Y Mean
	164.7	33.75	101.2

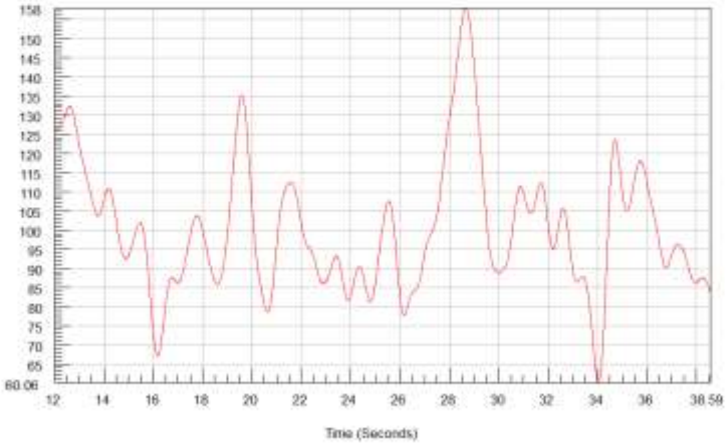
Tf [daN] speed: 7.2 km/h; depth: 10 cm; sample 3



speed: 7,2 km/h; depth: 10 cm; sample 3

Marker	Y Max	Y Min	Y Mean
	176.4	59.53	101.8

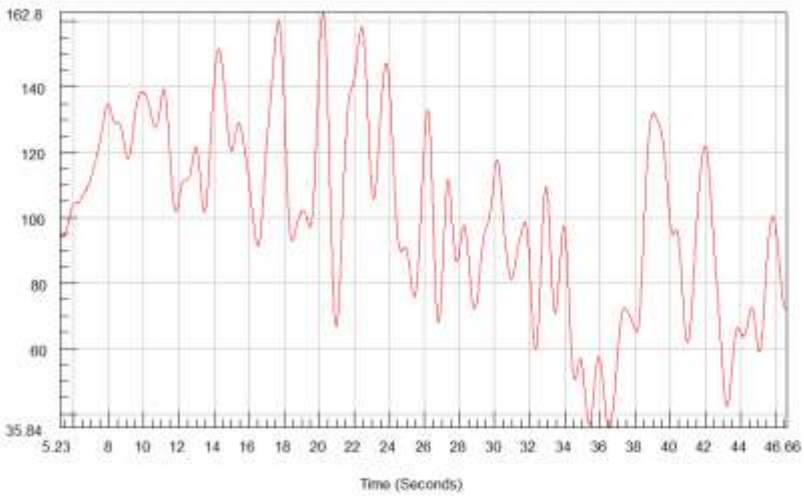
Tf [daN] speed: 7.2 km/h; depth: 5 cm; sample 1



speed: 7.3 km/h; depth: 5 cm; sample 1

Marker	Y Max	Y Min	Y Mean
	158	60.06	100.3

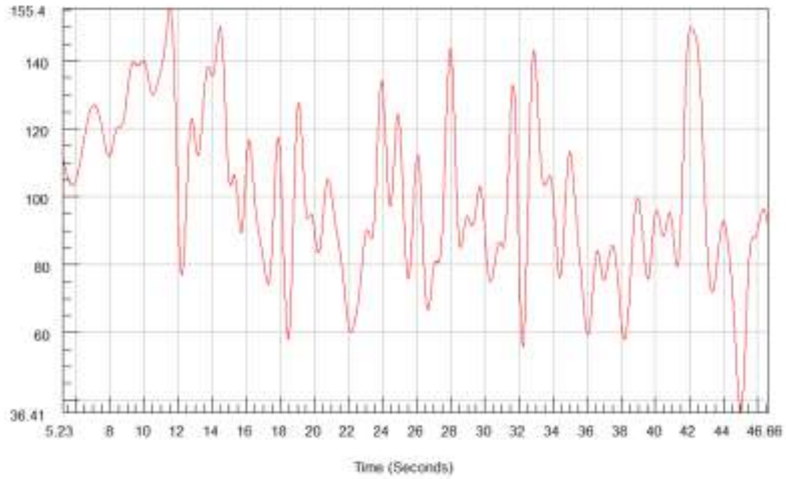
Tf [daN] speed: 7.2 km/h; depth: 5 cm; sample 2



speed: 7.2 km/h; depth: 5 cm; sample 3

Marker	Y Max	Y Min	Y Mean
	162.8	35.84	100.8

Tf [daN] speed: 7.2 km/h; depth: 5 cm; sample 2



speed: 7,2 km/h; depth: 5 cm; sample 3

Marker	Y Max	Y Min	Y Mean
	155.4	36.41	100.1

CONCLUSIONS

Soil humidity and compactness are two very important factors that have a great influence on the data obtained while determining the qualitative working or energy indices of the DRACULA combiner, because any variation of one or both of these factors leads to variations in measured data, as a result of the experimental research and implicitly of the obtained results.

That is why it is very important that the qualitative and energetic indices determined for the tractor unit + DRACULA combiner to be accomplished within a short period of time (maximum 3-4 days) on the same site (plot), and also, during this experimental period no variations were accepted (precipitations) because they have the ability to change the input parameters (soil humidity and compactity) and therefore, the measured output data will not be comparable to those measured prior to the occurrence of these improper conditions.

The experimental researches presented in this report respected these conditions and by analyzing the data obtained, it was observed that:

- soil moisture determined on 6 horizons (0 - 5/5 - 10/10 - 15/15 - 20/20 - 25/25 - 30 cm), corresponding to the work depths previously defined, varies with depth, growing with it;
- the soil compactness (penetration resistance) for the depth of 0 ÷ 30 cm (the maximum working depth of the combiner) increases with the depth (not uniformly due to the inhomogeneity and unevenness of the soil), reaching a maximum of 12.5 cm., after that it decreases continuously. (in these horizons the humidity is higher and the soil is not as rough);
- the vegetal debris coverage of the soil after the passing of the aggregate (incorporation of vegetal debris into the soil) by the active parts of the "DRACULA" combine is very good (92.25%), since this equipment does not overturn the soil;
- the soil grinding degree made by the "DRACULA" combiner has a comparative value with those made by the other germinating bed preparation equipment (disc grabs, tines. etc.). the results obtained with this equipment being made on a land that has been unprocessed and scarified for 20 years, so under very difficult working conditions; unlike conventional bedding equipment, this combiner is normally used directly in non-terrain (conservative soil treatment system);
- between all the determined energy indices, the skating and tensile strength (for different work speeds and depths, respectively humidities) had increasing values with increasing working depth and humidit,. respectively working speed, but fuel consumption decreased with the increasing of the work speed and increasing of the work depth and soil moisture had higher values.

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ZOOTECHNICAL CONSTRUCTIONS. SHELTER SYSTEMS FOR CATTLE. REVIEW / *CONSTRUCTII ZOOTEHNICE, SISTEME DE ADAPOST PENTRU BOVINE. REVIEW*

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Keywords: *types of construction, interior design, exterior design, stabulation.*

ABSTRACT

Development of cattle breeding conditions has passed over the years through many attempts, types of systems and technologies where there were looking for the best animal health and productivity standards. Consequently, beneficial effects on farm viability and economic growth have rapidly appeared through improving animal welfare and performance, improving labour efficiency (low time) stability and market competitiveness and a safer work environment for staff. The shelter should be designed specifically for animals and not as a general-purpose building.

REZUMAT

Dezvoltarea conditiilor de crestere a bovinelor. a trecut de-a lungul anilor prin multe incercari. tipuri de sisteme si tehnologii. unde s-au cautat cele mai bune standarde asupra sanatatii si productivitatii animalelor. In consecinta, efectele benefice asupra viabilitatii fermelor si a cresterii economice nu au intarziat sa apara prin imbunatatirea bunastarii si performantei animalelor. imbunatatirea eficientei muncii (timp scazut). stabilitate si competitivitate pe piata. iar mediul de lucru mai sigur pentru personal. Adapostul trebuie special proiectat pentru animale si nu ca o cladire cu scop general.

INTRODUCTION

The growing demand for animal products has gradually brought the replacement of classical farming and maintenance methods with new systems, where both production and labour productivity are at a higher level.

The most recent years characterize zootechnical production by introducing on a wider scale the mechanization and automation in this domain, using new techniques and technologies

The complexity of factors involved in obtaining healthy animals with high productive capacity shelters have gained a special share, and no one doubts the imperative necessity of their knowledge and exploitation to achieve comfort, microclimate factors and the conditions of hygiene.

The social role of animal shelters should not be neglected. as the conditions they provide aim not only at the protection of animal health but also of the people working in the livestock sector.

The progress made in the technique of animal breeding and exploitation in the world and in our country has led to radical changes regarding the concept of shelters and the problem of constructions for all categories of animals, to get new coordinates not only within the general framework of zootechnical sciences, but also in the practice of animal husbandry, whether it is the industrial system or the traditionally modernized system. Cattle breeding is a branch of agricultural production of particular importance because it provides the largest volume of animal products needed for human consumption, the highest proportion of raw materials for the food industry and light industry.(Corneliu, 2003)

The role of shelters has not always been understood as an essential condition for livestock breeding and as long as they were considered "a necessary evil" , the animal life conditions were totally inappropriate. With the creation of new breeds of high productivity animals, their requirements towards the "external environment" have changed so much that the specialists had to create an "artificial environment" through appropriate shelters, to ensure not only the development but also getting high productions and at the same time, allowing them to continually improve. This is even better underlined by Geneticist Jack Lush, who states that "every new generation of animals must receive continous environmental improvements, otherwise the recorded genetic gain will be lost." (Alexandru, 1981)

Livestock housing and animal husbandry must meet the physical and physiological needs of animals' comfort, allowing them to capitalize on their productive potential and also impose the behavioral discipline required by the technological process, the size of the accommodation, binding systems, subdivisions or constraints. In addition to ensuring the normal development of technological processes, in favorable working conditions for service personnel, zootechnical constructions must provide a high degree of universality and can be adapted to new technologies resulting from the progress of science and technology. (Corneliu, 2006)

The design and construction of shelters for breeding and exploitation of bovine animals must meet the operational requirements and technical performances of the equipment and installations. In many cases. there are contradictions between the wishes and requirements that the shelter system must meet. Therefore, it is important to make fair compromises that do not affect animal welfare, productivity and economic outcomes.

Particular attention must be paid to the design and location of animal buildings, as they are the basis for the efficiency of livestock, feed, straw and manure transport within the farm. Experience shows that a correct design, taking into account the possibility of expanding in the future, eliminates many of the problems. Since it is expected that farms outside the residential areas to be expanded, it is advisable to include landscaping, including planting trees and shrubs and choosing colors.

In the case of new shelters, the choice of building materials and types of construction is often based on the traditions and experience of the farmers, consultants and builders. (Mads Urup Gjodesen, 2010) .

These buildings must take into account the climate, topography and availability of feed and pasture. It is important to know the rules and regulations that influence the choice of location, design and operation type. It is important to choose a place for buildings and loading and unloading facilities located on well-drained soil. The location should also have a properly drained surface located away from currents, other waters and away from settlements. i. (SPCA. 2014)

MATERIAL AND METHOD

There are several types of construction that can be used for cattle, based on a number of factors: the type of enterprise (for meat or milk), the maintenance system adopted, the age of the animals. Two maintenance systems are distinguished in: fixed standing and free standing. Free standing is adopted for group technologies. e.g. the formation of groups of equally sensitive animals as physiological states and production yields in spaces called boxing.

Free standing can be in: undifferentiated speakers on continuous floor, on floor grills, differentiated in the feed-circulation area and rest zone and in individual loudspeakers. It is an economic solution in some cases, even in cold climates, due to the rusticity of cows breeds. Such systems are possible under special environmental conditions and imply for the firmer the obligation to accept some constraints in the working conditions. Before detailing the organization of these systems, it is necessary to talk about cow and calf dimensions. Table 1 shows some examples of sizing requirements for free-standing. (Brigitta KRIMBERGER. 2004)

Table 1

Space allocated for each cow and calf (Brigitta KRIMBERGER. 2004)

The area used (Part of the housing system)	Very large cows ~800kg	Big cows ~700kg	Medium cows & calves ~600kg	Movement area (m2) (winter and early spring) (Creep area)	Movement area (m2) (early autumn)
Standing (m)	4 – 5	3 - 4	3 - 4	-	-
Rest area (m2)	6 - 7	5 - 6	4.5 - 5	1 - 1.5	2
Resting area with slope (m2)	4.5 - 6	4 - 5	4 - 5	1 - 1.5	2
Floor with slats	3.4 - 3.6	3.1 - 3.3	2.8 - 3	-	-

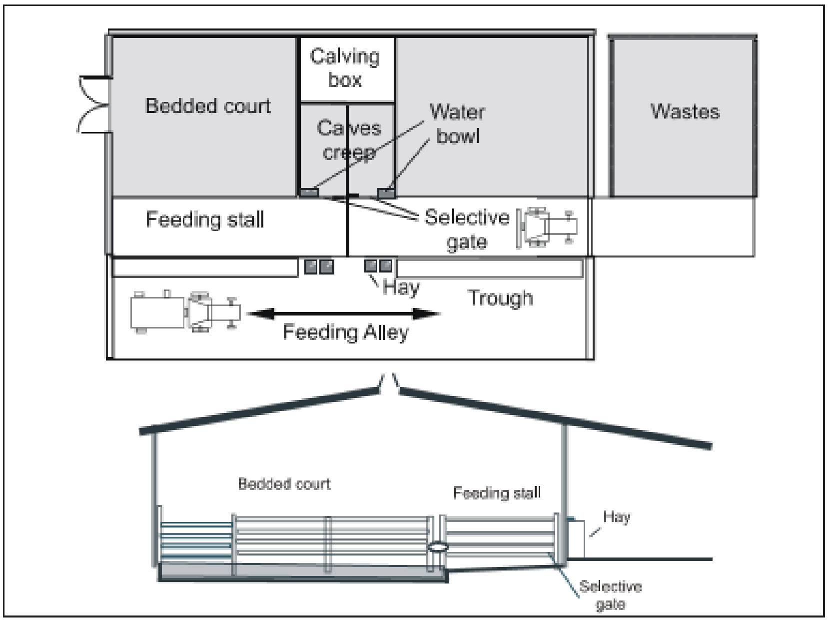

Fig. 1 - Arrangement and cross-section of a free-standing building, with a brace for the calves and a courtyard with concrete floor. (Brigitta KRIMBERGER. 2004)

A fixed standing building offers the animal an individual area. The system is widely used in dairy cows and this type does not even require bedding. Sometimes a small amount of straw is used on the concrete floor. There can be shelters with 2 to 4 rows of stands. The major problems that may arise in this system are: the size of the animals is changing and it will be difficult to optimize the cabin dimensions; animals can only be housed for a relatively short period (e.g. winter); it is often difficult to move animals. (Brigitta KRIMBERGER. 2004)

Cabin design requirements:
- The animal must stretch and stand up without touching the walls
- the length must match the animal's body space, head space and free space
- a curb in front of the cow helps her get up and stretch
- cows prefer a 2-3% slope in the back of the cabins, which also helps with drainage
- the feed area must have a width of at least 4.6 m behind the cabins.. (Robertson)

Table 2

Cabin length guidelines according to cow size. (Robertson)

The weight of the cow (kg)	The total length of the cage (m)		
	Open space	Closed space	Head to head
550	2.10	2.40	4.20
700	2.30	2.55	4.6
800	2.40	2.70	4.8

Table 3

Guidance on cabin width depending on size cow (Scribd)

Milk cows	1.00 - 1.30 m
Adult Bulls	1.60 – 2.00 m
Young females	50 – 90 cm
Male youth	0.60 – 1.20 m

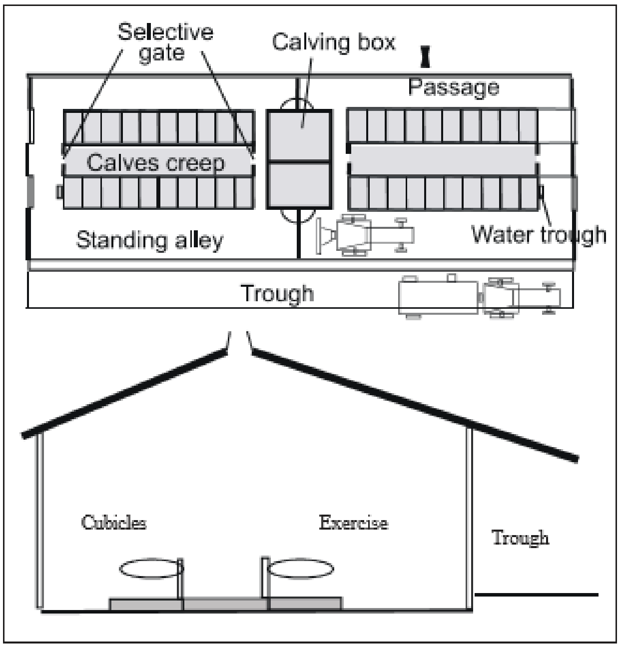

Fig. 2 - Arrangement and cross-section of the fixed standing construction with the calves between the rows intended for the cows.. (Brigitta KRIMBERGER. 2004)

RESULTS

Exterior design elements

Roof

A slope of 17 ° to 22 ° will ventilate the roof better than a slope between 7-10 °. Once the roof slope is set, the ventilation exits can be selected. The preferred roofing elements are glass fiber cement tiles because it is a durable material, has a limited absorption of condenst and produces an inner temperature more stable than steel plates.

Rooflights

Transparent roofs are a good source of natural light in an animal farm. It is recommended that 10-15% of the total roof area allow sunlight to penetrate into the farm, possibly up to 20% on the north side of the roof.

Sidewalls

Many cattle buildings require cladding of the side walls that are solid at the height of the animal with a form of air intake from the animal's height. (Robertson) Doors and gates can be swinging with a left or right opening. Gates can be sliding, sectional, rolling or PVC curtains. (Robertson)

Doors and gates

Doors can be swinging with a left or right opening.

Gates can be sliding, sectional, rolling or PVC curtains.

Elements of interior design

The floor

The floor of an animal building is subjected to a substantial physical and chemical strength. If a floor is well built and maintained, it will benefit the business by maximizing animal comfort. Surfaces must be slip resistant and free from edges or fittings that can cause injuries. They can be: concrete floors, slats floors and rubber floors.

Lighting

For efficient and safe operation, it is necessary to ensure adequate lighting that is evenly dispersed in the building and can be controlled. The intensity of light is measured in lux units. During the night (6-8 hours) less than 30 lux are required to maintain the hormonal balance in cattle. During the day (16-18 hours), at least 170 lux are required to increase live weight gain, according to "Dairy Housing" - a best practice guide (2012). (Robertson)

Ventilation

If wind blows, a combination of thermal forces will ensure the exchange of air. The fresh air enters through the holes and openings in the side flanks. The air contains heat, moisture and other contaminants that enter through the openings of the hip and side flanks. Even with the side walls closed on calm days, there is a change in air as a result of the cost effect(Brigitta KRIMBERGER. 2004)

Feeding and Adaptation

Depending on the range of feeds that make up the ration of dairy cows during one calendar year, two main feeding seasons are distinguished: winter season (canned fodder and concentrated fodder) and summer season (green fodder).. (Acatincai, 2004) Cows must have free access to water, both indoors and outdoors. Water requirements depends on animal weight, rationed dry matter content and ambient temperature.. (Brigitta KRIMBERGER. 2004) Milk cows require large amounts of drinking water, often exceeding 100kg / day.. (Arney & Aland)

Bedding

Secondary products in the wood industry are commonly used as cattle bedding. If straw is used, they will require much more complete than sawdust.. (Ruakura & Roads, 2015)

CONCLUSIONS

Cattle spend a good part of their time in shelter or even throughout the whole year. Over time, they have grown in size over previous years, so upgrading / building costs have increased and it is necessary to allocate enough space to each animal to avoid health, injury and stress problems resulting in reduced productivity. Adaptation, fodder, cleaning, ventilation, lighting and control over the internal climate are very important factors in the growth, development and production of cattle.

Because the cows evolved to thrive in different conditions, depending on race, climate, they are divided into dairy cows and meat cows, a detail that has to to be chosen from the beginning of the project, because depending on the role of the cow, the shelter will be built. I think that paying special attention to each stage, from the beginning to the end of the project, we can guarantee only a well-built shelter from all points of view, fact guaranteed by countless studies in this field.

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ANALYTICAL CALCULATION OF GEOMETRICAL ELEMENTS NECESSARY TO ACHIEVE FORESTRY TERRACES
/
CALCULUL ANALITIC AL ELEMENTELOR GEOMETRICE NECESARE REALIZĂRII TERASELOR FORESTIERE

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ABSTRACT

Terracing the slopes involves the level "steps" performing, which ensures a certain percentage out of land to be processed. The main constructive characteristic of a terrace is represented by the platform, respectively its height and counter-slope. The terrace platform is performed with counter-slope which assures the necessary conditions for meteoric water stock and slows down the speed of surface leakage, enabling the growth of wood vegetation (trees, shrubs) and retains the terraced soil.

Taking into account the above mentioned, the geometrical elements of a terrace endowed with counter-slope should be determined by analytical method, namely- find the total land territory (semi-profile) left (survey), find the total land territory (semi-profile) right (excavation), make the calculation of surface occupied by the terrace total width, calculate the slope length, calculate the transverse profile surfaces and, finally the terraces volume.

Determination of geometrical elements (respectively the surfaces covered by total land territory and slopes) is necessary because without them the volume of terracing operations, the volume of material to be dislodged and transport distances cannot be calculated. [6].

Once the expressions of geometrical elements of counter slope terrace (starting from terrace total width) determined, the execution time and cost of terracing works, respectively the amount of necessary investments according to digging volume, can be estimated. Algorithm presented may be applied also to agricultural type terraces, whose total width is bigger and are designed to orchards and vineyards.

REZUMAT

Terasarea versanților implică realizarea unor „trepte" de-a lungul curbelor de nivel, fapt care asigură prelucrarea terenului pe un anumit procent din întreaga suprafață. Principala caracteristică constructivă a unei terase este reprezentată de platform, respectiv de lățimea și contrapanta acesteia. Platforma teraselor se amenajează cu contrapantă, fapt care asigură condiții de acumulare a apei meteorice și încetinește viteza scurgerilor de suprafață. favorizând dezvoltarea vegetației lemnoase (arbori, arbuști) și fixarea solului mobilizat prin acțiunea de terasare.

Ținând cont de cele menționate. se ridică problema determinării analitice a elementelor geometrice ale unei terase prevăzută cu contrapantă, respectiv determinarea lățimii amprizei (semiprofilului) stânga (rambleu), determinarea lățimii amprizei (semiprofilului) dreapta (debleu), calculul suprafeței ocupate de ampriza terasei, calculul lungimii taluzurilor, calculul suprafeței ocupate de taluzuri, calculul suprafețelor profilelor transversale și în final calculul volumelor terasamentelor.

Determinarea elementelor geometrice (respectiv suprafețele ocupate de ampriză și de taluzuri) este necesară întrucât fără acestea nu poate fi calculat volumul lucrărilor de terasare, volumul de material ce urmează a fi dislocuit și distanțele de transport ale materialului dislocat [6].

Odată determinate expresiile elementelor geometrice ale terasei în contrapantă pornindu-se de la caracteristicile terenului, respectiv de lățimea amprizei terasei. se poate aproxima durata de execuție și se poate estima costul de realizare a lucrărilor de terasare, respectiv valoarea investițiilor necesare în funcție de volumul de săpătură. Algoritmul prezentat poate fi aplicat și pentru terasele de tip agricol, care au lățimi mai mari ale amprizei și care sunt destinate culturilor de pomi fructiferi și viță de vie.

MATERIAL AND METHOD

Performing the forestry terraces establishment of forestry vegetation

Degraded lands, especially eroded lands are most situated in slope areas. They were subject to deep settlement, because of grazing. Furthermore, in the context of climate change, the main effect is the heavy rain in short periods of time that generates surface leakages accompanied by afferent erosion. [10].

Mobilisation of soils situated in slope areas on their entire surface creates favourable conditions for increasing erosion. Therefore, when works must be performed, the soil should be mobilised along the level curve by processing the land in strips through ploughing or terracing.

Terracing the slopes is achieved by creating „steps” along the level curves, which ensures the processing of a certain percentage of the entire surface. Terraces can be made manually with minimum productivity or mechanically, by specific equipment [3]. The procedures involve the soil mobilisation up to 25÷30 cm depth. and terrace platform is placed in counter slope of $10^o \div 15^o$. Distances between the terraces performed and their platform width vary according to:

- Achievement method (manual/mechanized);
- Land slope;
- Soil depth;
- Quantity of soil skeleton within the mobilized matter;
- Type of lithological rock;
- Sub-area of forestry vegetation.

If the platform is made manuall,. its width can vary between 0.6 m to 1.2 m and the distance between terraces is of 1.5÷3.0 m. When terraces are mechanically performed, then the platform width is of 1.5÷2.5 m. and average distance between terraces is of 3.0÷5.0 m [5].

Counter slope of terrace platform ensures the retention of water that flows on slopes, in important quantities. This way, the surface leakage is diminished, the erosion is reduced especially in heavy rain conditions or wind. Water stock at counter slope base enables the growth of forestry vegetation, especially in first years after establishing it, thus reducing the percentage of seedlings planted, predominant phenomenon caused by lack of water. In areas of forestry vegetation appropriate to steppe and forestry steppe, where draught is manifest, the water gathering in counter slope terrace platform soil represents an essential condition for a successful crop, maintaining the moisture under the wilting coefficient, the soil humidity being able to increase by 10%÷20% than in case of non-terraced land.

Specialty works and researches made by renowned specialists in forestry have shown the fact that in case of non-supported terrace platform manually made there is a concordance between the distance between two terraces and their execution width [5]:

▪ Terraces of 0.7÷ 0.8 m width with distance of 2.0÷3.0 m., measured from one axis of platform to the other have given very good results in forestry area, respectively in sub-areas appropriate to sessile oak, spruce and beech growth as well as in low productive lands and eroded ones whose slope is of $15^o \div 35^o$ (40^o);

▪ Terraces of 0.75÷ 1.20 m width, placed at distances of 2.0÷3.0 measured from axis to axis have given very good results in draught areas such as steppe and forestry steppe as well as in lower parts (in terms of altitude) of forestry area on slopes with inclination of $10^o \div 15^o$ (20^o), with average deep soil (70 cm), disposed on lithological layer made of brittle rocks (loess, sand, gravel etc.);

In order to achieve the afforestation of damaged slope lands, the best results were obtained by establishing crops, the direct sowing having failed because of heavy conditions. Seedlings planting on the surface resulted after performing the terrace platform in counter slope can be made through:

▪ Planting in holes – is the most used method with the best results as establishing plantations and their success; it is used in land with soil prepared in terraces and soil prepared in strips, by ploughing;

Fig. 1 - O.S. Băneasa. U.P. IV M.Eminescu. u.a. 93B. Slope slightly waved. N. 28-30^0. Damaged land planted in 2006. Narrow non supported terraces prepared for seedlings planting [2]

▪ Plantation in belts – this method consists in planting at distances of 0.2÷0.5 min row of seedlings on narrow non supported terraces whose establishment is made at 2.0÷3.0 m distance, between terrace axes (Photo 1). Forestry species that gave the best results by belt planting (70%÷90% success) are: underbrush (*Hippophaë rhamnoides*), acacia (*Robinia pseudaccia*), Russian olive (*Elaeagnus angustifolia*), black alder (*Alnus glutinosa*), green alder (*Alnus viridis*), willow (*Salicaceae sp.*) produced from cuttings [5], and in case of very eroded slopes and in sliding surfaces, which lithological layer is made of marls or mixtures of marls and sandstones, the most adaptable forestry species is white underbrush (*Hippophaë rhamnoides*). Seedlings planted in belts on terraces form green barriers enable to set the land, while some support fences can last only 4÷6 years;

▪ Plantation of seedlings in holes with borrowed fertile land represents a method appropriate to soils situated on terraces platform. with rich skeleton content. Therefore, on the platform already performed, one continuous longitudinal ditch is made (parallel to slope edge), which transverse section varies within 20x30 cm, reaching the section of 30x30 cm. and the ditch dug is filled with fertile soil where seedlings will be planted;

▪ For planting the seedlings grown in pots, two methods involving the pot removing are known; when it is not biodegradable, respectively nutritive pot or polyethylene sack, the plantation is performed in holes made on platform surface.

Forestry specialists have shown the main advantages of planting forestry vegetation along the terraces [1]:

- Diminishes the effects of water and wind erosion on soil;
- Increases the water quantity accumulated on terrace counter slope;
- Modifies the microclimate due to wind speed reduction, air temperature variation change and increases the air relative humidity, diminishing direct and reflected light;
- Reduces air pollution by filtering the suspension micro-particles and dust;
- Improves and preserve the biodiversity;
- Improves the landscape appropriate to pattern and climate of respective geographical area;
- Ensures the carbon storage.

Location of forestry terraces in land.

Arranging the forestry terraces route on plans containing level curves implies making the analysis of whole surface where terraces will be placed. Plans of 1:5000 or 1:1000 should be used.

Figure 2 represents a sketch of a map containing level curves.

The figure also presents the trajectory of a future terrace marked in red line, placed within the interval between two adjacent level curves. In order to determine the work volume involved, it is necessary to mark the land by figures landscape markers situated on longitudinal trajectory of a future terrace whose emplacement should be of 15-25 m distance, in case of fragmented soils (similarly to marking method in accidental fields) [6].

The terrace ends should be marked (*PI* – entrance point and *PE* – outing point), points of changing the geodesic nature of land, points where there are torrential valleys and hills, crossing points with eventual plot lines and alignments points.

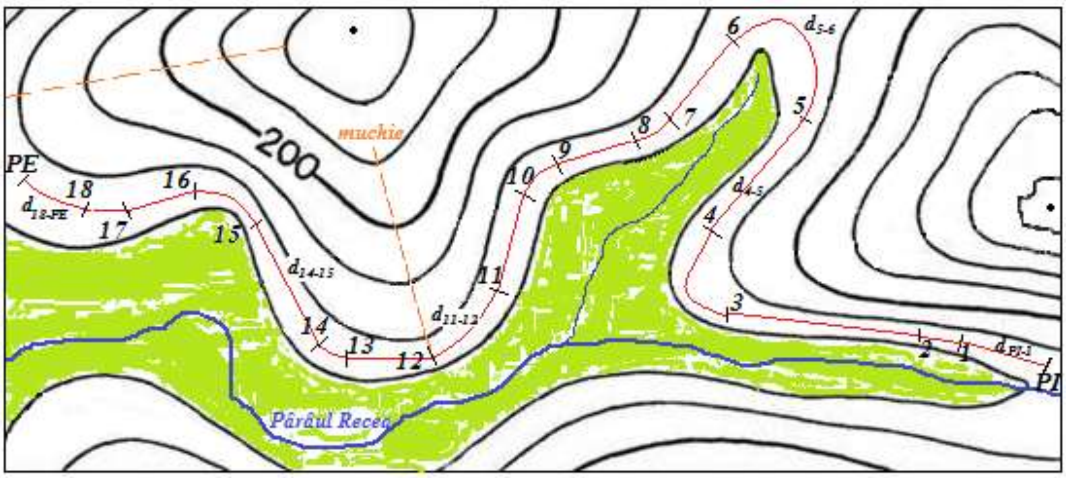

Fig. 2 - Scheme of location of a terrace placed between two level lines (level curve)

Straight in front of marks numbered in Arabian figures, the width of total land territory (*a*) and slopes length (L_{tr} and L_{td}) will be calculated. Distances between benchmarks ($d_{n-1.\ n}$) are determined by direct measuring between marks [6]. By adding the distances in alignment to distances resulted after calculating the radius, the total length of a terrace can be determined.

RESULTS

Geometrical elements of a terrace endowed with counter slope

Terracing comprises all the works such as digging, displacement and transplantation of soil dislodged, as well as filling it for achieving a forestry terrace with counter slope. respectively the platform with adjacent slopes. Dimensions and shape of terracing works depend on geometrical and constructive elements situated in the transverse section of the terrace according to conditions of land.

In figure 3 is shown a transverse section achieved by a forward slope whose inclination is under the angle *α.* The red line represents the shape of the terrace with counter slope including its geometrical elements.

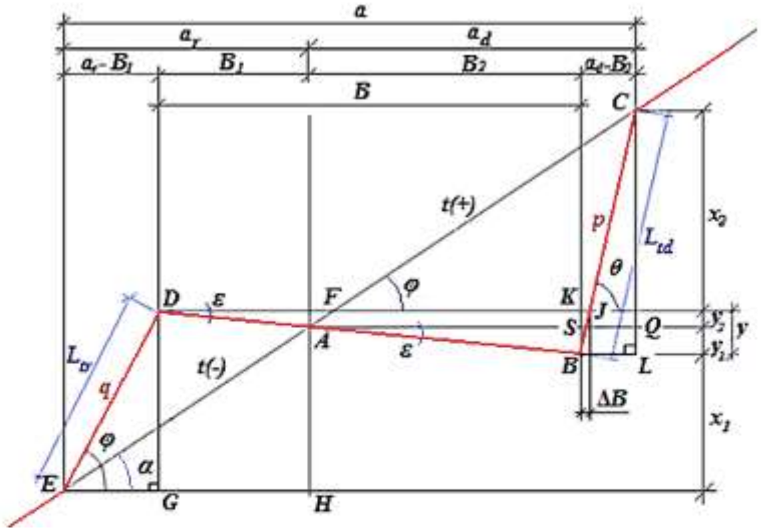

Fig. 3 - Section performed in slope by representing the geometrical elements of counter slope terrace

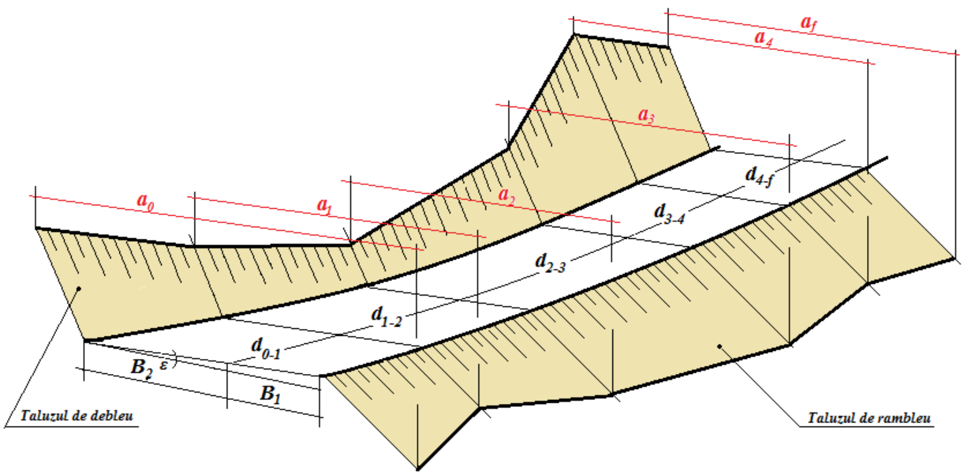

Fig. 4 - Surface of terrace territory; three-dimensional representation

Significance of notations from figures 3 and 4 represents:

B – total width of terrace platform;

B_1 – width of terrace platform disposed from the mound (made of dislodged material);

B_2 – width of terrace platform disposed from the excavation slope (made on non-dislodged land);

***a* – width of terrace** territory (total width occupied by platform and slopes);

a_r – width of mound semi-profile;

a_d – width of excavating semi profile territory;

α – land slope;

φ – mound slope;
θ –excavation slope;
ε – inclination angle of terrace platform (counter slope angle);
q – tangent of mound slope angle;
p – tangent of excavation slope angle;
t – tangent of land angle comparing to terrace axis;
(+) above terrace axis; (−) under the terrace axis;
L_{tr} – mound slope length;
L_{td} – excavation slope length;
x_1 – minimum quota (registered to the excavation slope);
x_2 – maximum quota (registered towards the mound slope);
y_1 – quota measured starting from the lower edge of excavation slope till the terrace platform axis;
y_2 – quota measured starting from the upper edge of mound slope till the terrace platform axis;
d_{0-1}. d_{1-2}.....$d_{n-1.\,n}$ – delimitations between measurements made between the territory benchmarks.

The calculation algorithm to be presented starts from the hypothesis the land slope is uniform.

In figure 3 one can observe that in triangle *ΔBDK*, right *FA* is parallel to side *BK*. According to fundamental theorem of similarity (TFA) triangle *ΔADF* is similar to triangle *ΔBDK*, forming proportional segments. Thus:

$$\frac{DF}{FK} = \frac{DA}{AB} = k^{\frac{1}{2}}$$

Replacing the segments by dimensions of terrace execution, respectively segment B_1 representing the width of terrace situated towards the mound slope made of dislodged material and B_2 representing the forestry terrace width towards the excavation slope, one can obtain [4]:

$$\frac{B_1}{B_2} = \sqrt{k}$$

Ratio of terrace widths depends on the fact that width B_1 comprises soil and skeleton proportional to hole volume whose earth was dislodged and moved from the excavation and which is more loosened than before the intervention. Specialty works indicate that the width ratio can be found in one expression of exponential functions ($k^{1/2} = \sqrt{k}$). If in previous relation one uses proportion fundamental property, then it can be obtained:

$$B_1 = B_2\sqrt{k} \quad (1)$$

Both terms of equality are added to B_2:

$$B_1 + B_2 = B_2 + B_2\sqrt{k}$$

As the terrace platform width B represents the sum of the two widths delimited by terrace axis (B_1 and B_2) the value of one of them can be expressed in compliance with total width occupied by terrace *B*.

$$B_2 = \frac{B}{1+\sqrt{k}} \quad (2)$$

Expression of coefficient *k* (determined experimentally),. is [9]:

$$k = \frac{K \cdot \sin(\varphi - \alpha)}{\sin(\varphi + \varepsilon)\cos(\alpha + \varepsilon)}$$

where: *K* = 1.2 coefficient of loosening of material dislodged after digging.

The previous experiments made by the specialists from ICAS (currently INCDS „Marin Drăcea") have demonstrated a dependency between the hill slope and mound slope, when terraces were executed mechanically [9].

Table 1

Dependency between the hill slope and mound slope

Hill slope ***α***	Mound slope ***φ***
15°	38.0°
20°	39.5°
25°	41.0°
30°	42.5°
35°	44.0°

Determination of total territory (semiprofile) left (mound)

Taking into account the left part from fig. 2 (respectively the part between terrace longitudinal axis and mound slope), it can notice that by applying trigonometric function tangent to rectangular triangle *ΔADF* takes place:

$$\operatorname{tg}\varepsilon=\frac{AF}{DF}\Rightarrow\operatorname{tg}\varepsilon=\frac{y_2}{B_1}\quad(3)$$

And in triangle *ΔDGE* we obtain:

$$\operatorname{tg}\varphi=\frac{DG}{EG}\Rightarrow\operatorname{tg}\varphi=\frac{x_1+y_1+y_2}{a_r-B_1}=q\quad(4)$$

Eventually, within triangle *ΔADF* the tangent function applying leads to:

$$\operatorname{tg}\alpha=\frac{AH}{EH}\Rightarrow\operatorname{tg}\alpha=\frac{x_1+y_1}{a_r}=-t\quad(5)$$

Negative symbol that comes from the tangent of land angle (*t*) related to terrace longitudinal axis is situated under its vertical axis, according to notation from fig.2. left.

From relation (3) results the value of $y_2=B_1\operatorname{tg}\varepsilon$

From relation (4) by applying proportions fundamental property, by multiplying average by extreme values, it results the value:

$$q(a_r-B_1)=x_1+y_1+y_2\Rightarrow x_1+y_1=q(a_r-B_1)-y_2$$

Replacing in the above equation the value obtained for y_2. It results:

$$x_1+y_1=q(a_r-B_1)-B_1\operatorname{tg}\varepsilon\quad(6)$$

Relation (7) expresses the length of total territory left, situated towards the mound slope. respectively a_r:

$$a_r=\frac{x_1+y_1}{-t}\quad(7)$$

The right term of relation (6) is replaced, obtaining:

$$a_r=\frac{q(a_r-B_1)-B_1\operatorname{tg}\varepsilon}{-t}$$

By multiplying average by extreme it results the value and then by changing the sign of relation obtained by multiplying with minus one and appropriate grouping the terms containing the mound territory width, it results:

$$a_r=\frac{B_1(q+\operatorname{tg}\varepsilon)}{q+t}\quad(8)$$

Relation (8) represents the expression of left territory (mound) width $\boldsymbol{a_r}$ comparing to tangent of mound slope angle – ***q***. Tangent of land angle to terrace axis – ***t***. Terrace platform width towards the mound slope made of material dislodged – $\boldsymbol{B_1}$ and value of angle provided for performing the counter slope – $\boldsymbol{\varepsilon}$.

Determination of width of territory (semiprofile) right (excavation)

Considering the right part in fig. 2 situated between longitudinal axis of terrace and excavation slope, it can notice that in the rectangular triangle *ΔABS.* Tangent trigonometric function is:

$$\operatorname{tg}\varepsilon=\frac{BS}{AS}\Rightarrow\operatorname{tg}\varepsilon=\frac{y_1}{B_2}\quad(9)$$

And in triangle *ΔCAQ*:

$$\operatorname{tg}\varphi=\frac{CQ}{AQ}\Rightarrow\operatorname{tg}\varphi=\frac{x_2+y_2}{a_d}=t\quad(10)$$

Finally, within the triangle *ΔCBL* applying tangent function leads to:

$$\operatorname{tg}\theta=\frac{CQ}{BQ}\Rightarrow\operatorname{tg}\theta=\frac{x_2+y_1+y_2}{a_d-B_2}=p\quad(11)$$

From (10) respecting the proportions fundamental property, it results the value:

$$x_2+y_1+y_2=p(a_d-B_2)\Rightarrow x_2+y_2=p(a_d-B_2)-y_1\quad(12)$$

Processing relation (10) leads to $a_d\cdot t=x_2+y_2$. That is replaced in previous relation, obtaining:

$$a_d\cdot t=p(a_d-B_2)-y_1\Rightarrow a_d\cdot t=pa_d-pB_2-y_1$$

$$a_d\cdot t-pa_d=-pB_2-y_1\;|(-1)$$

From relation (9) it results $y_1=B_2\operatorname{tg}\varepsilon$. It is replaced in the previous relation, obtaining the expression of excavation territory width;

$$a_d = \frac{pB_2 + B_2\,\mathrm{tg}\,\varepsilon}{p-t} \;\Rightarrow\; a_d = \frac{B_2(p+\mathrm{tg}\,\varepsilon)}{p-t} \quad (13)$$

Analytical determination of terrace territory total width

Total width of the territory, respectively the surface detained by the terrace for a random marking ($d_{n-1.n}$), will be the expression comprising the specific width of mound slope (a_r) and excavation slope (a_d):

$$a = a_r + a_d \;\Rightarrow\; a = \frac{B_1(q+\mathrm{tg}\,\varepsilon)}{q+t} + \frac{B_2(p+\mathrm{tg}\,\varepsilon)}{p-t}$$

If total width detained by terrace platform and slopes is expressed depending on relation (1), an expression related to B_2 will be obtained. Thus:

$$a = \frac{B_2\sqrt{k}(q+\mathrm{tg}\,\varepsilon)}{q+t} + \frac{B_2(p+\mathrm{tg}\,\varepsilon)}{p-t}$$

Replacing in the above relation the value of B_2 expressed according to total width of terrace B. respectively relation (2)., then the total width occupied by terrace can be expressed including also the slopes dimensions.

$$a = \frac{B}{1+\sqrt{k}}\left[\frac{\sqrt{k}(q+\mathrm{tg}\,\varepsilon)}{q+t} + \frac{(p+\mathrm{tg}\,\varepsilon)}{p-t}\right]$$

CONCLUSIONS

Therefore, when we know α – land slope, ε – inclination angle of terrace platform (counter slope angle) and constructive width provided *B*., it can be determined by analytical method *a* **–** terrace territory width (total width of platform and slopes) in front of places with benchmarks disposed in longitudinal way of the future terrace. At the same time, by applying the algorithm presented, it can be estimated the degree of occupancy of the land with narrow forestry terraces, which eventually enables to calculate the costs of works and approximate the execution time depending on method used.

It is important to remember that the present calculation algorithm is appropriate to determination of forestry terrace territory width in front of marks in the field, the other calculations (calculation of surface occupied by terrace territory, slope length, surfaces detained by slopes, surfaces of transverse profiles and calculation of terracing volume) being subsequently established, after having studied the road and marking the place of the future terrace.

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WASTEWATER TREATMENT THROUGH THE FLOTATION PROCESS
/
EPURAREA APELOR UZATE PRIN PROCESUL DE FLOTAȚIE

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ABSTRACT

Water purification is a complex process of retention and neutralization of dissolved colloidal or suspended solids present in industrial and urban wastewater which is not accepted in the aquatic environment where the spillage of treated waters is made and which enable the restoration of physical – chemical properties of water before use. Waste water treatment comprises two major categories of successive operations, namely: retention or neutralization of the noxious or recoverable substances present in the wastewater, respectively processing of the material resulting from the first operation. Flotation is the process of entraining particles suspended in a liquid at its surface, with the help of gas bubbles adhering to these particles. The basis of this process is the formation of "light particles + air or gas bubbles" associations, to be transported to the surface of the flotation basin, forming foam that is removed by various processes.

REZUMAT

Epurarea apelor este un proces complex de reţinere şi neutralizare a substanţelor nocive dizolvate ,în stare coloidală sau de suspensii, prezente în apele uzate industriale şi orăşeneşti, care nu sunt acceptate în mediul acvatic în care se face deversarea apelor tratate şi care permit refacerea proprietăţilor fizico-chimice ale apei înainte de utilizare. Epurarea apelor uzate cuprinde două mari categorii de operaţii succesive şi anume: reţinerea sau neutralizarea substanţelor nocive sau valorificabile prezente în apele uzate respectiv prelucrarea materialului rezultat din prima operaţie. Flotaţia reprezintă procesul de antrenare a particulelor suspendate într-un lichid la suprafaţa acestuia, cu ajutorul bulelor de gaz aderente la aceste particule. La baza acestui proces stă formarea de asociaţii “particule uşoare + bule de aer sau gaz”, care urmează să fie transportate la suprafaţa bazinului de flotaţie, formând o spumă ce este îndepărtată prin diverse procedee.

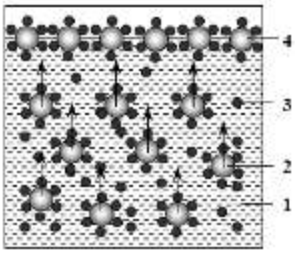
INTRODUCTION

Wastewater treatment comprises two major categories of successive operations, namely: retention or neutralization of the noxious or recoverable substances present in the wastewater and processing of the material resulting from the first operation. (Bendicho. C.. et al.. 2014). In this way, the purification process is used for the purification of waste water.

The main wastewater treatment methods differ depending on the present pollutants. They can be classified, first of all, according to the mechanism leading to the pollutant re-emission by "conventional" physical-mechanical, physical-chemical, biochemical or biological methods. The combination of these methods allows for advanced purification and purified effluents may be introduced into the economic circuit. The adoption of a particular process depends on the quantity of the fluency, the content in the pollutants, the quality conditions imposed on the discharge of the purified water into the emissary and the financial means of the respective economic operator. As efficiency and cost, the best results were obtained in adsorption treatment, ion exchange and chemical oxidation processes. Adsorption treatment processes allow the elimination of small amounts of organic substances remaining after the biological treatment step and apply especially for the advanced removal of phenols, detergents and other substances that can give a bad smell or taste to the drinking water.

Typically, adsorbent material uses activated carbon obtained by the special conditioning of fossil or vegetal coal. Ion exchange treatment processes are commonly used to remove mineral pollutants found in water in ion form: calcium, magnesium, sodium, sulphates, nitrates, phosphates, ammonium, heavy metals. etc. Certain types of ion exchangers, synthesized, can also purify organic compounds such as phenols, detergents, dyes. etc. Chemical oxidation processes are effectively applied to remove inorganic pollutants (cyanides, sulphides, certain heavy metals, etc.) and organic pollutants (phenols, dyes, certain pesticides,. etc.). Chemicals with oxidizing properties are used as reagents: ozone, hydrogen peroxide, chlorine with its derivatives (hypochlorite, chlorine dioxide). Future purification techniques refer to the elimination of pollutants at high temperatures in plasma reactors and ultraviolet radiation treatment (Wojcech D. et al.. 2017).

Flotation is a process based on introduction of bubble air, to which solid particles or emulsions are attached. The aggregate thus formed rises to the surface of the fluid as a result of the density difference (Figure 1 of the general presentation and Figure 1b detail). The formation of air bubbles in the mass of the liquid ensures the appearance of a large contact surface between the pollutant particles and the bubbles. The process is based on the ability of dispersed particles (solid or liquid) to adhere to air bubbles, forming conglomerates that rise to the surface due to the ascent forces of the bubbles [8].



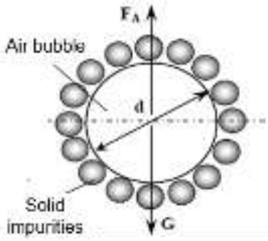


Fig. 1 – Flotation priciple

1 – suspension (emulsion); 2 –bubble- particles aggregate; 3 –solid particles 4 – bubble assembled with floated particles

Flotation can be described as the process of separating solid slurries by forming a particle-bullet conglomerate of a specific weight less the specific weight of the water and which is raised to the surface of the water from where it is removed. Depending on how it is made, flotation process is divided into:

- ✓ **natural flotation** in which the specific gravity difference is sufficient to remove the suspensions;
- ✓ **assisted flotation** in which certain compounds are added to improve particle separation;
- ✓ **induced flotation** by which the specific weight of the particles is greater than the specific weight of the water and air must be introduced to eliminate them.

Depending on the method of producing the bubbles, the following processes are distinguished:

a) Electrolytic Flotation. The basis of electro-flotation is the generation of hydrogen and oxygen bubbles in an aqueous environment by imposing a continuous current between two electrodes. The size of bubbles generated by electro-floting is low and the hydraulic charge for this type of process is limited to 4 m / h. The application of electrolytic flotation was mainly restricted to thickening the sludge or for small flows (10-20 m3 / h);

b) Flotation with dispersed air. It is an unusual process for treating water because bubbles formed by dispersing air into the water are large and create turbulence.

c) Flotation with dissolved air. Air bubbles are generated by reducing the pressure in a stream of air saturated with air. Diluted air flotation in turn is divided into vacuum flotation, microflota and pressure flotation.

Out of these, pressure flotation is the most widely used method by which air is dissolved in water by applying a pressure. From the point of view of water flow distribution, flotation of the entire flow, partial flow or recycle flow can be achieved. For applications where flocks are fragile, flotation with recirculation of the pressure flow is recommended. A schematic of this process is shown in Figure 2.

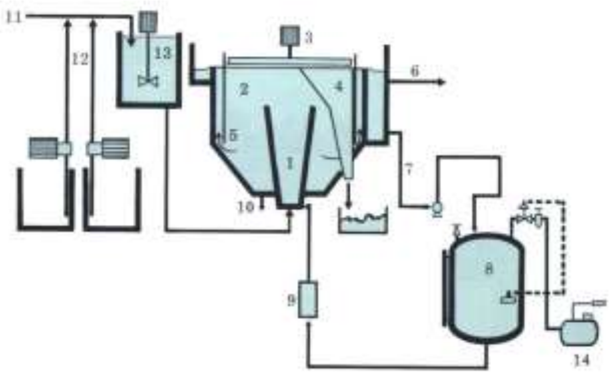


Fig. 2 - The usual process scheme of flotation in water (Scholz M.. 2016)

1. Mixing chamber 2. Separation area; 3. Foam collection system; 4. Foam exhaust pocket; 5. Clear water area; 6. Water exhaust 7. Pressurized water; 8. Pressurizing container; 9. Contact device 10. Sludge drainage; 11. Raw water; 12. Reagents of coagulation-flocculation; 13. Reaction room; 14. Air pressure vessel

In this process, the whole or partial flow is subjected to the flocculation coagulation process, after which it is introduced into the flotation basin. Part of the effluent of the flotation basin is pressurized and saturated with air. It is recirculated by means of a special device where the pressure is reduced to atmospheric pressure with bubble release (diameter 10-100 μm). Bubbles gain ascending motion and bring particles to the surface. (Racoviteanu G.. 2003). Water oxygenation processes are encountered in waste water treatment and treatment plants, in the food. fish and chemistry industries. Oxygen dissolved in water is known as dissolved oxygen (Fig. 3) and is conventionally measured in milligrams of oxygen / litre.

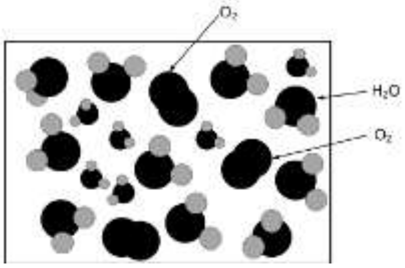


Fig. 3 - The molecular structure of dissolved oxygen in water (Baran N. et al.. 2011)

Figure 3 shows that each molecule of water consists of an oxygen molecule to which two hydrogen molecules are bound (a black sphere coupled with two white spheres), between the molecules of water being oxygen molecules (black spheres) which is the dissolved oxygen.

The maximum amount of air that can be dissolved (absorbed in water) depends on several physic-chemical factors: water pressure, water temperature, water salinity (the amount of salt present in water), water clarity. Factors that lead to the decrease of air dissolved in water are: increased water temperature, low water pressure, water pollution with oil, oil, detergents, ice, water depth and high turbidity. The amount of oxygen dissolved in water varies depending on: atmospheric pressure, water temperature, different content in mineral salts and organic substances (Baran N. et al.. 2011)

The dissolved air flotation separates the solid phase from the liquid phase by the ascending motion of the air micro bubble- introduced into the slurry or the supernatant recirculated in a pressurized vessel. In the diagrams of Figures 4 and 5, the components are presented for the case of full pressurization of the sludge flow rate or partial pressurization of the supernatant.

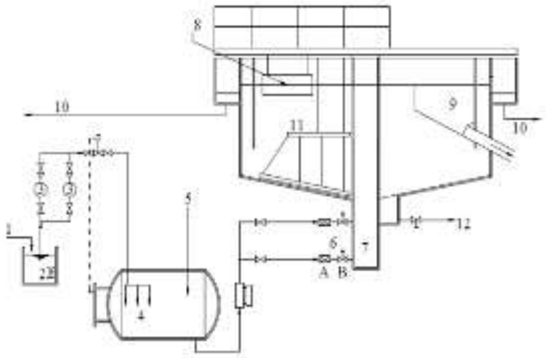


Fig. 4 - Scheme flotation procedure with total pressurization

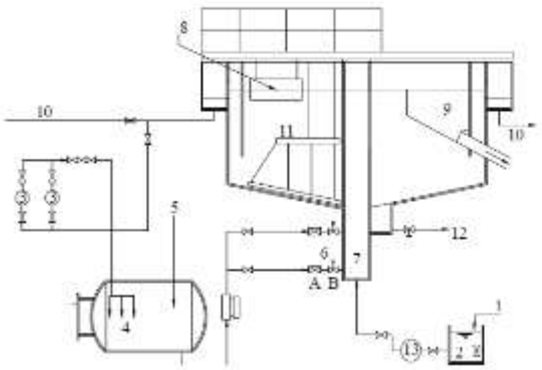


Fig. 5 - Scheme of flotation with supernatant pressurization. (Baran N. et al.. 2011)

1– Influential sludge; 2 - Mixing pool. compensation; 3 - Pumping station; 4 - Saturation vessel (4-5 bar); 5 - Compressed air supply; 6 - Double pressure reduction system; 7 - Expansion chamber; 8 - Surface collector; 9 - Mud collector channel; 10 - Supernatant; 11 - Racors; 12 - sedimentation sludge discharge; 13 pumping station influential sludge;
A. B - system for pressure reduction and bubble creation 50-100 μm

MATERIAL AND METHOD

Performing overpressure of air in waste water can be done in several ways. Thus, the air can be introduced with suction water or the air can be pumped under pressure into the wastewater located in a closed enclosure. Regardless of how there should be a large bubble removal system, depending on the nature of the suspension, various reagents and flocculants are introduced into the water to increase process efficiency. Thus, in Figure 6. such a system is presented after a system designed by Gibbs and Barry. (Amaral J. et al.. 2016)

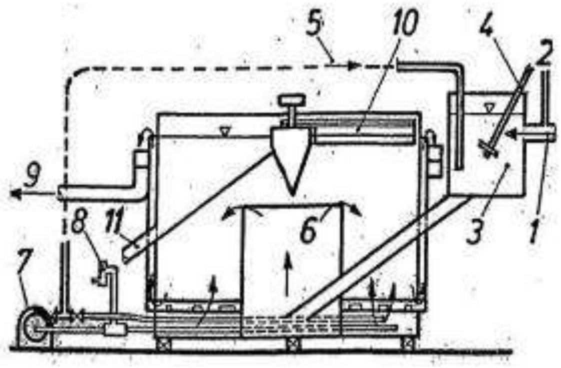


Fig. 6 - Gibbsy overpressure flotation plant. (Amaral J. et al.. 2016)

1-entrance in raw water; 2- pipe for reactives adding; 3- mixing vessels; 4- stirrer; 5- wastewater pipe with air; 6- cylindrical compartment for flocculation; 7- pomp; 8- air intake connection; 9- treated water outlet; 10- tscraper for water surface collecting suspensions; 11- system for removing the collected suspensions

The size of these installations ensures the treatment of about 6 to 12 m³ of wastewater. The duration of the process is about 10-20 minutes. The amount of air to be used in the waste water depends on the degree of water loading, but it is usually between 10 and 100 liters of air per 1 m3 of waste water. The working pressure is between 1 and 4 atm. and the energy consumption is between 0.05 and 0.25 kWh / m3 of waste water. [6] The purpose of flotation is to form a stable foam that incorporates the insoluble particles. Flotation can be done in circular or rectangular basins. In Fig. 7, is a schematic diagram of a flotation system with pressurized air.

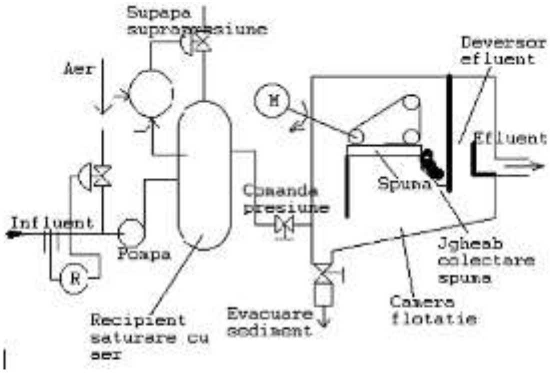


Fig. 7 – Air flotation installation with underpressure air

A dissolved air-flotation installation is also shown in figure 8. It is characterized by the residence time of 5-10 min, the amount of air 0.2 - 0.8 m^3 / m^3 of water and the water depth is 1.2 - 2.75 m [2].

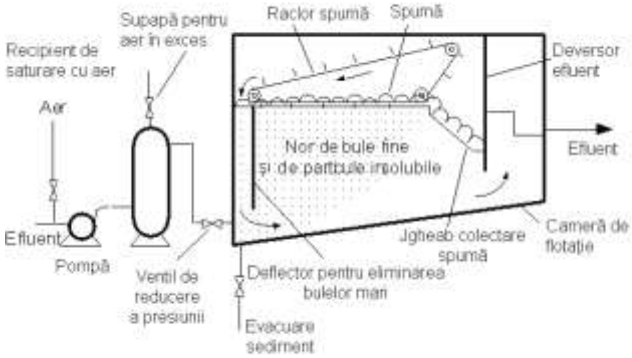


Fig. 8 - Scheme of an air-pressure flotation installation (Dodu A. et al. 2003)

The basis of this process is the formation of "light particles + air or gas bubbles" associations, fig. 9., to be transported to the surface of the flotation basin, forming a foam which is removed by various processes.

Fig. 9 - Establishing of solid gas association. (Racoviteanu G.. 2003)

For good air / solid association formation, it is necessary to take into account the following factors: laminar flow conditions, speed grading and composition of the mixture. From the point of view of the composition of the mixture, in the process of admixing the particles in suspension at the surface of the air bubbles, a determinant role is given by the degree of water ability, given by the hydrophobic or hydrophilic properties of the particles. The degree of wet ability of a solid is controlled by the value of the angle of contact formed between the planes tangent to the solid - liquid and liquid - air separation surfaces (Fig.10). (Racoviteanu G.. 2003).

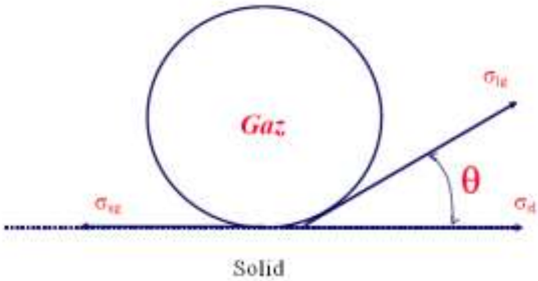


Fig.10 – Establishing the contact angle (Racoviteanu G.. 2003)

The contact angle is measured so as to include the liquid phase between its sides. Considering the contact surface between the three phases, we define the superficial tensions that occur:

- σ_{sg} – solid surface gas tension;
- σ_{sl} – liquid solid surface tension;
- σ_{lg} – superficial tension liquid-gas.

$$\sigma_{sg} - \sigma_{sl} = \sigma_{\lg} \cos\theta \Rightarrow \cos\theta = \frac{\sigma_{sg} - \sigma_{sl}}{\sigma_{\lg}}$$

In the literature it is recommended to calculate the resultant of these tensions, also called particle adhesion energy to the gas bubble, λ. with the relation:

$$\lambda = \sigma_{\lg} + \sigma_{sl} - \sigma_{sg} \Rightarrow \lambda = \sigma_{\lg} + \sigma_{sl} - \left(\sigma_{\lg}\cos\theta + \sigma_{sl}\right) \Rightarrow \lambda = \sigma_{\lg}\left(1 - \cos\theta\right) = 2\sigma \sin^2\frac{\theta}{2}$$

It is found that the occurrence of the flotation phenomenon on a solid material is determined by its adhesion energy, λ. which increases with the value of the contact angle θ, fig.11. Hence, hydrophobic particles have the best adhesion (Racoviteanu G.. 2003)

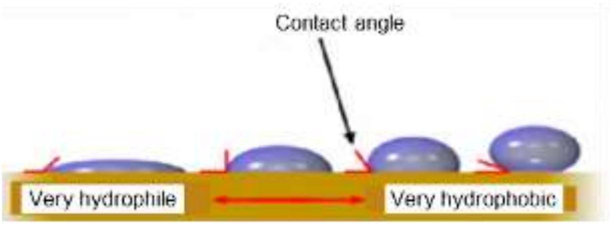


Fig. 11 - Contact angle and degree of hydrophobicity (Racoviteanu G.. 2003)

In the case of hydrophilic suspensions (such as most metals), forced hydrophobicity is required resulting in different types of flotation. In the flotation process, in addition to the phenomena of adhesion and superficial tensions, there are forces of the Archimedes type, according to which the calculations for the removal of suspensions and emulsions are performed. Thus, the ascending velocity of the particles depends on their density and average diameter and is obtained from graphs of the shape of figure 4. in the case of natural flotation [4].

RESULTS

In the flotation process, in addition to the phenomena of adhesion and superficial tensions, there are forces of the Archimedes type, according to which the calculations for the removal of suspensions and emulsions are performed. Thus, the ascending velocity of the particles depends on their density and average diameter, in the case of natural flotation. [4]

The overall yield of the flotation process increases as the bubble diameter is lower. Figure 12 shows the variation of the ascending speed at different bubble diameters for two different water temperatures (200 ° C and 40 ° C).

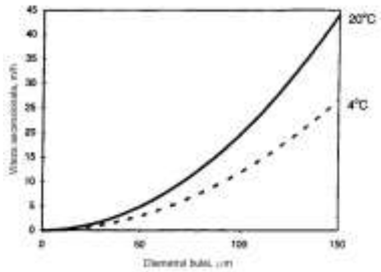


Fig. 12 - Variation of ascent speed according to bubble size and temperature (Racoviteanu G.. 2003)

In the range of usual temperatures and pressures for the flotation process (0-300C and 200-800 kPa), air is mainly a mixture of nitrogen and oxygen. It can be assumed that this mixture is subject to Henry's law:

$$p = K_H C_{aer}$$

where: p - air pressure (kPa); Caer - the concentration of dissolved air in water (mg / l);
KH - Henry's constant (Kpa / (mg / l)).

In a continuous saturated system, the gaseous phase above the water mirror does not have the same composition as air because oxygen is more soluble than nitrogen. The amount of nitrogen that is found in the gas introduced into the tank is higher than in atmospheric air. This results in a reduction of about 9% of the gas mass that can be dissolved. Figure 13 shows the amount of air dissolved in water at different pressures and temperatures.

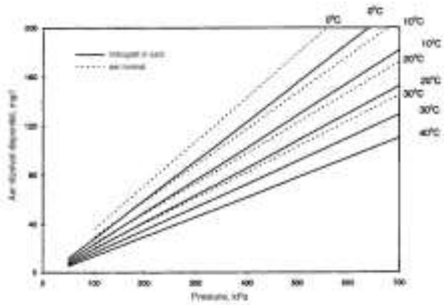


Fig. 13 - The amount of air dissolved according to pressure and water temperature. (Racoviteanu G.. 2003)

The density of flocks produced by coagulation - flocculation processes is close to water density, so they are very easy to float. The more bubbles produced are, the more their number increases and the greater the probability of forming particle-bullet conglomerates. At the same time the ascent speed decreases as the bubbles are smaller. This leads to an increase in the flotation basin (Figure 14). In practice, the size of the bubbles in the dissolved air flotation process is in the range of 10-120 µm, with an average of 40 µm.

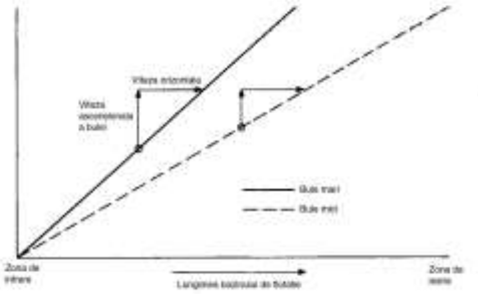


Fig. 14 - Effect of bubble size on flotation tank size. (Racoviteanu G.. 2003)

The mass concentration of the air released in the water mass is calculated with the following equation [5]:

$$C_b = \frac{(C_r - C_{fl})}{1+r}$$

where: Cr - the mass concentration of the air in the recirculation flow (mg / l); Cfl - the mass concentration of air in the effluent of the flotation basin (mg / l); r - recirculation rate.

The mass concentration of air in the recycle flow Cr is obtained from the equation expressing Henry's law. The equation for the mass concentration of the air released in the water mass assumes that the air that is discharged from the flotation basin is at saturation. The air concentration in the contact area is expressed as a function of the number of bubbles Nb or the volume concentration of the bubbles Φb, which is determined with the following relations:

$$\Phi_b = \frac{C_b}{\rho_{aer}} \cdot \; N_b = \frac{6\Phi_b}{\pi d_b^3}$$

in which: ρ_{aer} - density of air saturated with water vapour (kg / m^3), db - average diameter of the bubbles (μm).

The ascending speed of the flocculated particle conglomerate can be determined by Stokes law. (Racoviteanu G.. 2003):

$$v_{pb} = \frac{g(\rho_w - \rho_{pb})d_{pb}^2}{18\mu}$$

in which: vpb - the ascending velocity of the particle-bullet conglomerate; g - the gravitational acceleration; ρw - water density; ρpb - density of particle-bullet conglomerate; dpb - diameter of particle - bullet conglomerate; μ - dynamic water viscosity.

For the transition regime (1 <Re <50) and considering a sphericity coefficient of 0.8 of the particles, the Stokes law is modified as follows (Racoviteanu G.. 2003):

$$v_{pb} = \frac{16.7^{0.8}(\rho_w - \rho_{pb})^{0.8} \cdot d_{pb}^{1.4}}{\rho_w^{0.2}\mu^{0.6}}$$

The density of the particle - ball conglomerate is determined with the relation:

$$\rho_{pb} = \left[\frac{\rho_p d_p^3 + N_{ab}\rho_b d_b^3}{d_p^3 + N_{ab} d_b^3}\right]$$

where: ρpb - density of particle-bullet conglomerate; ρp - density of the flocculated particle;
ρb - density of air bubbles; dp - particle diameter; db - bubble diameter;
Nab - the number of air bubbles attached to the flocculated particles.
The equivalent diameter of the flocculated particle conglomerate is calculated with the following relation (Racoviteanu G.. 2003):

$$d_{pb} = \left[d_p^3 + N_{ab} d_b^3\right]^{1/3}$$

The design of the contact area must be at least 90 s. The efficiency of the contact area will exceed 95% if the coagulation process is correctly conducted (α pb> 0.1) and if the concentration of the bubble volume Φb is minimum 5000 mg / l (5 litres of air / m^3 of treated water). Table 2 shows a comparison of design parameters for different types of flotation.

Table 2

Comparison of design parameters for different types of flotation. (Racoviteanu G.. 2003)

Process	Airflow (nm^3/m^3 water)	Bubble size	Adsorbed power (Wh/m^3)	Flotation time (min)	Hydraulic load ($m^3/h.\ m^2$)
Assisted Flotation	100-400	2-5 mm	5-10	5-15	10-30
Mechanical flotation	10.000	0.2-2 mm	60-120	4-16	-
Flotation with dissolved air	15-50	40-70 µm	40-80	20-40	3-10

CONCLUSIONS

Dissolved air flotation is the most widely used wastewater treatment process whereby the air is dissolved in water by applying pressure and separates the solid phase from the liquid by the ascending motion of the air micro-bubbles.

The efficient use of this technological process is applicable to the treatment of domestic, industrial wastewater (pulp and paper industry, mining, food, textile, oil). in water tanks where algae can form in the process of thickening of the sludge and in drinking water.

The purpose of flotation is to form stable foam that incorporates colloidal particles and remove oils, fats and generally all lighter substances than water from the wastewater that rises to its surface.

ACKNOWLEDGEMENT

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WASTEWATER TREATMENT SYSTEMS IN AQUACULTURE
/
SISTEME DE EPURARE APA UZATA IN ACVACULTURA

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ABSTRACT

This paper discusses recent researches in aquaculture, specifically in recirculating aquaculture systems (RAS) with emphasis on wastewater treatment. The review analyzes RAS advantages and its development around the world. Several technologies for wastewater treatment are discussed, including the utilization of Moving Bed Biofilm Reactors of algae and phytoremediation. We also discuss future research priorities that can contribute to increasing the sustainability and help reducing the ecological impact of RAS.

REZUMAT

Prezenta lucrare prezintă rezultalele celor mai recente cercetări din domeniul acvaculturii, în special pentru sistemele de acvacultură recirculante, cu accent pe epurarea apelor uzate. În prima parte a lucrării se prezintă stadiul actual al sistemelor de acvacultură recirculante, cu avantajele și dezavantajele identificate în cadrul aplicațiilor din întrega lume. De asemenea, sunt prezentate câteva tehnologii de epurare a apelor uzate printre care tehnologia MBBR, epurarea cu ajutorul algelor si fitoremedierea. Autorii prezintă direcțile viitoare de cercetare pentru cresterea sustainabilitatii si minimizarea impactului ecologic al sistemelor recirculante de acvacultură.

INTRODUCTION

a. Aquaculture around the world

The fishing industry includes any industry or activity concerned with taking, culturing, processing, preserving, storing, transporting, marketing or selling fish or fish products. Directly or indirectly, the livelihood of over 500 million people from developing countries depends on fisheries and aquaculture. Table 1 presents the world's fish production and utilization. Specialists worldwide admit that aquaculture is the fastest-growing area of food production.

Table 1

World fish production and utilization (FAO 2016)

Production (million tons)	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Capture						
Inland	10.5	11.3	11.1	11.6	11.7	11.9
Marine	79.7	77.9	82.6	79.7	81.0	81.5
Total capture	90.2	89.1	93.7	91.3	92.7	93.4
Aquaculture						
Inland	34.3	36.9	38.6	42.0	44.8	47.1
Marine	21.1	21.1	23.2	24.4	25.5	26.7
Total aquaculture	55.7	59.0	61.8	66.5	70.3	73.8
Total capture and aquaculture	**145.9**	**148.1**	**155.5**	**157.8**	**162.9**	**167.2**
Per capita food fish supply (kg)	**18.1**	**18.5**	**18.6**	**19.3**	**19.7**	**20.1**

In 2014, the Northwest Pacific was the most productive area for capture fisheries, followed by the Western Central Pacific, the Northeast Atlantic and the Eastern Indian Ocean. Except for the Northeast Atlantic, these areas have shown increases in catches compared with the average for the 2003–2012 decade. The situation in the Mediterranean and Black Sea is yet alarming, as catches have dropped by one-third since 2007, mainly attributable to reduced landings of small pelagic fish such as anchovy and sardines, and most species groups also affected. World catches in inland waters were about 11.9 million tonnes in 2014, continuing a positive trend that has resulted in a 37 % increase in the last decade. Sixteen countries have annual inland water catches that have exceeded 200, 000 tonnes and together they represent 80 % of the world's total.

Although aquaculture is considered an important food source, fish farms must aslo be developed in a sustainable and pollution-responsible way. The rapid and unorganized growth of intensive aquaculture systems (RAS) has already created many problems in some parts of the world, affecting both human health and the environment. RAS has been on the frontline of public concerns regarding sustainability. Different issues are raised in RAS, such as the use of fish meal and oil as feed ingredients, escapees into the wild and the discharge of wastewater in the environment (*Martins C.I.M. et all. 2010*).

The waters systems surrounding RAS opperations can be affected by algae growth generated by discharged nutrients (ex.: phosphorus (P), nitrogen (N) and organic carbon). A negative aspect of RAS is the fact that water pollution can cause death for certain aquatic species and indirectly constitute a danger to humans who may eat contaminated fish and/or drink polluted water. It is known and unfortunate practice so simply move a RAS operation elsewhere when the neighboring ecosystem has become too polluted. . That is why aquaculture specialists are seeking for better wastewater treatment equipment and RAS technologies.

In RAS, the water is partially reused after the treatment. Each wastewater treatment stage reduces the pollutants and the water can be further reused or reintroduced in the fish tanks. Based on the amont of treated water aquaculture systems are described as flow through systems (>50 m^3/kg feed), reuse systems (1-50 m^3/kg feed), conventional recirculation systems (0.1-1 m^3/kg feed) and 'next generation' or 'innovative' RAS (<0.1 m^3/kg feed) (*Martins C.I.M. et all. 2010*).

Despite the environmental problems of RAS, as wild stocks decline, the demand for farmed fish rises. Therefore, albeit polluting RAS becomes increasingly important. Aquaculture systems are not environmental friendly and a lot of their problems remain to be solved. The main problems caused by freshwater aquaculture are related to: high quantity of chemicals used in fish farms, presence of antibiotics in water, different other pollutants that are discharged in waters; public health risks; and pollution from open aquaculture systems that reduces wild fish populations and thus threaten food security for local communities. Other problems generated by fish farms are: high footprints for the existing wastewater treatment plants (WWTPs) from RAS; high investments in RAS' WWTPs; the important percentage of fresh water needed in RAS (min. 10%); a certain number of fish (some RAS are using genetically modified fish) escape from cages/tanks and thus pressure on the natural environment.

In 2014, 25 countries recorded aquaculture production in excess of 200,000 tones compared with 2013 (FAO, 2016). Collectively, they have produced 96.3% of the farmed fish and 99.3% of the farmed aquatic plants in the world. China remains the most important producer, although its share in world fish production from aquaculture has declined from 65% to less than 62% in the last twenty years.

Sustainable aquaculture development can help society to defeat the hunger around the world. Today, aquaculture represents about 50% of the total consumed fish. It creates jobs and provides an income to producers and farmers. Therefore, aquaculture can contribute towards hunger eradication and bring food and nutrition security. The goal is to make aquaculture sustainable and safe.

b. Wastewater treatment in RAS

Overall, the yield of RAS technology is still small compared to that of flow-through systems, ponds or cages. This is mainly because of the high initial capital investments in RAS caused by the need to have very efficient wastewater treatment (*FAO. 2016*). However, new treatment solutions have been developed increasing the competitiveness of RAS.

The main problems and pollutants related to water treatment and reuse are:

- suspended solids (SS) - particulate matter resulted from fish faces and food leftovers. If not mineralized, the SS can significantly reduce the amount of fish that can be reared into a system and can cause numerous fish health problems. Suspended solids mainly consist in particulate organic matter which can quickly led to decay and collapse of the dissolved oxygen content in water. The suspended solids are primarily removed by mechanical filtration such as drum and sand filters.

- disinfection without chemicals. Ultraviolet light and/or ozonization are commonly used for water treatment and sometimes for recirculated water disinfection, before it reenters the fish tanks.

- nitrogen compounds (both organic and inorganic). These compounds are considered the main contaminants in the wastewater from aquaculture. Ammonia is the main waste produced by the metabolism of fish. To reduce/eliminate harmful waste products, biological treatment stages are introduced in the treatment flux. Moving Bed Biofilm Reactor (MBBR) technology was recently used in closed aquaculture systems for the removal of pollutants. Several biofilm carriers were tested in MBBR bioreactors.

- CO_2 elimination and its fixation in plant or microbialbiomass. Currently, in RAS, CO_2 is removed from water by using aeration techniques or striping.

- maintaining a certain level of water temperature.

The main pollutants came from unconsumed fish food and feces, as presented in figure 1 *(Yoshitani. 2010)*.

In general, ammonia is toxic to fish at levels above 0.02 mg/l. Figure 3 *(based on Bregnballe J.. 2015)* shows the maximum concentration of total ammonia nitrogen (TAN) allowed at various pH levels for a level below 0.02 mg/l of ammonia to be ensured.

Although the lower pH levels minimises the risk of exceeding the 0.02 mg/l ammonia treshold, it is recommended to reach a level of minimum pH 7 to maintain high biofilter efficiency.

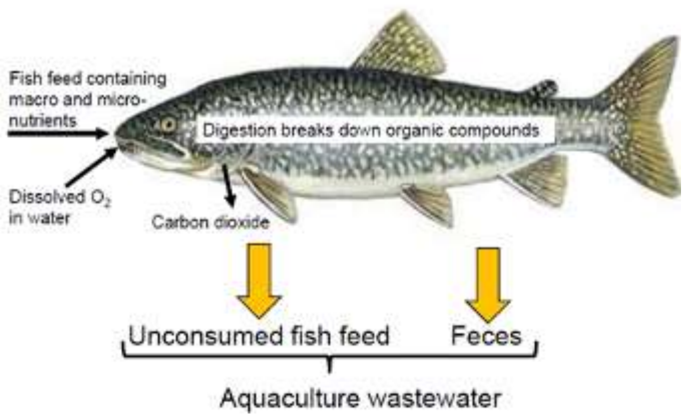

Fig. 1 - Pollutants in aquaculture systems *(Yoshitani. 2010).*

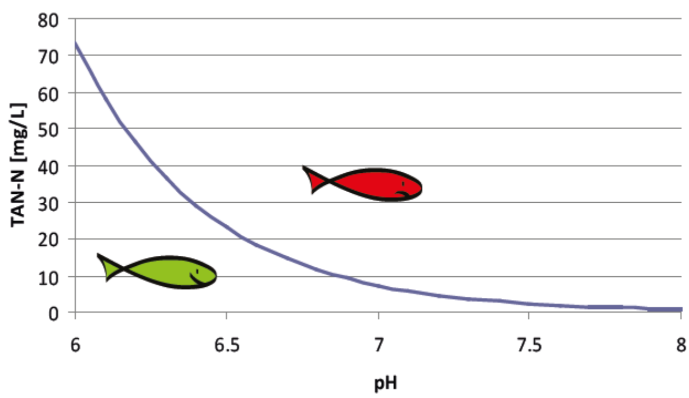

Fig. 2 - The relation between pH and the amount of TAN available for breakdown in the biofilter, based on a toxic ammonia treshold of 0.02 mg/l (Bregnballe J.. 2015).

Unfortunately, the total concentration of TAN to be allowed is thereby significantly reduced, as can be seen in figure 2 *(Bregnballe J.. 2015).* Thus, there are two opposite working vectors of the pH that a fish farmer has to take into consideration when adjusting his/her biofilter. Nitrite is formed as anintermediate step in the nitrification process and is toxic to fish at levels above 2.0 mg/l *(Bregnballe J.. 2015).* If fish in a recirculation system are gasping for air, although the oxygen concentration is fine, a high nitrite concentration may be the cause. At high concentrations, nitrite is transported through the gills into the fish blood and obstructs the oxygen uptake. Nitrate, also resulted from the nitrification process, is generally considered harmless, yet levels above 100 mg/l have negative impacts on fishes *(Bregnballe J.. 2015).*

The reduction of the organic compounds and ammonia is made in the biological treatment stages of WWTPs.

MATERIAL AND METHOD

a. RAS wastewater treatment using Moving Bed Biofilm Reactors

A biological treatment stage is always present in a RAS WWTP. Biofilters used in recirculation systems can be designed as fixed or moving bed biofilters. All biofilters used in water recirculation today work as submerged units. In the fixed bed filter, the plastic media is fixed and on only the liquid moves. The latest researches recommend using moving bed biofilm reactors (MBBR) instead. The MBBR technology uses plastic media (also known as biomedia or biofilm carriers) giving a high surface area per surface area of biofilter. Microorganisms attached to the biomedia will grow as a thin film on the carriers, thereby occupying an extremely large surface area. The aim of a well-designed biofilter is to reach as high a surface area as possible per m^3, without packing the biofilter so tight that it will get clogged with organic matter during operation.

Air bubbles are also used to create turbulence in the tank while organic matter is decomposed. In the moving bed filter, the plastic media is moving inside the water tank by means of small size air bubbles (figure 3.b).

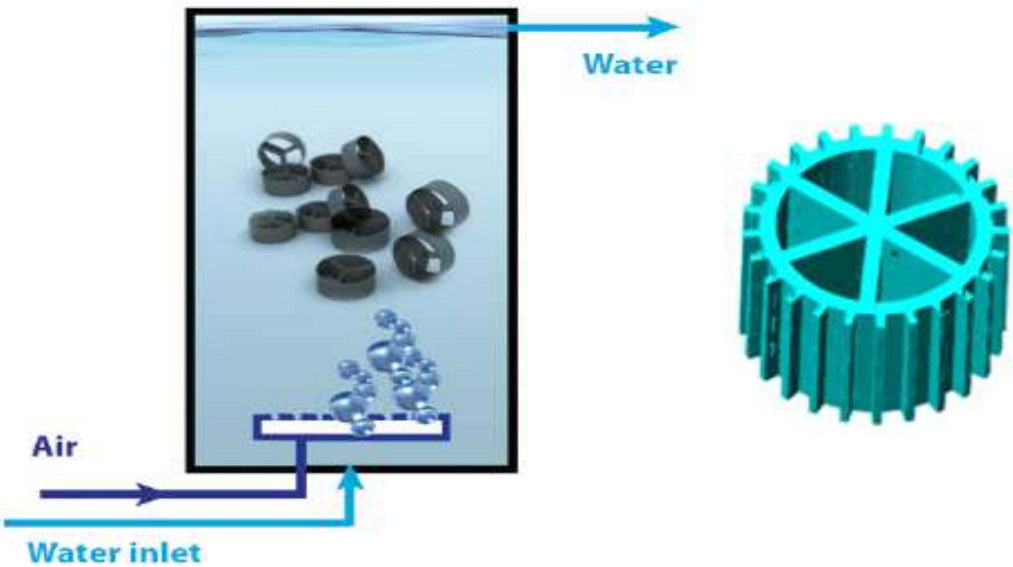

Fig. 3 – a. MBBR (Bregnballe J.. 2015); b. example of a biofilm carrier (Patent RO 123174/28.01.2011)

Because of the constant movement of the media, moving bed filters can be packed harder than fixed bed biofilters, thus reaching a higher turnover rate per volumeof biofilter. There is however no significant difference in the turnover rate calculated per filter surface area, as the efficiency of the bacterial film in either of the two types of filter remains more or less the same. In the fixed bed biofilter, however, fine organic particles are also removed as these components adhere to the bacterial film. The fixed bed biofilter will therefore also act as a fine mechanical filtration unit, removing microscopic organic material and leaving the water clearer.

Both filter systems can be used in the same system or they can be combined; for example using moving bed biofilters to save space and using fixed bed biofilters to benefit from its increasing particlle adherence features. The ultimate design of a biofilter system ultimatedly depends on farm size, species of fish cultured, sizes of the fish and others.

In RAS, one of the key water treatment steps is biological filtration, as a key means of water treatment for reuse within the system (Guerdat *et al.*. 2011). Recent developments in biofilters have lead to using moving bed biofilm reactors (MBBR) more frequently, mainly because of their commercial success in large scale WWTPs and relatively low costs of manufacture (*Pfeiffer and Wills. 2011*).

In most RASs, nitrogen is removed by a combination of moving bed and fixed bed nitrification reactors and, in some cases, additional denitrification reactors as well (*Losordo et al.. 1999*). The *nitrification* process in RAS is hampered by the level of organic matter entering the bio-filters (*Eding et al.. 2006*). As a result, both autotrophic and heterotrophic bacteria grow in reactors. A typical RAS block flow diagram is presented in Figure 4 *(Yoshitani. 2010),* where the nitrification/denitrification tank can be of a MBBR type.

Fig. 4 – Typical RAS block flow diagram ***(Yoshitani. 2010)***

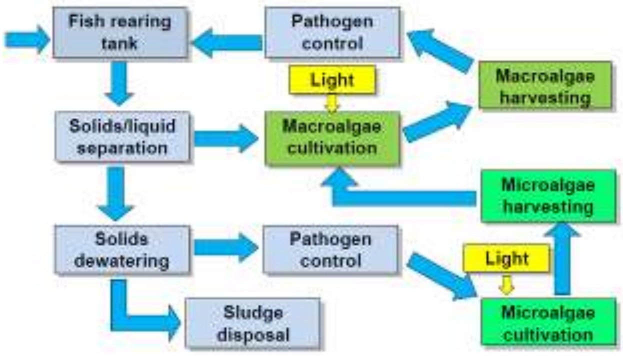

Fig. 5 – Algal integrated RAS block flow diagram ***(Yoshitani. 2010)***

b. RAS wastewater treatment using algae

Photosynthetic microorganisms (including filamentous green algae) are used in biofilter because they are metabolically versatile, they grow either strictly photosynthetic (with carbon dioxide as carbon source) or mixotrophic (using both inorganic carbon and organic carbon as carbon sources), they are able to catabolise organic substrates from wastewater, but can also use nitrate, ammonium and phosphors together with carbon dioxide. The concept of wastewater treatment using microalgae was firstly proposed by Oswald in the 50s-60s(*Oswald. 1957*; *Oswald. 1963*) and nowadays is under visible increase (*Markou and Georgakakis. 2011; Sapna et al.. 2014 and references herein; Boelee et al.. 2012*).

At the beginning, the idea was to take advantage of algal metabolism and grow algae in large open ponds. As advocated by Benemann and Oswald, (1996) a major benefit of such advanced pond systems is that they require much less energy to operate than conventional technologies. Furthermore, converting the algae produced in the high rate ponds to methane may produce a net output of energy rather than consume power. Proponents of this ideea have calculated that 1 kg of BOD removed in an activated sludge process requires 1 kWhr of electricity for aeration, which produces 1 kg of fossil CO_2 through the power generation. In contrast, 1 kg of BOD removed by oxygenic photosynthesis requires no energy inputs and produces enough algal biomass to generate methane, that can produce 1 kWh of electric power (*Benemann & Oswald. 1996*). Benemann & Oswald (1996) have concluded that algal technology could play a significant role in energy self-sufficiency, and that microalgae in general could become an important contributor to the global greenhouse gas reduction (*Benemann & Oswald. 1996*).

Furthermore, some microalgae contain lipid micro-droplets within their cells in variable proportion, depending of strain and conditions of cultivation, which in some cases can reach 50% of the dry biomass. Apart from lipid micro-droplets algae cells can also contain other economically important chemicals (*Markou and Georgakakis. 2011*).

Microalgae cultures could offer an elegant solution to tertiary and quaternary water treatments due to the ability of the microalgae to use inorganic nitrogen and phosphorus for their growth and algae biomass has a number of other potential uses as well(*Manea and Ardelean. 2016*). Bio-treatment with microalgae is particularly attractive because of their photosynthetic capabilities, converting solar energy into useful biomass and incorporating nutrients such as nitrogen and phosphorus which cause eutrophication of natural ecosystems (*Sapna et al.. 2014 and references herein).*

Figure 5 *(Yoshitani. 2010)* presents the flow diagram of the algal treatment stage within RAS.

c. RAS wastewater treatment using aquatic plants

In this study, the possibility of using aquatic plants in reducing the pollution potential of aquaculture wastewater will be discused. We have evaluated the water treatment efficiency of five water plants (*Wolfia ariza, Spirodela plyrhiza, Lemna trisulca, Lemna gibba* and *Lemna minor*), namely their capacity to reduce the pollution potential of aquaculture wastewater, in the form of nitrogen compounds and phosphorus.

The *Lemnaceae* family consists of four genera (*Lemna. Spirodela. Wolffia & Wolffiella*) and 37 species have been identified so far. Compared to most other plants, duckweed (*Lemna minor*) does not require structural tissue to support leaves and stems, therefore its biomass has low fiber content (about 5%). This plant can be used to remove pollutants such as organic matter, soluble salts, nutrients, suspended solids and heavy metals from wastewater (*Nieder et al.. 2004*). Differences in absorption rates of the key wastewater nutrients, ammonium and phosphorus bettween various aquatic macrophytes can be used for optimizing the composition of wastewater effluents. As generated data suggests, the composition of the wastewater can be modified not only by using distinct species, but also by changing the source plants' metabolic profile, by exposing them to different abiotic or via biotic stresses.

Duckweed species have been used for over 30 years to remove nutrients from wastewater and they are also a reliable source of proteins, which are essential for the production of value-added products such as animal feed and also for making bio-ethanol (*Muradov et al.. 2014*). Duckweed is a floating aquatic macrophyte, which can be found all around the world, on the surface of rich fresh and brackish waters (*Zimmo et al.. 2005*).

Lemna is the largest genera among all duckweed species. They are small ubiquitous plants and the whole plant body is reduced to a leaf-like structure called frond which consists of leaflets and a root-like structure. The ideal growth conditions are water temperatures between 6 and 33°C and pH from 5.5 to 7.5. They reproduce asexually and are easy to culture in laboratory, therefore they are the material of choice for many ecotoxicological investigations (*Mkandawire et al.. 2007*).

Unique properties of the species which establish them as ideal phytoremediation agents include: fast growth and multiplication (doubling biomass between 0.2 and 7 days); high bioaccumulation potential; ability to transform or degrade contaminants; regulate chemical speciation; capacity to treat variable contaminants (both organic and inorganic); some species have been commercially exploited to recover valuable metals like Au and Ag from wastewater and mining wastes (*Obek and Sasmaz 2011*).

In uncontaminated waters, average yield of *Lemna* corresponds to 20–50 g m^{-2} d^{-1} dry biomass while 200 g^{-2} d^{-1} dry biomass has been reported under laboratory conditions and tropical regions. Under ideal media and nutrient conditions *Lemna* species, particularly *L. minor* and *L. gibba*., a growth rate of 0.6 d^{-1} has been observed. High biomass production rate equates with high bioaccumulation potential. Duckweeds can remove wide range of inorganic and organic contaminants such as heavy metals, radionuclides, nutrients, pesticides and explosives from domestic. municipal and industrial wastewaters.

Spirodela (greater duckweed) and *Wolffia* species have been reported to accumulate and hence to treat metal-contaminated waters. *S. polyrhiza. S. intermedia* and *Wolffia* showed As, Pb, and Cd accumulation and tolerance efficiency. The adsorption process followed by first-order kinetics and the biosorption mechanism cause ion exchange between monovalent metal ions present in the medium.

Phytoremediation by *S. polyrhiza*, *Salvinia molesta* and *Lemna sp*. carried out in synthetic wastewater under controlled condition to precisely evaluate nutrient removal efficiency of NO^{3-}-N. PO_4^{3-}. NH_3-N. COD and pH in the water sample has shown that ammonia removal was rapid, significant for *S. polyrhiza* and *Lemna sp..* with efficiency of 60% and 41% respectively within 2 days. *S. polyrhiza* can reduce 30% of the nitrate. *Lemna sp*. has achieved the highest phosphate reduction of 86% at day 12 down to 1.07 mg/L PO_4^{3-}-P (*Ng YS. Chan DJC.. 2017*).

Lemna minor (duckweed) is a free-floating aquatic plant that grows in both still and running freshwater, such as lakes, rivers and streams. Depending on the circumstances, duckweed can be an extremely invasive species or a welcomed aquatic plant. Also, any plant of the genus *Lemna* can be considered duckweed. The plants usually have small vestigial roots and grow in the form of thick green carpets of rounded free-floating thalloids, flattened structures which resemble leaves. Duckweed can rapidly spread to cover waterways resisting all attempts to eliminate it. These plants typically reproduce by budding, although they can produce small flowers on occasion and prefer water which is rich in nitrogen and other nutrients. They readily filter substances including toxins from water. They can also provide shelter for aquatic animals, in addition to nutrition for larger creatures like ducks and geese. Some species are even considered attractive making them potentially appealing as ornamentals in water gardens. Some duckweed species have even genetically engineered to perform specific functions (*Gijzen and Khondker 1997*).

Lemna gibba, which belongs to same family (*Lemnaceae*), is a rooted free-floating aquatic plant consisting of small fronds. Due to the high growth rate and large uptake metal potential, members of Genus *Lemna* have appeared as potential candidates for designing a duckweed-based heavy metal phytoremediation set-up. A few workers demonstrated previously high potency of *L. gibba* in heavy metals removal from the aquatic environment (*Abdallah. 2012*).

The initial metal load and the pH of growth medium are critical factors in metal uptake and in chemical kinetic processes. Such parameters need to be optimized in order to design an industrial-scale duckweed pond system for a wastewater treatment process. As pH is deemed to have a decisive role in this bio-remediation process, the need exists to monitor and control the pH appropriately and to invest more effort in stuying pH effects. After reviewing the available scientific literature, it was realized that studies in course of metal loads and pH of culture media are not sufficiently advanced. The contributory effect of metal load and pH performance on achieving maximum removal will further help to target metal pollution problem efficiently. Therefore, another aim of this study is to evaluate the the impact of the pH and of the concentration of metals in aquatic media on the removal efficiency by duckweed system containing *L. gibba* as test species. The role of such parameters in plant growth and metal uptake yield was also studied using laboratory-based batch set-ups (*Verma and Suthar. 2015*).

Lemna trisulca (L.).,named as Star Duckweed, is a natural contributor to reducing the concentration of anatoxin-a in the aquatic environment and the growht of of the cyanobacterium *Anabaena flosaquae* (Lyngb.).

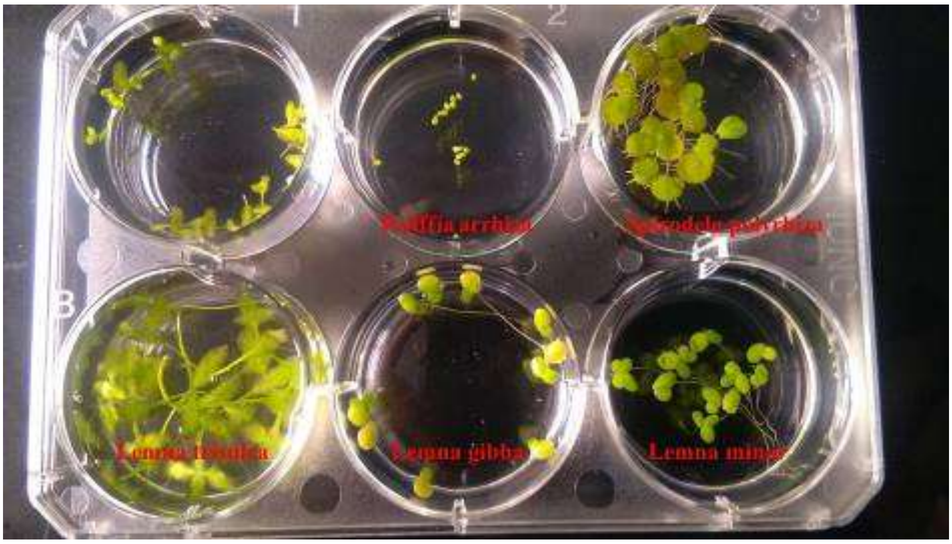

Fig. 6 - Experimental device used in plant stabilization before experiment

Another aim of this this study is to select a *Lemna* species for bioremediation experiments.

1. We will determinate the optimal growth conditions using a static growth system (pH. salt content of synthetic growth medium), temperature and light.

2. We will use a synthetic medium rich in polluting compounds (NH_4^+ and PO_4^{3-}) and determine the growth profile for every *Lemna* sp. assayed to select optimal species and the uptake efficiency of pollutants.

3. Using synthetic medium that is rich in polluting compounds (NH_4^+ and PO_4^{3-}) and antibiotics we will determine the growth profile for all *Lemna sp*. assayed in order to select optimal the species and yield of consumption of polluting compounds.

The results will describe the the optimal condition for the next step of experiments used to demonstrate the efficacy of *Lemna* bioremediation in aquaculture systems.

RESULTS

Algae are autotrophs, i.e. they can synthesize organic molecules themselves from inorganic nutrients. Regarding the most common elements, the average algal cell stoichiometry is $C_{106}H_{181}O_{45}N_{16}P$. and for the most part it is assumed that these elements should also be available in these proportions in the growth medium in order to achieve optimal growth. It has been demonstated that microalgae are efficient at removing nitrogen, phosphorus and toxic metals from a wide variety of wastewaters. There are extensive studies of algae growth in municipal, agricultural and industrial wastewaters (*Sapna et al.. 2014 and references herein*). Recent studies (*Boelee et al.. 2012*) have demonstrated that high removal efficiencies of more than 90% nitrate (NO_3^-), the main N source in Dutch municipal wastewater effluents and more than 80% phosphate (PO_4^{3-}) can be achieved with microalgal biofilm systems.

During laboratory experiments, it was revealed that the high affinity of phototrophs for NO_3^--N and PO_4^{3-}-P enables phototrophic biofilms to achieve effluent concentrations well below the target concentrations of 2.2 mg N/L and 0.15 mg P/L (*Boelee et al. 2012*). With the promising results of microalgal biofilm systems in the laboratory, it is important to scale up these systems to a pilot-scale study and to test the experimental systems under variable and realistic outdoor conditions over a prolonged time period (*Boelee et al.. 2012 and references herein*). In fact, there is a large interest in using photosysnthetic microorganisms in municipal, agricultural and industrial wastewaters (*Sapna et al.. 2014 and references herein*). Their use for RASs is only at the beginning (*www.algaxperts.com*).

Our published results on outlet water from a municipal wastewater plant (*Manea and Ardelean. 2016*) whose composition mimics the composition of outlet water from RAS show promising results. So, 10 g wet weight of free photosynthetic micro-organisms in 1.000 ml input water, removal efficiency of total nitrogen was 15% on the first day, 29% on the second day and 33% on day 4, while total phosphorus removal efficiency was 31% in the first day, 57% on second day and 80% on day 4. In relation, the mass / volume of 10 g wet weight of free photosynthetic micro-organisms in 1.000 ml effluent water, removal efficiency of total nitrogen was 40% on the first day, 66% on day 2 and 79% on day 4, while the removal efficiency of total phosphorus was 22% on day 1.50% on day 2 and 67% on day 4. Experiments with photosynthetic microorganisms immobilized in an artisanal cage showed greater efficiency at removing nutrients (nitrate decreased by 70% and phosphorus by 50%) compared to experiments with free photosynthetic micro-organisms (where nitrate was removed by 64% and total phosphorus by 39%) subjected to the same experimental conditions.

The research team will design and achieve an experimental RAS WWTP (laboratory model) relying on four innovative technological solutions including: dissolved flotation unit and biological treatment; MBBR and algae; algae alone; Lemna and algae combinations. A novel type of biofilm carrier will be used and patented. The WWTP will be highly automated and will rely on SMS communication to inform personal if an event occurs. In figure 7 is presented a simplified scheme of the laboratory WWTP for RAS.

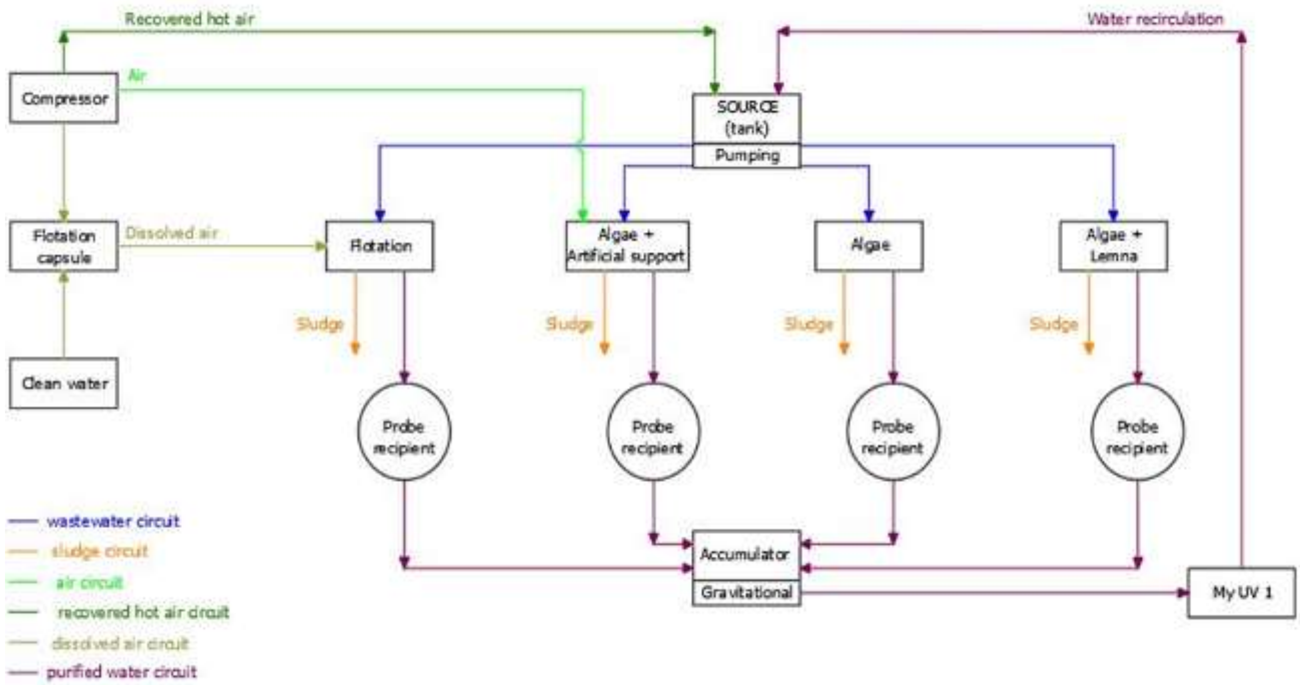

Fig. 7 – Technological scheme of the laboratory installation that will be used to determine the most efficient technology for RAS (will be tested the DAF utilization in the biological stage combined with biomedia; algae treatment and biofilm carriers; algae treatment; algae and *Lemna* treatment)

CONCLUSIONS

Fish and other aquatic organisms release their nitrogenous wastes primarily as ammonia excreted across the gill membranes. In addition, urine, solid wastes and excess feed have undigested nitrogen fractions, which are additional sources of ammonia as well. Ammonia is an important nitrogen waste released by aquatic animals in the environment and a major contributor to RAS-based pollution. Phytoremediation can combine wastewater treatment in the aquaculture system, focusing on optimizing the nitrification, denitrification and absorption of the nutrients released by the fish to grow aquatic plants.

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THEORETICAL CONSIDERATIONS CONCERNING THE INFLUENCE OF FREEZING STORAGE ON FOOD INDUSTRY
/
CONSIDERENTE TEORETICE PRIVIND CONSERVAREA PRIN CONGELARE ÎN INDUSTRIA ALIMENTARĂ

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Keywords: *freezing, food industry, food chain, storage, preservation.*

ABSTRACT

This paper is a brief review of the importance of artificial cold in the food industry, as cold is considered a determining factor in maintaining the quality of food and, implicitly, the health of consumers.

The paper focuses on the role of artificial cold in food industry, as well as the main ways of using it during the processing or storage of food.

In the actual context, worldwide, yearly are produced and processed about 4 billion tons of food products, half of them requiring a special treatment induced by artificial cold. But only a quarter of these products undergo this treatment. About 30% of the food products do not reach the consumer, being considered waste. The main causes of these losses are: mechanical actions (structure degradation caused by the crush), drying processes, aging (especially in the case of fruit) and degrading pests (microflora, rodents, birds,. etc.). That is why, the implementation of modern methods of cold treatment on food products essentially reduces the losses of resources of animal and vegetal origin.

The overall conception of the refrigeration chain and its links has specific characteristics depending on the temperature level to be ensured and the nature of the products preserved by cold.

Thus, there is one refrigeration chain for each product or group of chilled products and one refrigeration chain for each frozen product or group of products.

REZUMAT

Prezenta lucrare se constituie ca un scurt review asupra importanţei frigului artificial în industria alimentară, frigul fiind un factor determinant în menţinerea calităţii produselor alimentare şi implicit a stării de sănătate a consumatorilor.

În lucrare sunt amintite rolul frigului în industria alimentară, precum şi principalele modalităţi de folosire a acestuia în timpul procesării sau depozitării produselor alimentare.

La momentul actual, pe plan mondia, anual sunt produse şi procesate circa 4 miliarde tone de produse alimentare, jumătate dintre acestea necesită tratament cu frig artificial. Însă numai o pătrime din aceste produse sunt supuse acestui tratament. Circa 30% din produsele alimentare nu ajung până la consumator, fiind considerate pierderi. Principalele cauze ale acestor pierderi sunt: acţiuni mecanice (degradări de structură prin strivire), procese de uscare, îmbătrânire (în special în cazul fructelor) şi acţiuni degradante ale dăunătorilor (microfloră, rozătoare, păsări etc.). De aceea, realizarea metodelor moderne de tratament prin frig reduce esenţial pierderile de materii prime de origine animală şi vegetală.

Concepţia de ansamblu a lanţului frigorific şi verigile acestuia au caracteristici specifice în funcţie de nivelul temperaturilor care trebuie asigurate şi. Respectiv, natura produselor conservate prin frig.

Astfel. există câte un lanţ frigorific pentru fiecare produs sau grup de produse refrigerate şi câte un lanţ frigorific pentru fiecare produs sau grup de produse congelate.

INTRODUCTION

Cooling is the process of extracting the thermal energy of an entity, this energy being transferred to another entity. As a result, the first entity (the cooled entity) decreases its temperature, while the temperature of the second entity increases.

Artificial cold has a widespread use in the food industry due to the conservative action it has on perishable food, by braking or even stopping the action of modifying agents, as long as food is kept at low temperatures.

Generally, cold does not improve the original quality of food: it only aims at preserving an appropriate appearance and sometimes a specific consistency (butter, chocolate), slows down or stops possible alterations and produces a pleasant freshness (beverages, ice cream, etc.). Cold changes in a very reduced proportion the original taste of the fresh products. If used in an inadequate manner, cold can degrade the qualities of the products. Like all other conservation processes, cold can not avoid a series of losses in case of long-term preservation, even in the frozen state.

Freezing is one of the oldest and most used methods of food preservation. This method of conservation dates back to ancient times - the Neolithic and the Paleolithic period, when its principles were used strictly for the cooling of food.

The need to bring food at a suitable temperature in order to maintain their proper characteristics over a longer period has attracted the attention of the specialists involved in this industry, demonstrating the usefulness of using the artificial cold. The 19th century marks the most significant progress reported both to freezing processes and refrigerants used. Thus, the refrigeration properties of ammonia were analyzed, being considered the first substance with refrigerant valences according to its physicochemical properties. The rapid technological progress of the period has prompted the replacement of ammonia with freon to improve efficiency and safety, with a low impact on the environment.

The rapid increase in the number of the consuming population has made it necessary to produce large quantities of food in order to achieve their needs. Taking into account the biochemical degenerations suffered by the products during storage, it has been found to be necessary to apply a thermal treatment at low temperatures. By applying low temperatures to foods, the energy of reaction to biochemical processes is inhibited to distort them.

Freezing is a method of preserving food that can ensure a high degree of safety, nutritional value preservation, sensory quality and accessibility. Compared to other conservation methods, freezing has many advantages that consist, in principle in improving the quality of vegetable products, fish and meat at all times and places far from the place of harvest or slaughter.

In addition, to exemplify the benefits of freezing as a conservation method, freezing can provide enjoyable food experiences. This is exemplified by ice cream, a product whose origins date back to the 17th and 18th centuries where it was served as a luxury to aristocracy and is now a global player in the frozen food market. Although there is a clear definition of "ice cream" in many countries, the authors use a broader name (more colloquial), the term including ice cream, sherbet, ice pieces, etc.

In the past, most frozen foods were cooked before consumption, providing an important advantage in terms of microbiological safety. In the current context, the focus has been put on the notion of comfort and a much wider range of available foods, many of which are specifically designed to be kept and distributed in the frozen state. These foods are considered "modern" and can be pre-cooked as components of a menu or a dish or dish that simply needs to be reheated before consumption.

In addition, many frozen cakes and desserts (including ice cream) are designed to be consumed after proper defrosting or directly from the freezer without the need for cooking for consumption. By eliminating any stage of preparation for consumption, it has become an impetuous need to ensure microbiological safety before freezing and determine the processes carried out before and during freezing.

MATERIAL AND METHOD

Freezing is a method of preserving food that can provide a high level of safety, nutritional value, sensory quality and accessibility. Compared to other conservation methods, freezing has many advantages found in principle in improving the quality of vegetable products, fish and meat in every moment and in places that are located far from the place of harvest or slaughter.

The main purpose of freezing is to conserve perishable food. From this point of view, freezing, as a preservation method, increases the shelf-life of food over 5 ... 50 times comparing to the preservation by refrigeration. Increased conservability obtained by freezing is based on the effects of low temperatures of strong slowing or complete inhibition of microorganism development, reduction or canceling of metabolic processes in living products and reduction of chemical and biochemical reactions. (Judith A. Evans. Paul Nesvadba. 2009).

Freezing ensures an appreciable increase in the conservability of food products, but requires compliance with the conditions imposed by the specific technology and some general conditions:
• the use of appropriate raw materials and quality products; introducing them into freezer compartments or devices as soon as possible after their production;

• ensuring all hygiene-sanitary elements necessary to avoid contamination of micro-organisms with products before freezing or after thawing;

• providing adequate refrigeration temperatures in cases where products are not introduced directly into freezer compartments or devices, or are not used immediately after thawing;
• avoiding freezing of food inadequate for consumption, as this method of preservation does not improve the original qualities.

Before being frozen, foodstuffs are subjected to preliminary operations and treatments specific to the type of product, the freezing method used and the purpose for which the product is intended.

Ensuring the nutritional quality of food products is a growing concern for consumers and a challenge for the food industry. With regard to frozen products, the challenge is to maximize the preservation of nutrients without compromising microbiological safety.

The essential step in the freezing process is to lower food temperature in order to prevent or at least minimize the rate of microbial multiplication and chemical modification. Thus, the freezing of food is dominated by a series of complex changes of physical and chemical nature.
In short, as the temperature drops below 0 ° C, the water in the food starts to turn into ice. As a result, the dissolved solution becomes more concentrated in the remaining liquid water, thus reducing the freezing point. Depending on their chemical and physical structure composition, frozen natural foods may contain up to 8% water in the liquid phase. This liquid phase contains a complex mixture of cell metabolites at high non-physiological concentration. (Vladimir Dimitriev, Mircea Bernic, Leonid Ivanov. 2012)

Moreover, as ice crystals increase their volume in natural food structures, they can cause intracellular rupture and intercellular walls and membranes, resulting in the release and mixing of substrates and enzymes previously compartmentalized. Therefore, although keeping foods below zero degrees may reduce the rate of reactions with potential adverse effects on their safety, quality and nutritional intake, changes in substrate and enzyme concentrations may act to increase the rate of these reactions.
Other factors that have a significant impact on the freezing effect include the freezing rate, the composition of the product or the ingredients of the food, the packaging material, packaging dimensions, storage temperatures/ storage life, defrosting conditions and physical condition (e.g. growth) of microorganisms during cooling/ freezing.

RESULTS

Biochemical aspects concerning the cold conservation of food products

The complexity of the biochemical reactions occurring in the mass of the product determines changes in their structure. These changes may have beneficial effects with a positive impact on the consumer as well as undesirable effects caused by the synthesis of compounds resulting from carboxyl degradation. The formation and intensity of these reactions can be controlled by applying low temperatures. Among products susceptible to cold treatment, it is distinguished:

• products to be preserved until their use by the consumer (mainly fruit and vegetables). The issue of conserving them is purely biological and seeks to delay the aging process and the occurrence of undesirable processes;

• products that are killed by cold (frozen fruits and vegetables) or products that reach the cold store after slaughter or fishing (slaughtered animals, fish, etc.).

As long as they are alive, cells that make up plant and animal products use some of their energy to maintain their constituents. Appropriate preservation of these in vivid conditions implies a slowing of physiological activity that will prolong life; a moderate cold (0 ... 12ºC. depending on the situation) will be effective, but it will not be able to ensure long-term conservation. At temperatures lower than 0ºC, a dead zone will be rapidly reached. (Heldman. R. R. and Singh R. P. 1981).

If cold preservation is preceded by a treatment that affects the structure of the product (peeling, cutting, etc.), it causes an increase in breathing intensity and at the same time an increase in microbial activity.

Chemical and microbiological effects of freezing conservation

Preserving products in a fresher state has a number of limits and difficulties, which make us use the preservation of abiotic products. Cell death, in turn, carries a double risk: chemical and microbiological, Thus, dead vegetable cells remove toxins, a solution made up of different chemical products able to react with each other. In the presence of air, enzymes oxidize lipids and phenols causing the formation of new odorous and disagreeable color substances. This organic environment also favors the development of microorganisms, agents of other undesirable chemical alterations. In order to limit chemical hazards, enzymes are blocked in practice by hot water scrubbing, limiting oxygen access to the product with the appropriate packaging and preserving at low temperatures (-18...30°C) without these measures increasing the cost of storage too much.

To limit the risk of microbial deterioration, it is recommended that products have a minimum initial microflora and keep at a lower temperature.

The hygienic quality of food also poses a major requirement imposed by the consumer. In this context, it should be stressed that if the cold as a preservative does not cause the appearance of toxic products, it does not even eliminate those that originally exist in the product.

Low temperatures prevent the development of microflora and increase the shelf life of perishable food. In the case of frozen products, the number of germs remains virtually unchanged, but at high temperatures, their number increases, a point highlighted at the end of freezing and defrosting respectively, when the number of germs increases after a latency period.

In food, microorganisms develop at different temperatures. The temperature zone specific to a microorganism is the result of adaptation to the environment. Optimal temperature is the temperature at which the development of a microbial species is done under the best conditions. The minimum temperature is the lowest temperature that a microorganism can withstand (below the minimum, the growth of microorganisms is stopped). Maximum temperature is the highest temperature at which a species develops (above the maximum, there is a lethal effect on micro-organisms). Temperatures below the minimum temperature have a microbiostatic effect. Temperatures higher than the maximum temperature have a microbicidal effect. (Mark Berry, John Fletcher, Peter McClure and Joy Wilkinson. 2009)

When freezing water and some of the water bound to cellular compounds turns into ice crystals, it increases the concentration in enzymes, which produces osmotic shock, resulting in irreversible changes in macromolecular conformation and cell membrane permeability. In this process some of the microbial cells are destroyed, which is a favorable environment for the growth of surviving cells. In the case of slow freezing (3 - 72h), water migrates from the microbial cell to the outside forming large ice crystals, which break cell membranes, destroying them. Dehumidification of these products produces large losses of juices.

Fast freezing produces small intracellular and extracellular crystals, which cause smaller microbial cell destruction than slow freezing.

After defrosting, cells that have preserved integrity easily absorb water and are reactivated, resulting in rapid deterioration of the defrosted product. In thawing, the product is richer in nutrients, because it is easier to release the juice from the plant tissue or animal tissue that benefits the growth of microorganisms.

In the product, during storage in the frozen state, the enzymes released from the destroyed cells can act as long as the storage life is limited (from a few months to a year), as there is a possibility of changing the quality of the frozen product due to lipid-type microbial enzymes remain active.

Physical implications of the freezing process on the products

Freezing a food is the cooling process in which the following important physical phenomena occur:
• solidification to a certain proportion of the water contained in the product;
• increasing product volume;
• strengthening consistency.

The above physical phenomena occur as a result of the heat exchange from the freeze-dried product to a cooling medium (air, intermediate or cryogenic refrigerants, etc.). The temperature of the cooling medium must be lower than the final average temperature of the product undergoing freezing. The temperature in the foodstuffs to be frozen varies according to the time and place of the measuring point during the cooling process. The highest temperature point at a given time is called the thermal center of the body and is an indicator of the assessment of the freezing stage.

The freezing of agrifood products is considered to be completed when the average temperature is equal to the temperature at which storage is to take place.

Cooling food below 0°C is accompanied by an ice forming process, starting with a specific temperature characteristic of each product, called cryoscopic point temperature.

The minimum freezing rate at which the cooling process takes place must be set so as not to produce undesirable microbiological and enzymatic changes.

Classification of freezing methods can also be done after other criteria exceeding the average freezing speed. Thus, in many countries, preserved products by freezing are found under the following names:

• frozen products - "Frozen foods";

• fast-frozen foods - "Deep-Frozen foods".

Frozen products are obtained by regular freezing, during which the average temperature falls below -10°C for a period that does not allow undesirable enzymatic and microbiological reactions to be triggered; storage of these frozen products is done at temperatures below -10 ° C. (Ronan Gormley. 2009)

The relationship between the freezing time and the characteristics of the product to be frozen

Defrosted products after freezing should show properties that make them indistinguishable from the fresh product. This requirement is easier to achieve for foods than for others. Delicate food is more susceptible to cellular damage. However, for the main categories of food (bread, meat, fish, vegetables), the quality of the thawed product is comparable to that of the fresh product (and, in some cases, by the application of certain criteria such as vitamin, food sold in cold form).

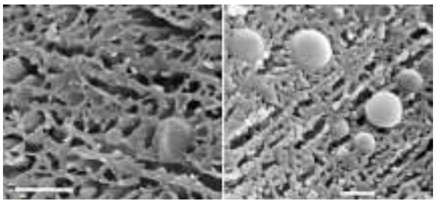

Fig.1 - Ice cristals – microscope view

Freezing time affects the quality of frozen foods. The maximum crystal formation range refers to the range between 0 ° C and -5 ° C if the heat of the fusion heat is eliminated. Rapid cooling takes place when a food exceeds the maximum ice crystals for less than 30 minutes. Rapid freezing occurs with the production of several small ice crystals that cause minimal water mobility outside the cell, leakage and chemical damage to the cell due to cell chemical destruction.

Slow freezing favors the formation of large ice crystals, which can lead to mechanical and chemical destruction caused by partial cell dehydration. The food becomes friable and soft. Rapid freezing is usually advantageous for foods consumed as such and for other categories such as frozen vegetables, seafood and chicken.

The time required to freeze food depends on several factors. The factors according to which the freezing time is determined are: the shape and size of the foods, the thermal characteristics of the foods (specific heat, thermal conductivity, freezing point, food density and moisture content), initial food temperature, heat of the freezing medium (air velocity, degree of contact), packaging characteristics. The size and temperature of the freezer and the amount of food placed in the freezer in a single day determine how quickly the products will be frozen.

Fast freezing is generally recommended for products in order to minimize damage due to ice crystallisation. This process causes the formation of smaller ice crystals. There has been no explanation of the unfavorable effect of rapid freezing, but it can be said that during rapid freezing, intracellular ice crystals are formed which have a lethal effect on the cell membrane. In the case of slow freezing, the contained water can be transferred to external ice crystals due to the difference in vapor pressure.

CONCLUSIONS

Food freezing is a method of preserving to maintain the quality of products for a longer period, equivalent to a proposed time interval. The main objective of the present study was to highlight the importance of the use of artificial cold in the food industry in order to ensure an adequate quality of food.

Compared to the last 50 years, the frozen food market has expanded to a global extent to include a wide variety of products. Even if a food is frozen in an appropriate manner, the physico-chemical and biochemical changes occurring during storage may lead to degradation in quality. The quality of frozen food is highly dependent on the storage temperature and constant and systematic control is required to maintain the appropriate temperature range in relation to frozen products throughout the refrigeration chain to consumption. Also, storage and transport conditions have a major influence on the quality of frozen food.

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MODIFYING EQUILIBRATION CONDITIONSACCORDING TO ROTOR ROTATION ANGLE OF MC 22 HAMMER MILL
/
MODIFICAREA CONDIŢIILOR DE ECHILIBRARE ÎN FUNCŢIE DE UNGHIUL DE ROTAŢIE AL ROTORULUI MORII CU CIOCANE MC 22

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ABSTRACT

Biomass grinding operation is part of the processing phase of biomass. In order to fulfil this operation, so that the material will be able to be properly processed in the next phases of processing, the equipment must correspond both as design and functionality. Thus, studying equipment components is an important step in ensuring its reliability. In general.,biomass grinding is realized with the help of hammer mills that have their hammers and rotor as their main components. An adequate equilibration of these elements contribute to an optimum working process with reduced energy consumption and a grinded material according to further requirements. In the present paper, MC 22 hammer mill rotor equilibration was analyzed, by modifying equilibration conditions according to the rotor rotation angle.

REZUMAT

Operația de mărunțire a biomasei face parte din procesul de prelucrare al biomasei. În vederea indeplinirii acestei operații astfel încât material să răspundă cerințelor următoarelor etape de prelucrare este necesar ca echipamentele să corespundă atât din punct de vedere al designului cât și al funcționării. Astfel, studierea componentelor echipamentului este un pas important în asigurarea fiabilității acestuia. În general, mărunțirea biomasei se realizează cu ajutorul morilor cu ciocane ale căror elemente componente principale sunt rotorul și ciocanele. O echilibrare corectă a acestor elemente contribuie la un process de lucru optim cu un consum de energie redus și un material măcinat conform cerințelor ulterioare. În această lucrare, s-a analizat echilibrarea rotorului morii cu ciocane MC 22 prin modificarea condițiilor de echilibrare, în funcție de unghiul de rorație al rotorului.

INTRODUCTION

Rotor represents the spinning part of an equipment which rotates during the working cycle around the shaft on which it is mounted and it is used at transmission and replay of a driving torque [3]. This type of component, which is in a state of rotation or oscillation is related to vibration, inertia forces and noise generator.

In case when reliability enhancement is needed for the equipment, a component which needs to be regarded is the rotor which must be balanced so that it will reduce the level of vibration at an acceptable level.

Causes of disequilibrium may be:

- rotor might be made out of a inhomogeneous material;
- equipment components eccentricity;
- mechanical deformations which include assembly vibrations, electrical problems, assembly errors for the equipment components, corrosion, erosion, material deposits, deformations which require dynamic equilibration at nominal working temperature, even if the rotor was properly balanced [4].

In order to have a reliable equipment, rotor equilibration must be achieved in conditions close to the real working conditions.

Static equilibration – rotor mass center must be found on its rotation axis;

Dynamic equilibration – rotation axis must be the main inertia axis for the rotor.

Theoretically, in the design phase, the equilibration calculations can be realized with a high precision. But practically, theoretical conditions for design are not found in totality for the materialized rotor [5].

Referring to hammer mill rotors, they can be classified by many criteria:
a. from a constructive point of view, hammer mill rotors can be:
- drum type;
- disc type;
- disc set type;
b. from a mechanical point of view rotors can be:
- narrow;
- wide.

If we refer to hammer mill rotors, then wide rotors usually have a small diameter which makes the inertia moment in relation to the rotor axis to be reduced, hammer mass reaching up to 50% of the rotor mass. The advantage of these types of rotors is that they can easily be equilibrated because the inertia ellipsoid has a sphere like form. This type of rotor is generally used on hammer mills for fibrous materials [1].

Similarly, narrow rotors have a large diameter which makes the inertia moment in relation to the rotor axis to be also large. Advantage of such rotors is outlined by the reduced consumption of metal, hammer mass representing just 15-20% of the rotor mass. Disadvantage of these rotors is given by the fact that it is hard to equilibrate them, because the inertia ellipsoid is flattened in relation to the rotor rotation axis, so it requires a high technicity [1]. Hammer mill rotor static equilibration condition is achieved if the opposite bolts the equal amount of hammers is found. Also the rotor must be dynamically equilibrated because the centrifugal inertia moments in relation with the Oxyz system must be zero.

In the present paper, modifying equilibration conditions in relation to the rotor rotation angle were researched.

MATERIAL AND METHOD

Modification of the equilibration conditions in relation to the rotor rotation angle was realized starting from the MC 22 hammer mill technical data, used during experimental research for doctorate studies.

In order to talk about rotor equilibration conditions, we must first talk about hammer arrangement on the rotor and the way it influences the process. For an equilibrated rotor, the right hammer arrangement must fulfil the following conditions: through the same path, only one hammer should pass, material should not bundle in a certain area of the grinding chamber and the hammers must cover the entire working area. So, hammer arrangement is achieved in the following ways:
1. following helicoidal lines with one or more starting points (fig.1);
2. in parallel rows (fig.2);
3. in a combined system (helicoidal lines and parallel rows) (fig.3);

In this figure, the following notations were made:
a- distance between symmetry lines of two neighboring paths (left by moving hammers);
b- distance between two neighboring hammers on the same axle;
c- arc length according to the bolts axes between two neighboring bolts;
t_e- hammer arrangement propeller spacing;
D_0- rotor diameter according to the hammer bolts articulation axes;
L- rotor length;
I. II. III bolts order numbers.

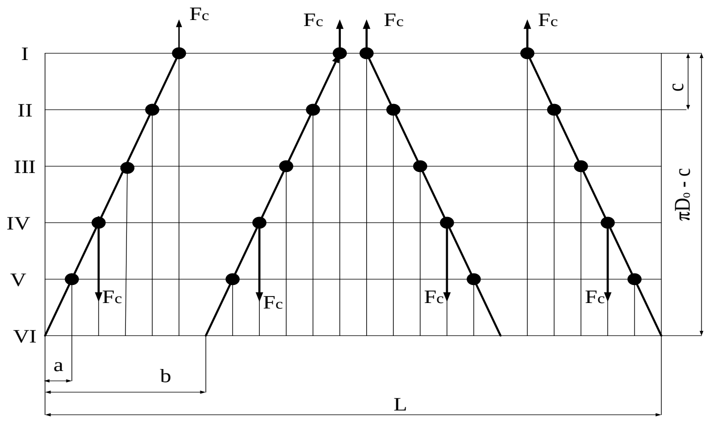

Fig. 1 - Rotor hammer arrangement model following two symmetrical helicoidal lines [1]

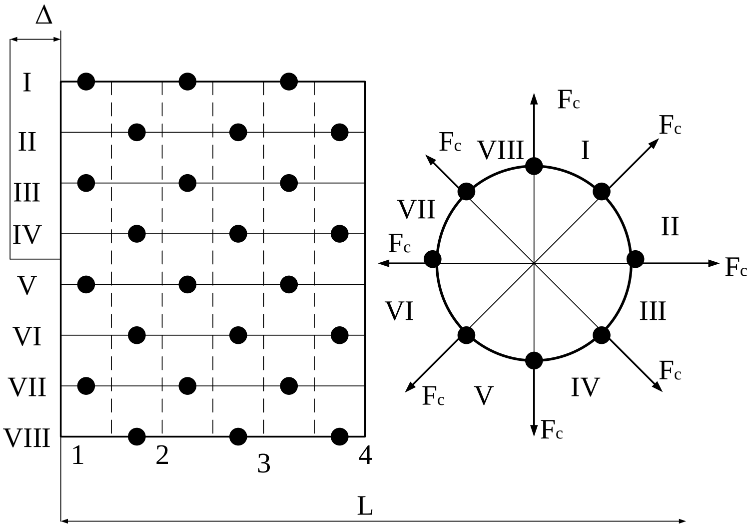

Fig. 2 - Rotor hammer arrangement model following two parallel lines [1]

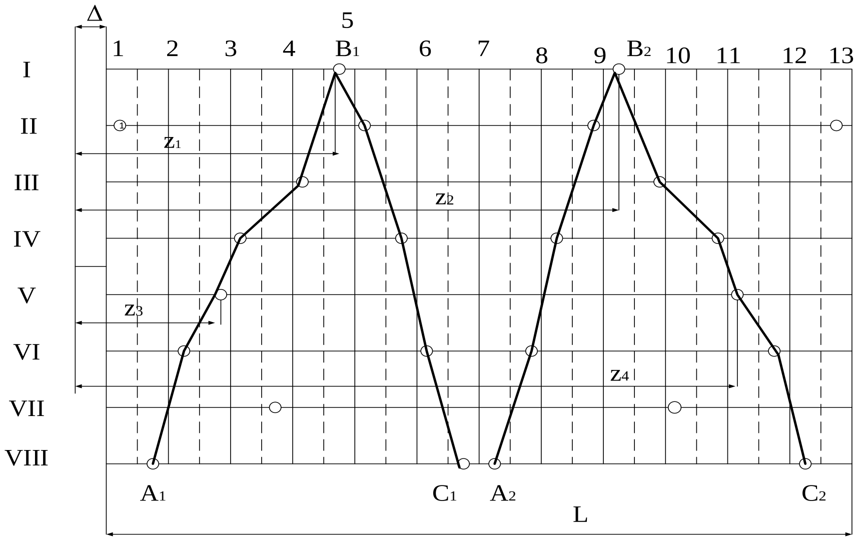

Fig. 3 - Rotor hammer arrangement model following combined systems [1]

Knowing these arrangements, we can say that hammer shock equilibration is achieved through symmetrical arrangement according to the rotor medial transversal plane. If the rotor is calculated as a rotating moving solid, around Oz axis, the condition that during work there will be no extra reactions in the chambers due to developed hammer inertia forces or due to their moments, is given by the following equation system:

$$F_{ix} = nx_0\omega^2 + m\varepsilon y_0 = 0 \quad (1)$$

$$F_{iy} = ny_0\omega^2 + m\varepsilon x_0 = 0 \quad (2)$$

$$M_{ix} = -\omega^2 I_{yz} + \varepsilon I_{zx} = 0 \quad (3)$$

$$M_{iy} = -\omega^2 I_{zx} + \varepsilon I_{zy} = 0 \quad (4)$$

where:

- m – rotor mass;
- ω – rotor rotation speed;
- x0. y0 – circle abscissa and circle ordinate;
- ε – rotor angular acceleration;
- Iyz. Izx – rotor centrifugal inertia moments in relation to Z axis of the system axis Oxyz where Z axis is along the rotor;

These relations verify if the inertia moments are equal to zero, if the conditions for rotor equilibration, both static and dynamic are the same. Equilibration condition is met if on the opposite bolts we find an equal number of hammers. For dynamic equilibration a verification on the equation which represents the equilibration condition, is necessary, meaning:

$$I_{yz} = \sum y_i z_i * M_c = M_c \sum y_i z_i \qquad (5)$$

where: Mc – hammer mass; y_i – hammer ordinate; z_i – measured distance on Oz hammer axis i.

In general, dynamic equilibration is achieved if the hammers have a symmetrical arrangement on the rotor. Disadvantage of this type of arrangement following helical lines is given by the fact that it bundles biomass in one of the grinding chamber's areas.

In order to establish the equilibration conditions of the MC 22 hammer mill rotor, we calculated the inertia moment for its rotation angles from in steppes of 15 degrees.

RESULTS

Inertia moment calculus results are presented in table 1

Table 1

Moment of inertia values in relation to the rotation angle

Rotation angle	**J_{zx} kg m^2**	**J_{yz} kg m^2**	**Rotation angle**	**J_{zx} kg m^2**	**J_{yz} kg m^2**
0	0	2.1E-03	-	-	-
15	0.5E-03	2E-03	**105**	2E-03	-0.5E-03
30	1E-03	1.8E-03	**120**	1.8E-03	-1E-03
45	1.4E-03	1.4E-03	**135**	1.4E-03	-1.4E-03
60	1.8E-03	1E-03	**150**	1E-03	-1.8E-03
75	2E-03	0.5E-03	**165**	0.5E-03	-2E-03
90	2.1E-03	0	**180**	0	-2.1E-03

Rotation angle	**J_{zx} kg m^2**	**J_{yz} kg m^2**	**Rotation angle**	**J_{zx} kg m^2**	**J_{yz} kg m^2**
195	-0.5E-03	-2E-03	**285**	-2E-03	0.5E-03
210	-1E-03	-1.8E-03	**300**	-1.8E-03	1E-03
225	-1.4E-03	-1.4E-03	**315**	-1.4E-03	1.4E-03
240	-1.8E-03	-1E-03	**330**	-1E-03	1.8E-03
255	-2E-03	-0.5E-03	**345**	-0.5E-03	2E-03
270	-2.1E-03	0	**360**	0	2.1E-03

Considering equations (6) and (7) and also knowing the hammers length of 153 mm and width of 60 mm, the hammers moment of inertia and resistance mode were calculated.

$$I_z = \frac{b \cdot h^3}{12} = 1.79 \cdot 10^{-5}\ [m^4] \qquad (6)$$

$$W_z = \frac{b \cdot h^2}{6} = 2.3 \cdot 10^{-3}\ [m^3] \qquad (7)$$

Also the full hammer mass is Kg thus the moment of inertia becomes:

$$J_x = \frac{m \cdot h^2}{3} = 0{,}0044\ [kg \cdot m^2] \qquad (8)$$

$$J_y = \frac{m \cdot b^2}{3} = 0{,}00069\ [kg \cdot m^2] \qquad (9)$$

$$J_{xy} = \frac{m \cdot b \cdot h}{4} = 0{,}0013\ [kg \cdot m^2] \qquad (10)$$

From date resulted after calculus for each rotation angle the minimum and maximum for the moment of inertia are:

$$J_{zx} = J_{yz} = 0{,}0021\ [kg \cdot m^2] \qquad (11)$$

Variation diagrams for the moment of inertia were drawn knowing also the hammer thickness of 8 mm and the disc thickness of 10 mm.

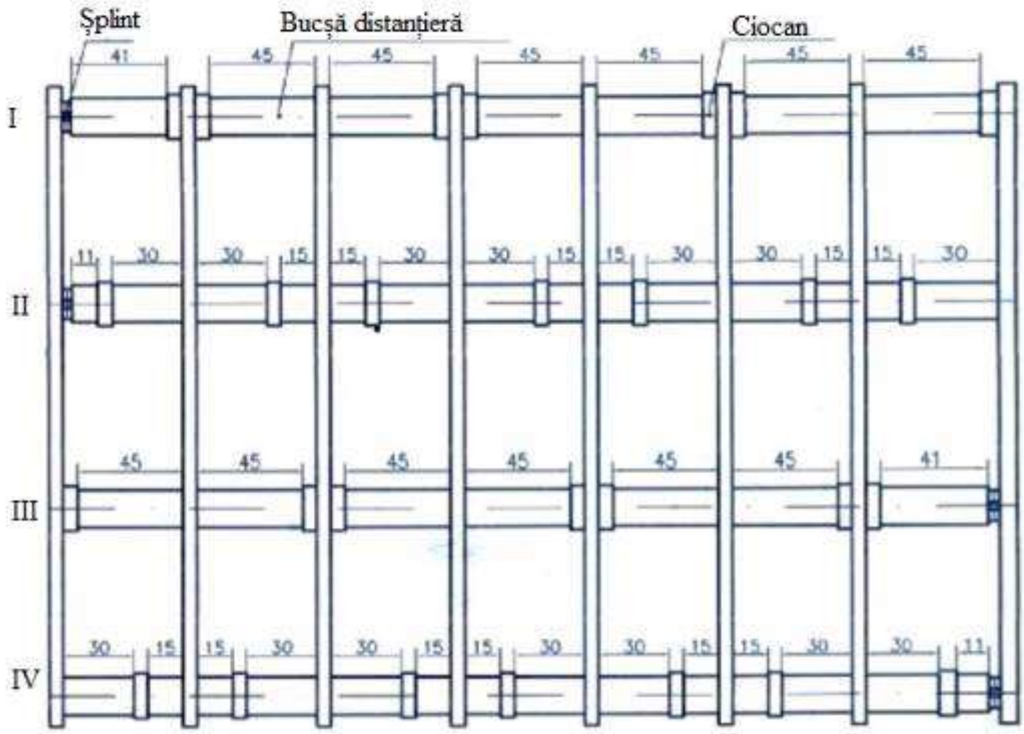

Fig. 4 - Rotor hammer arrangement [2]

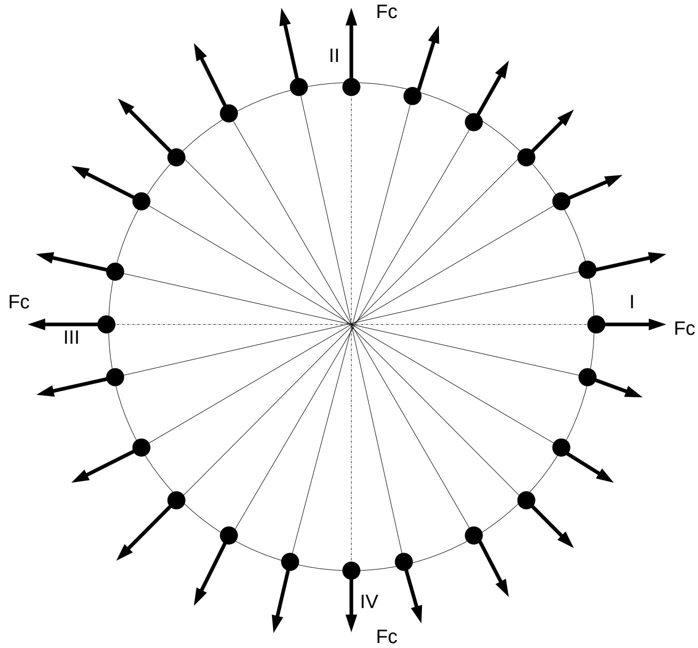

Fig. 5 -Analysis points regarding rotor equilibration in relation with the rotation angle

Figure 6 represents the inertia moment in relation to the rotor rotation angle. We can observe a sinusoidal curve with positive and negative values, with the inertia moment between 2E-03 și -2E-03.

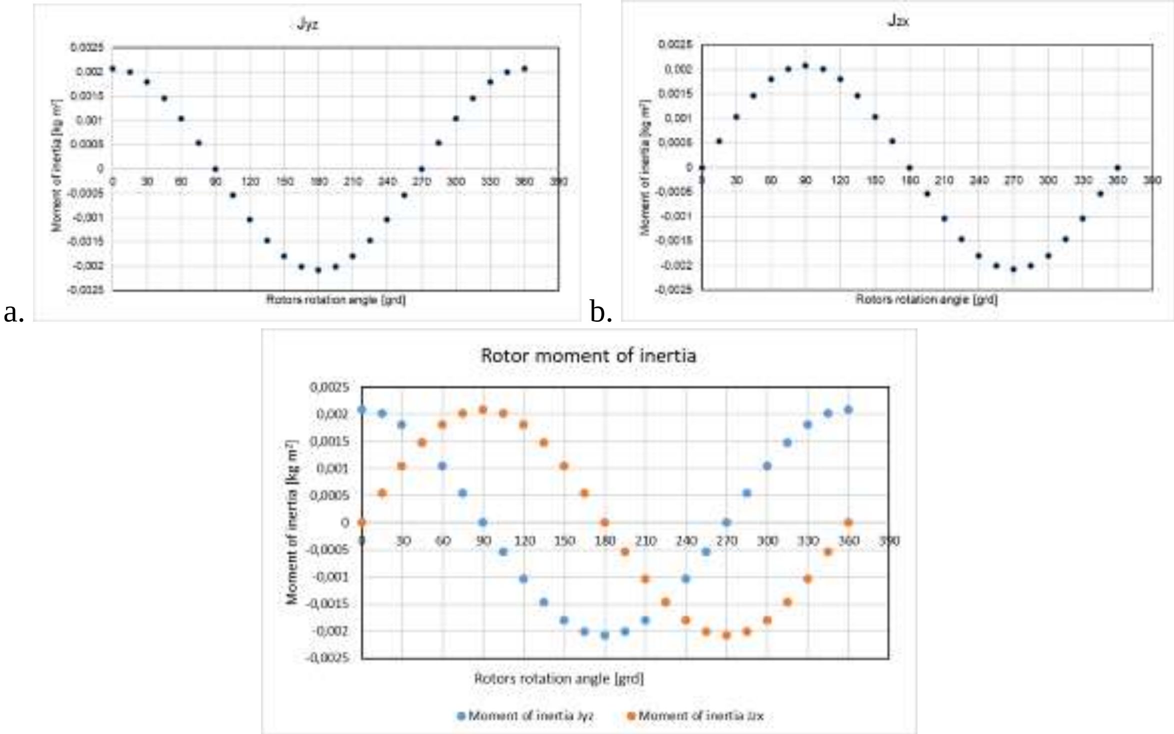

Fig. 6 - Inertia moment variation;
a.Inertia moment variation on the Ox axis; b. Inertia moment variation on the Oy axis

From what can be observed in figure 6, the two inertia moment variations never go simultaneously through zero. Also, the maximum value is the same for both inertia moments, maximum and minimum values of J_{zx} and J_{yz} being relatively small.

Also, for certain positions the inertia moment on the OY axis is zero and the inertia moment on OX axis is either maximum either minimum or reversed. These values of the centrifugal inertia moments can introduce vibrations on the rotor in relation to the Z axis (the length of the rotor).

CONCLUSIONS

Any deviation from the hammer geometry and from its mass introduces a balance disruption during the hammer rotor spin, which leads to a high vibration working cycle, no matter how small the deviations are. Any deviation from the hammer arrangement dimensions on the rotor (alongside the articulation bolts) also introduces balance disruptions and the working cycle will be high and vibration and shaking. Any deviation on the angular position of the articulation bolts, no matter how small, will also lead to a low performance due to high vibration. For the MC 22 hammer mill, the dimensions presented in the rotor assembly sketch introduce different zero values for the centrifugal inertia moments which can lead to a high vibration working cycle and an accelerated ageing process for the equipment.

ACKNOWLEDGEMENT

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[3] https://dexonline.ro/definitie/rotor);
[4] http://rotofix.ro/ro/echilibrare-dinamica-rotor-de-ce-trebuie-echilibrat-un-rotor/);
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INFLUENCE OF TECHNOLOGICAL PARAMETERS OF PSEUDOFLUIDIZED LAYER GRAIN DRYER ON THE GRAIN DRYING QUALITY
/
ВЛИЯНИЕ ТЕХНОЛОГИЧЕСКИХ ПАРАМЕТРОВ ЗЕРНОСУШИЛКИ ПСЕВДООЖИЖЕННОГО СЛОЯ НА КАЧЕСТВО СУШКИ ЗЕРНА

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Keywords: *drying, dryer, grain temperature, pseudofluidization, drying agent.*

ABSTRACT

The values *of the main technological parameters of pseudofluidized layer grain dryer that allow improving the quality of grain material drying, are proved.*

АБСТРАКТНЫЕ

Доказаны значения основных технологических параметров псевдожидкостной зернистой сушилки. которые позволяют улучшить качество сушки зернистого материала.

INTRODUCTION

New dryer construction is suggested. Its technological process is carried out at the account of grain layer pseudofluidization by drying agent.

The investigations to prove technological parameters of drying installation and determining their possible values providing the preset limits of variations of wheat seeds temperature and eliminating grain overheating, were carried out. To process experimental results, we applied experimental statistics. Regression equation is obtained to determine optimal technological parameters of the dryer.

Grain losses and their quality decrease are provided with many factors, including imperfection of dehydration technique. Safety and improvement of technological qualities of harvested grain are achieved first, by drying. Drying, by using scientifically grounded modes, allows improving efficiency of the process. resistance of stored grain, improving its seed and food qualities (Tarasenko A.P.. 2008; Pilipyuk V.L.. 2009; Zhuravlev A.P.. 2014).

Now, in Russia there is the situation when grain is concentrated at agricultural producer and technical base on its processing is in the possession of other holders. In this situation, the producer has to sell raw material on very unprofitable conditions. Accordingly, creation of small-sized mobile machinery to organize own grain drying at producer is the most promising direction of agricultural enterprise development (Shhitov S.V.. Krivutsa Z.F.. Kozlov A.V.. 2016; Bibik G.A.. 2016; Volkov A.V.. 2017).

On the ground of comparison of the most effective existing methods of grain drying, providing high process rate and small sizes of drying installations of new types “vibrating fluid bed”, “falling bed”, “suspension bed”, “pseudofluidized layer” (Volzhentsev A.V.. 2014; Kalashnikova N.V. и Volzhentsev A.V.. 2009; Kuznetsov Y.A.. Volzhentsev A.V.. Kolomeichenko A.V.. Kalashnikova L.V.. 2017), it is possible to stress that utilization of installations of type “pseudofluidized layer” discovers maximum potential to increase efficiency and intensity of drying process.

MATERIAL AND METHOD

General view and basic constructional units of the developed experimental drying installation are presented in figures 1 and 2.

Alteration and control of the basic parameters of the drying installation were carried out in the following way:

– the air flow pressure adjustment at inlet and outlet from grain layer was provided by alteration of flow section of forced-draught fan ВЦ14-46-2.5-01А. Pressure control is done by digital differential pressure gauge ДМЦ-01М;

– the air flow rate in drying chamber was measured by digital differential pressure gauge ДМЦ-01М. However, the flow rate of drying agent was determined at 9 points: at 6 points along drying chamber walls and at 3 points along symmetry axis of functional area, stretching from loading hole to outlet louver;

– the temperature of drying agent in lower turning joint and in drying chamber was controlled according to the data of digital differential pressure gauge ДМЦ-01М. The necessary drying agent temperature was provided with periodical switching off one or more sections of electric heater.

Fig. 1 – General view of experimental dryer of pseudofluidized layer

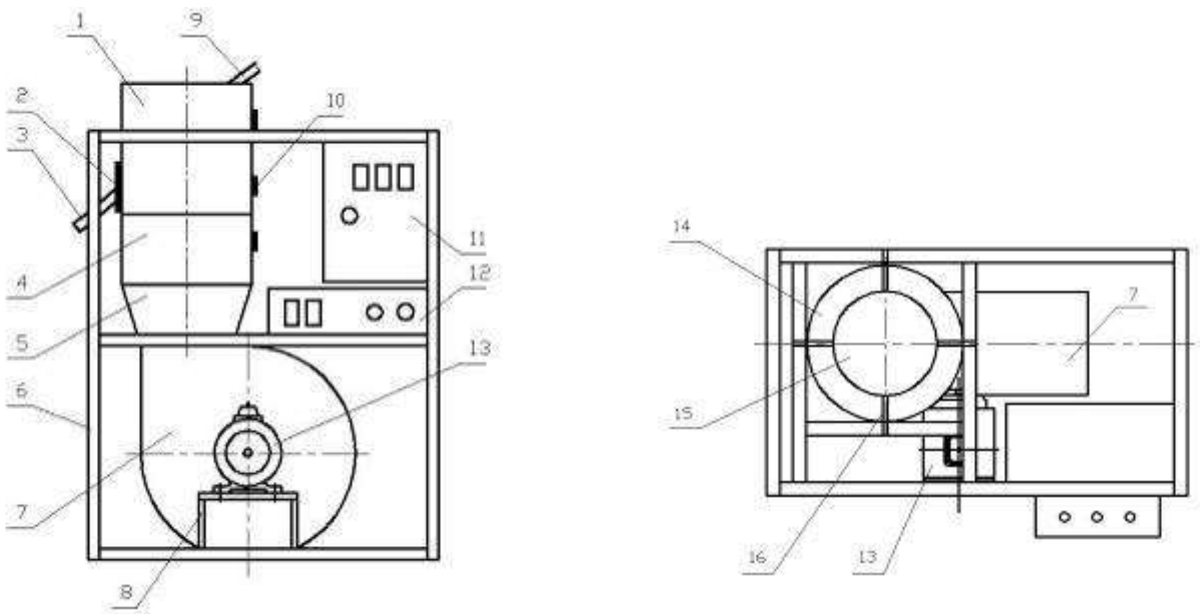

Fig. 2 – **Constructional units of drying installation**

1 – working chamber; 2 – slider; 3 – unloading sleeve; 4 – electric heater; 5 – diffuser; 6 – frame; 7 – fan; 8 – electric engine frame; 9 – loading sleeve; 10 – plug of technological hole for measurements; 11 – console unit; 12 – measuring instruments; 13 - electric engine; 14 – cooling chamber; 15 – drying chamber; 16 - holder

RESULTS

Technological process of experimental dryer operation proved that the main factors, determining grain drying quality, are drying agent temperature and drying time.

The investigations were carried out to ground technological parameters of drying installation and determined their possible values providing the specified limits of seed wheat temperature variations and eliminating grain overheating. In this regard, it was necessary to study the temperature changes of drying agent *t* and drying time $B_{drying.}$ into heating temperature θ of pseudofluidized layer of grain.

Drying agent temperature *t.* ^{0}C was selected with the following values: 60; 80; 100. Temperature variation was done by means of switching on and switching off additional sections of electric heater. Drying time $B_{drying.}$. *s* was admitted equal to 100; 200; 300; 400; 500; 600.

The experimental results on study the influence of the mentioned factors on temperature and humidity of pseudofluidized layer of grain material are presented in figures 3, 4, 5.

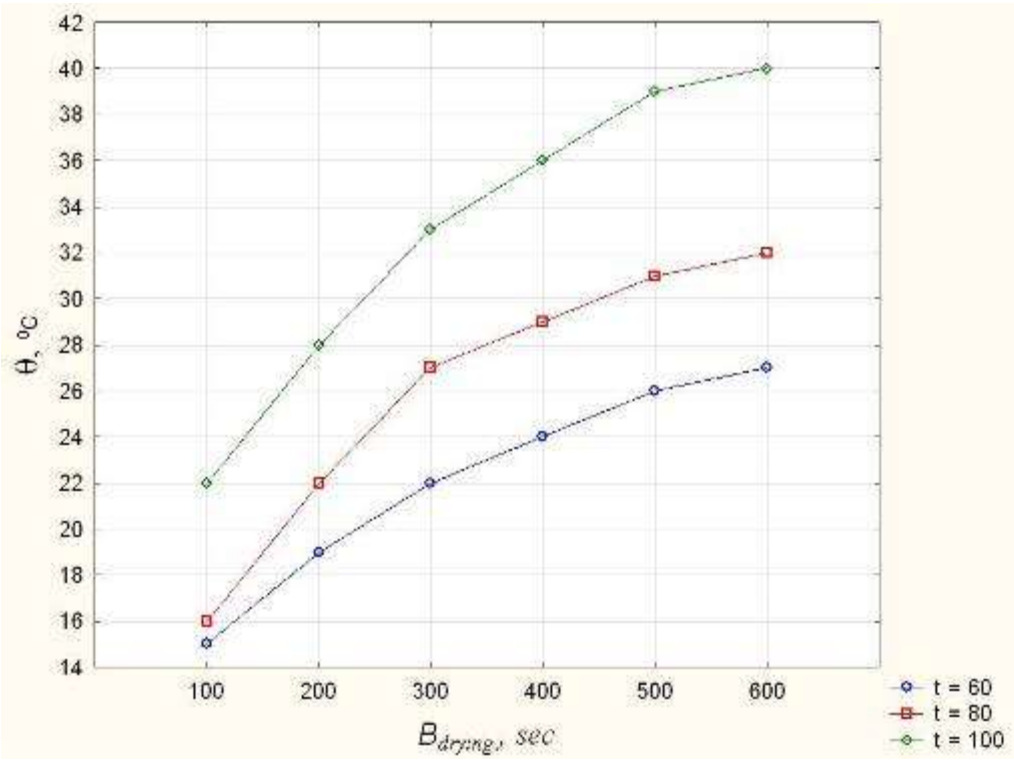

Fig. 3 – Dependence of grain temperature *θ* from drying time $B_{drying.}$ at different values of drying agent temperature *t*

Analyzing obtained dependences of grain temperature (fig. 3) from drying time $B_{drying.}$ at different values of drying agent temperature *t*., it is possible to conclude that at drying time increase, grain temperature increases and at the end of time limit does not exceed maximum permitted time. With increase of drying agent temperature grain heating process is intensified sharply and at the meaning of t = 100 ^{0}C grain temperature θ reaches critical value.

Characteristic curves analysis of grain temperature *θ* from drying agent temperature *t* (fig. 4) displays that with the increase of drying agent temperature, grain temperature increases and reaches ultimate and maximum permitted value at *t*= 100 ^{0}C.

Grain heating intensity depends also on air flow rate (filtering rate) *v*. penetrating pseudofluidized grain layer. Minimum operating air rate providing sustainable and even layer boiling was admitted equal to 2.2 m/s. Maximum filtering rate value was 3 m/s. Further rate increase was inappropriate because it results in nonproductive losses of drying agent.

Characteristic curves analysis of grain temperature *θ* from filtering rate *v* (fig. 5) at different temperatures of drying agent *t* displays that the process grain heating is significantly intensified with rate growth *v*. Grain temperature *θ* reaches its maximum value at drying agent temperature equal to 100^{0}C and air flow rate about 3 m/s.

Further rate growth *v* results in overheating and gran technological properties decreasing.

To estimate the effect of interaction of technological and operating parameters of the experimental dryer on the grain material temperature full factorial experiment was carried out. The regression equation of the following type was obtained:

$$\theta = 47.729 - 0.899\,t + 0.0033\,B_{drying.} - 8.624\,v + 0.0045\,t^2 -$$
$$- 0.00004\,B^2_{drying.} + 0.1423\,t\,v + 0.0003\,t\,B_{drying.} + 0.0122\,B_{drying.}\,v. \quad (1)$$

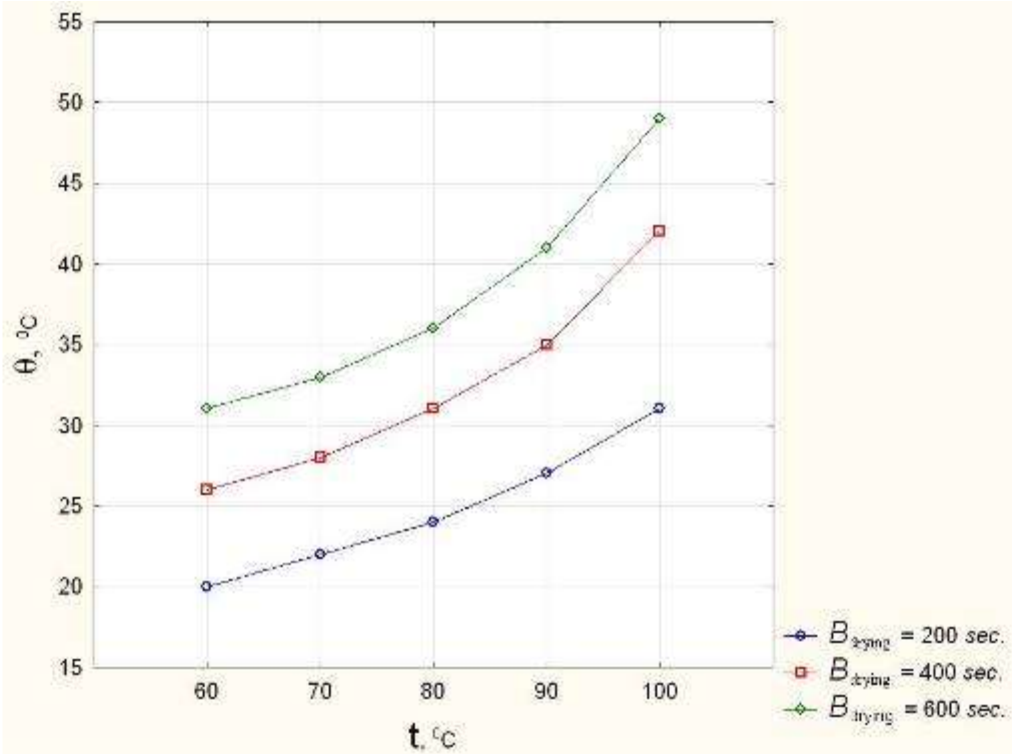

Fig. 4 – Dependence of grain temperature *θ* from drying agent temperature *t* at different values of drying time $B_{drying.}$

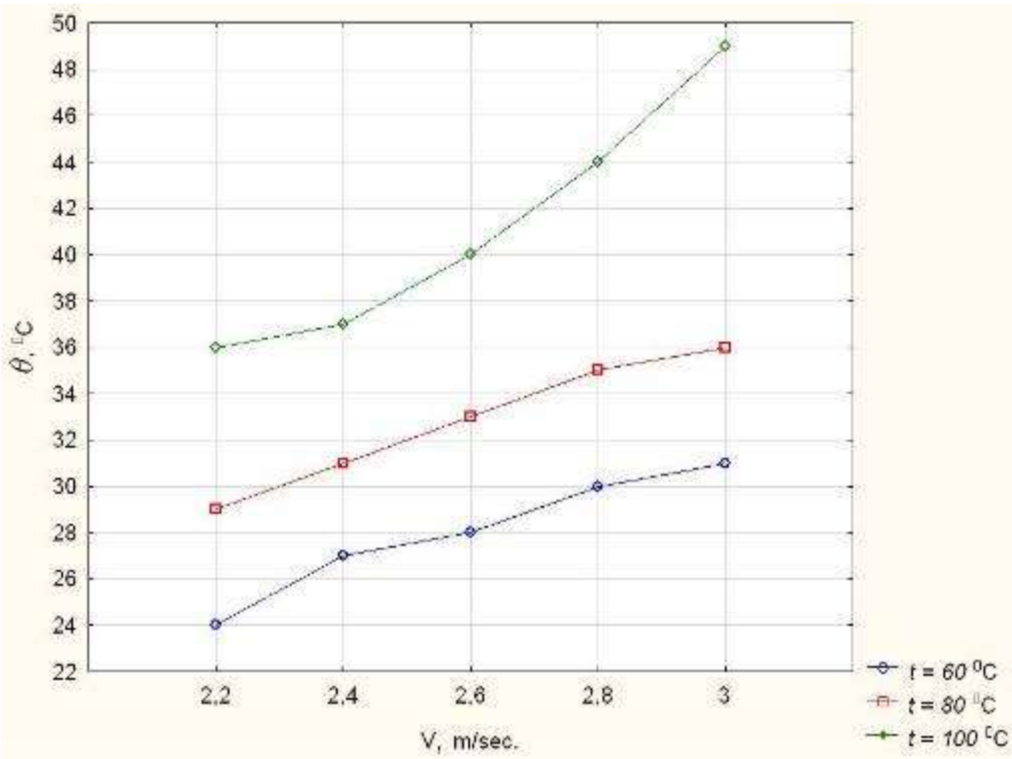

Fig. 5 – Dependence of grain temperature *θ* from filtering rate *v*

After substitution of the corresponding values of the main factors, factorial dependence of temperature variations of grain θ in grain dryer, is drawn (fig. 6).

Graphical interpretation analysis of the obtained data suggests that grain heating temperature increases with increase of temperature and drying agent rate. However their marginal values correspond to the following values: t = 100 ^0C . v = 3 *m/s*. Maximum drying time at different values is 600 *s*. Further increase of the concerned factors is unreasonable, because it will result in grain overheating and its quality deterioration.

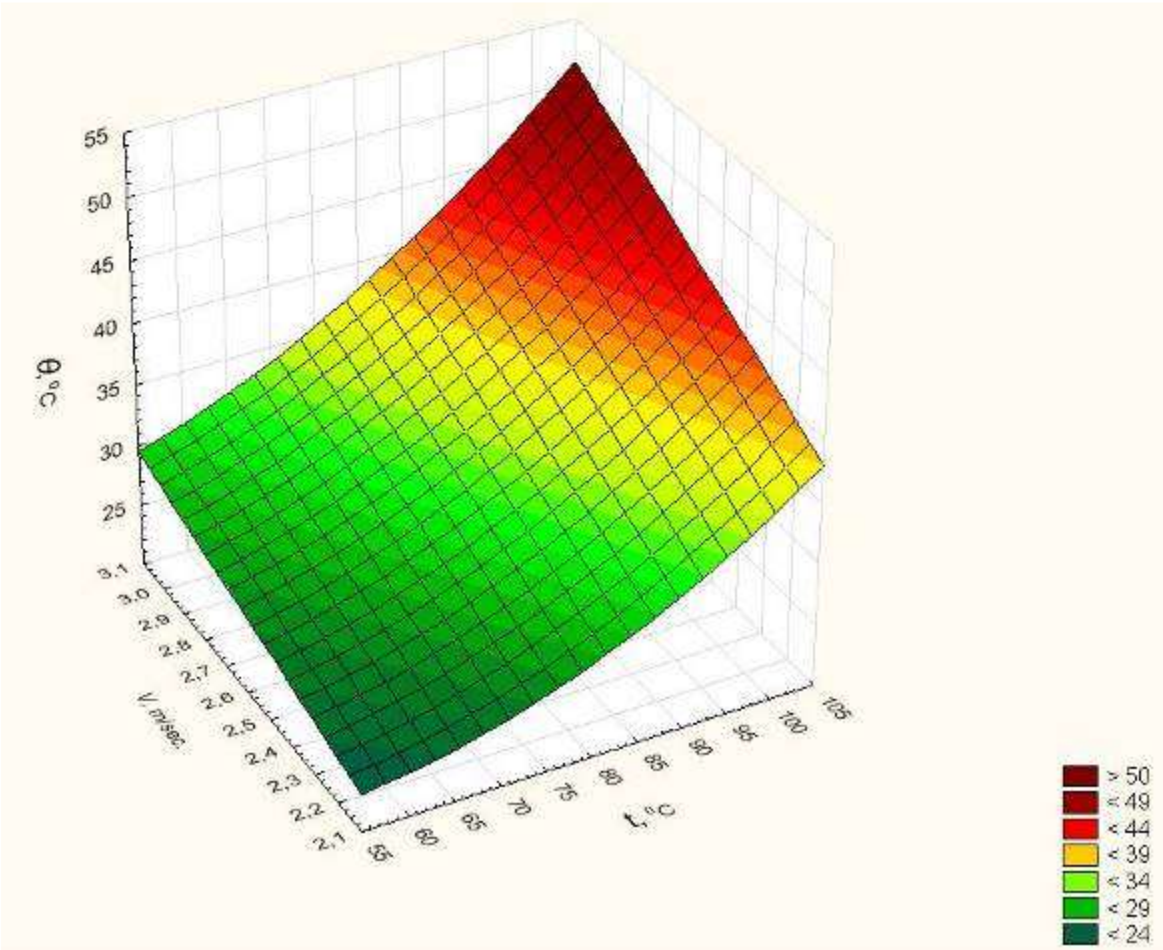

Fig. 6 – Factorial dependence of temperature grain heating with experimental dryer

CONCLUSIONS

1. On the ground of the laboratory research, practical guidelines to manufacture are developed: at grain drying in pseudofluidized layer, it is recommended to use drying agent with temperature up to 100 ^{0}C. Further increase of air flow temperature at seed drying of food and especially of seed designation is unreasonable because it will result in grain material overheating.
2. While designing grain dryers of pseudofluidized layer we should limit ourselves with the range of drying agent rates from 2.2 to 3 m/s.

Approval and validity

The result validity is proved with manufacturing tests based on Research and Education Production Center «Integratsia» of Federal State Budgetary Educational Establishment of Higher Education, “Orel State Agrarian University named after N.V. Parakhin" (Russian Federation). The tests provided drying up to normal amount of moisture and cleaning from light impurities of grain-thrashed heap. The tests were carried out at the place of postharvest treatment of grain material. On completing, the technological process of drying at unloading grain from dryer, caryopses with changed color or flavor as the evidence of their damage were not detected. The usage of the developed dryer allowed high quality grain drying after its harvesting at drying installation efficiency of 180...250 *kg/h*.

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INVESTIGATION OF EXPRESSION OF HIGH-MOLECULAR SUBSTANCES, AS THE CONSEQUENCE OF EXPOSURE TO LASER LIGHT ON THE ORGANISM EARTH WORMS OF EISENIA VENNETA
/
ДОСЛІДЖЕННЯ УТВОРЕННЯ ВИСОК-МОЛЕКУЛЯРНИХ РЕЧОВИН ЯК НАСЛІДОК ЕКСПОЗИЦІЇ ЛАЗЕРНИМ ОПРОМІНЕННЯМ НА ОРГАНІЗМ ЗЕМЛЯНИХ ЧЕРВ'ЯКІВ EISENIA VENNETA

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Keywords: soluble proteins, membrane proteins, substrate, bottom mud, radiation exposure.

ABSTRACT
The effect of laser light on the content of soluble fractions and a membrane protein in tissues of worms of parental forms and generation F1 of the species Eisenia venneta, was estimated.

Studies have shown changes in the protein spectrum in the tissues of animals of the F1 generation relative to the parent forms that were differently exposed to laser light.

ТЕЗИ
Зроблена оцінка впливу лазерного опромінення на вміст розчинних та мембранних фракцій білків тканин черв'яків батьківських форм та покоління F1виду *Eisenia venneta*. Досліджені зміни у білковому спектрі тканин тварин першого покоління порівняно з батьківськими формами. спричинені різним за часом лазерним опроміненням.

INTRODUCTION
The effect of laser radiation on living organisms, including on invertebrates causes the researchers' unrelenting interest. However, up to the present time there is no unified theory explaining all the effects that arises when it acts. It has been established that the effect of laser radiation of low intensities on biological objects is a stimulating effect on many physiological processes in the organisms of animals and plants (Karu. 2001). Red light is beginning to be acknowledged as an essential component of vermicomposting, bringing the worms to maximum effectiveness. There are many potential lighting options for large and small scale worm bins, depending on the size and depth. It was shown the benefits are connected with the colour of the light (Owa. *et al..* 2007). Other studies show similar results with earthworms either being more efficient because of red light, or all congregating towards areas with red light (Wu *et al..* 2011. de Souza *et al..* 2005. Lopes *et al..* 2009). Different factors affect the rate at which worms process the compost. There are the temperature. type of feed, moisture, oxygen availability, species of worm, pH, pests and lighting. The worm castings produced by this process are a mineral rich fertiliser and soil conditioner that enhance plant growth (germination, roots, crop yield), improve overall soil quality (aeration, microorganisms, water capacity) and even have broader environmental benefits (van Groenigen *et al.* 2014).

Key structures in cells and cellular organelles that are sensitive to the effects of laser radiation, are identified (Vladimirov. 1999). Laser radiation with a different exposure time can also be a promising tool for selecting and forming a new population of the *Eisenia venneta* worm. The new population acquires new qualities, including increased resistance to the transfer of adverse conditions. The genus *Eisenia* is the main captive breed of worms that belongs to the family *Lumbricidae* and differs from others in biological features and environmental requirements. Selection work with *Eisenia venneta* has noticeable differences from traditional farm animals and is exacerbated by the biological features of the species: the complexity of identifying phenotypes, hermaphrodites and, at the same time, the necessity of having a sexual partner for a normal reproductive process. The aim of the study was to study the dynamics of the expression of cytosolic and structural proteins of the *Eisenia venneta* population under the action of a geno-modifying factor-laser radiation (0.63 μm wavelength).

MATERIAL AND METHOD

The investigations were carried out at the Department of Biotechnology of the UDHTU and the Department of Biochemistry and Biophysics of the DNU. The tissues of invertebrate species of *Eisenia venneta* were used for the experiment.

Animals of the species *Enisenia venneta* from the tested population that did not reach the reproductive function in their development were presented and divided in equal amounts (20 individuals) into four experimental groups. Each group of earthworms was treated with laser radiation of the type LGN-208B (power - 1 megawatt). Exposure time for each group: 1 group - 5 minutes; 2 group - 15 minutes; 3 group - 25 minutes and 4 group - 30 minutes. These groups are the parent forms. Animals of each group in equal quantities (20 individuals each) were spread over two substrates: substrate 1 - bottom sediments (sapropel); substrate 2 - soil. Substrates for selection of offspring were checked twice a week. Generation F1, consisting of youngest samples was transplanted into similar substrates. All experimental groups of animals: parent forms: generation F1 and group control (without laser treatment) were kept at the same temperature ºC. humidity and substrate composition.

Adult individuals were selected during the experiment. The productive indices of the groups are as follows: the average weight in the control group is 190 mg,.the average weight of the special individuals, the irradiated groups contained on the sapropel substrate being 214 mg. The average weight of the individuals of the irradiated group contained on the soil substrate is 212 mg. Individuals opf which the tissues were selected from each group, were examined according to a standard procedure (Osterman. 1981)

The protein was extracted by homogenization in appropriate buffers with further centrifugation at 1500 revolutions. The soluble and membrane fractions were obtained. The soluble fraction was obtained by homogenizing the tissues of Enisenia venneta in 50 mM *Tris-HCl* buffer (pH 7.4). To extract the membrane fraction of Eisenia venneta tissues. the same buffer was used with the addition of *SDS* 1%. The total protein content was determined in wavelength 780nm. The sample buffer was added to the supernatant after centrifugation. Protein fractioning was performed in polyacrylamide gel with the addition of SDS. Gel plates were painted using Kumasi blue and scanned after electrophoreses with software “Alphèmager 2200”.

RESULTS

The basis for research in the field of population genetics is the processing and analysis of experimental data. which makes it possible to verify the hypotheses put forward and to discover new effects in the genotype of the population. At the same time, existing methods for recognizing high-molecular substances by gel electrophoresis of proteins under denaturing conditions, are based on approximate methods for comparing the contrast of electrophoregrams with a standard solution of known substances (Colman. 2000).

Studies of eartworml tissues on the presence of soluble and membrane proteins were carried out when they reached mature reproductive function (the presence of a girdle on the body).

The protein spectrum of the tissue samples under study is shown in Table 1.

Table 1

The proteins spectrums of the earthworm tissue samples under laser irradiation.

Studied group																	
Control (without exposure)		Parents forms								Generation F1							
Soluble proteins	Membrane proteins	Soluble proteins				Membrane proteins				Soluble proteins				Membrane proteins			
		Exposure. min.				Exposure. min.				Exposure. min.				Exposure. min.			
		5	15	25	30	5	15	25	30	5	15	25	30	5	15	25	30
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
F	F	F	F	F	F		F		F	F	F	F	F	F	F	F	F
G	G	G	G	G					G		G	G	G	G	G	G	G
H									H		H	H	H		H	H	H
I											I	I	I		I		I
											J				J		

It is established that the differences in the protein spectrum of the tissue samples under study are fixed by the presence in the *FI* fractions. *F* fraction of membrane proteins does not exist after irradiation for 5 and 15 minutes. Fraction of soluble protein *G* disappears after irradiation for 30 minutes. The same fraction is absent from the electrophoregrams of membrane proteins obtained at exposures of 5-25 minutes. The fraction of membrane proteins *H* and *I* appears after irradiation with a dose of 30 minutes, respectively.

Comparison of the protein spectra of parental forms and the generation of *F1* indicates the appearance of fractions of *H* and *I* soluble and membrane proteins in doses of 15-30 15.30 minutes, respectively. Fraction *J* is fixed in proteins of soluble and membrane proteins after irradiation for 15 minutes.

It was found a high molecular weight protein compound that belonged to the F1 generation with an exposure of 15 minutes.

Electrophoregrams of soluble and membrane proteins revealed by electrophoresis in animal tissues, a control group, a group of exposed laser light exposure 15 minutes and generation *F1* of this group are shown in Fig. 1 and 2. The graph for calculating the molecular weight of the unknown protein was constructed from electrophoretic mobility data and the logarithm of the marker protein masses. The logarithm of the protein mass and then the mass itself were found using the equation of a straight line. This was confirmed when processing the researched electrophoregrams with the AlphImager 2200 program.

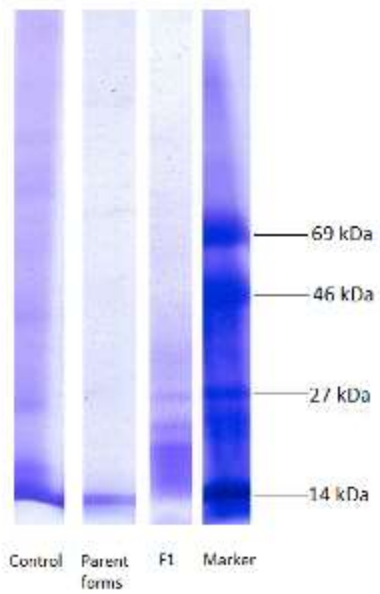

Fig.1 - Electrophoregram of soluble proteins

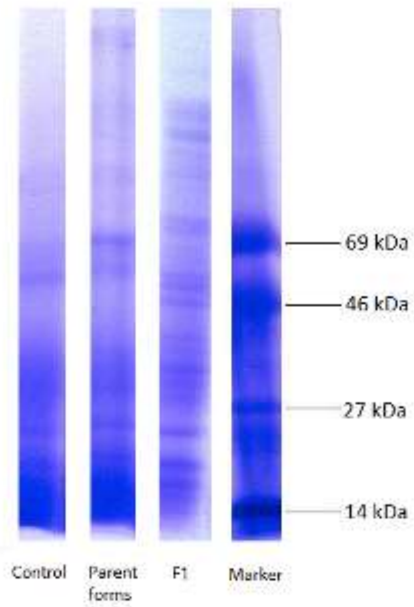

Fig.2 - Electrophoregram of membrane proteins

Comparing the tracks presented on the electrophoregrams: control - proteins of non-irradiated animals with tracks F1 - proteins of the first generation of worms irradiated by exposure for 15 minutes visually see the difference in the spectrum of proteins, both soluble and membrane fractions. A new protein with a molecular weight of 16.4 kDa was found in groups of F1 animals that are descendants of parental forms irradiated with a laser with an exposure time of 15 minutes

CONCLUSION

Comparison of the protein spectra of parental forms and the generation of *F1* indicates the appearance of fractions of *H* and *I* soluble and membrane proteins in doses of 15-30 15.30 minutes, respectively. Fraction *J* is fixed in proteins of soluble and membrane proteins after irradiation for 15 minutes.

It can be assumed that a new high molecular weight protein compound, which is found in the tissues of the *F1* generation worms (exposure time of 15 minutes) was not detected by the program on the remaining electrophoregrams. It is the result of the action of the laser of *F1*. manifested in generation, as a genetically modifying factor.

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MECHANIZATION OF PLANTING WORKS IN DEFORESTED AREAS FOR REHABILITATION AND INCREASING SOIL STABILITY
/
MECANIZAREA LUCRĂRILOR DE PLANTARE ÎN ZONE DEFRIȘATE, ÎN VEDEREA REABILITĂRII ȘI CREȘTEREA STABILITĂȚII TERENURILOR

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Keywords: *forestization, degraded lends, lend rehabilitation, soil stability*

ABSTRACT

This paperwork presents the mechanization technology of planting works adequate degraded areas and regions where the destruction phenomenon of forests through uncontrolled cuts, has resulted in soil degradation with negative ecological and economic impact. Taking in to consideration climate change with extreme weather events (high precipitations in short periods of time accompanied by wind intensifications) and generates massive mass destruction and uncontrolled and unpredictable natural disasters. From this point of view, urgent measures must be taken in order to reduce and stop the land deterioration by carrying out reforestation works in accordance with the pedological requirements of the affected area. The technology described corresponds to the technological conditions specific to the process of afforestation and mechanized planting of green infrastructure in these areas during the optimum agro-technical period in order to ensure a high percentage of harvesting of the juveniles.

REZUMAT

Lucrarea de față își propune prezentarea unei tehnologii de mecanizare a lucrărilor de plantare adecvată zonelor și regiunilor degradate, unde fenomenul de distrugere al pădurilor prin tăieri necontrolate, a avut ca rezultat degradarea solului cu efecte negative în plan ecologic și economic. Având în vedere schimbările climatice cu manifestări meteorologice extreme (precipitații ridicate în perioade scurte de timp însoțite de intensificări ale vântului) generează distrugeri materiale în masă și dezastre naturale necontrolate și imprevizibile. Din acest punct de vedere se impun măsuri urgente de diminuare și stopare a gradului de deteriorare a terenului prin efectuarea lucrărilor de reîmpădurire în concordanță cu cerințele pedologice ale zonei afectate. Tehnologia descrisă corespunde condittțiilor tehnologice specifice procesului de împădurire și plantare mecanizată de infrastructură verde în aceste zone, în perioada optimă agrotehnică pentru a asigura un procent ridicat de prindere a puietului.

INTRODUCTION

The mechanization planting technology presented in this paper is dedicated to afforestation of degraded areas and in areas where the phenomenon of forests' destruction through uncontrolled cuts led to soil degradation, with ecological and economic negative impact. These deforestations produced climatic changes, accompanied by extreme weather events (high precipitation in a short period of time, accompanied by wind intensities) generate mass destruction, uncontrolled and unpredictable natural disasters. For these reasons, it is necessary to take effective measures to reduce and stop the land deterioration, by carrying out reforestation works according to the soil requirements of the affected areas.

The current state of development of degraded land technologies for afforestation is nowadays at the begging because its working conditions are heavy and presents high risk, and due to that is indicated to use manly human working force. Among the rehabilitation actions and measures of forest areas are afforestation and reforestation on medium and long term, as well as non-productive areas outside the forest fund. The works that are included in afforestization technology are: green infrastructure establishment in degraded and deserted lands; management activities to maintain the wood mass at the level of their support with the forest plantations and green infrastructure regeneration of forest vegetation on non-productive land.

The correct establishment orientation has an important role in degraded slope sites, compared to its cardinal points. North mountain sides, being less sunny, can provide good conditions for vegetation development and will exhibit less soil erosion. The south sides that have the same inclination has more pronounced erosion, due to the fact that in the spring, after a more pronounced exposure of the sun, the snow will suddenly melt favouring the surface leakage with a high flow, thus enhancing the erosion phenomenon. Taking into account these phenomena, appropriate specific measures can be taken to reduce the erosion phenomenon and restore fertility, and the production of wood material will not only be stable, but economically also.

In terms of ***precipitation***, namely their quantity, distribution and intensity are another important factors to be taken into account in the soil erosion process. The most severe erosion processes usually occur when rainfall fall in large quantities in a short period of time. Following these findings, the vegetation carpet - the forest and grass vegetation - is a major role in combating soil degradation. Forests are the best natural regulator of precipitation, by intermingling it between soil and rainwater. The water absorbed by the vegetation is then gradually released to the soil and infiltrated part is absorbed by the strains. In this way the leakage is small, although the initial precipitation amounts are large.

The diagonal planting schemes diminish very much leaks and erosion risks, also the same rule can be used for level curve. An important role has also the forest engineer, because must be made a detailed analysis of the rehabilitated area, in which is taking into account the topography of the area (the relief), erosion stage, soil fertility, autochthone vegetation, precipitations, annual temperatures and so on.

MATERIAL AND METHOD

The researcher from National Institute of Research - Development for Machines and Installations Designed to Agriculture and Food Industry - INMA Bucharest, had developed an innovative technology for reforestation of degraded lands in slope. The technological afforestation process realized by this innovative technology is suited to heavy working conditions, namely degraded lands, and for this reason it is necessary to comply with technical and safety requirements.

The innovative afforestation technology of slope degraded lands, corresponds to the real need for technical equipment in degraded areas (with 15 º slope), for green infrastructure establishment or rehabilitation, respectively the forests re-establishment, in order to increase the soil stability and ecological value, to eliminate the pollution sources, to reduce the natural calamities risks and so on. The technology can also be used on other land categories with a minimum width of 1 m.

The innovation degree, consists in the fact that a number of equipment's adapted to the heavy working conditions (such as soil quality, reduced working distance, inclination of the counter slopes and so on) have been powered by a 19 HP motocultivator, such as horizontal milling cutter for total processing, counter-slope blade, augers for generating planting holes, as can be seen in Fig.1.

The main part of this technology is the BERTOLINI moctocultivator that is used as an energy source, which works in aggregate with a series of innovative equipment's designed to work degraded soils, such as: ***Horizontal soil Mill*** – FM to increase soil granulation, ***Leveling Blade*** - LM to model counter-slope terrace surface and ***Drilling power by Motocultivatour*** - BM to generate planting holes.

The afforestation process, must be appropriate to degraded land working conditions, must be made in a certain sequences:

- The FM equipment makes the first working operation and has the role to granulate the terrace soil and de – compaction and it is made from a horizontal rotor on which are placed L-shaped curved blades, made of manganic and silicon alloy steel;
- The LM equipment makes second operation and generates the terrace counter-slope, and removes the exploitation bumps. The leveling blade is equipped with a double-edged knife and several positioning indexing systems on longitudinal side, inclination and high.
- The BM equipment has the last part in this process, namely the hole planting generation that can be made by augers that have dimensions (lxLxH) of 0.3x0.3x 0.3 m and 0.4x0.4x0.4 m, those two augers are realized in order to have one to plant seedling with nude roots or with earth bale roots. For this operation it is required two operations, one to command the motocultivator and the other one directs the auger. The drilling mechanism has a guidance mechanism so that the planting hole to be in the upright position.

Sometimes the earth mill can be introduced after the terrace modeling in order to increase the water and mineral solution permeability in order to rich the rooting system and their absorption. In this way the green infrastructure development can be developed on surface and also on underground.

Fig.1 - Innovative technology for the afforestation of degraded slope lands.

The technologic adjustment that can be made for each equipment are described in the next paragraphs.

The horizontal soil mill, named FM, because it powered by the motocultivator PTO has two working parameters. The ***working depth*** is adjusted by tilting the coverage center (1) by removing the bolt (2) and moving the perforated rod (3) to another hole, depending on the ground type, see Fig.2. The ***soil shredding grade*** can be made by adjusting the position of the movable coverage near to milling cutter by pushing the adjusting rod (4) towards the power socket and change its position by compressing the spring (6) which ensures that the working position is maintained to the working position through the position bolt (5), see fig. 3.

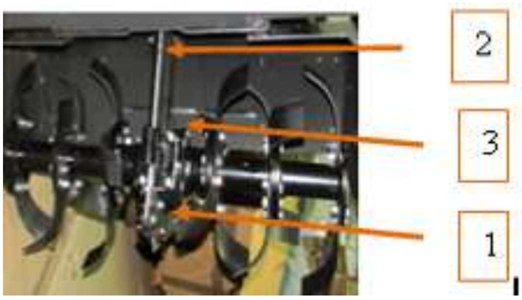

Fig.2. Adjusting the working depth
1 – mill coverage, 2- bolt; 3- performed rod

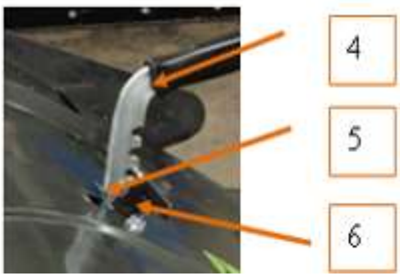

Fig.3 - Adjusting the shredding grade
4- handle, 5 – bolt, 6- compression spring

To work correctly with the milling cutter, must be proceed as follows: engage the milling at the rated speed when it is raised, after which work is effectively started with the milling cutter progressively keeping a steady speed. In this way, active organs are protected from shocks that can damage them prematurely.

Leveling Blade, named LM, is trailed by the motocultivator and has now powered elements.

The ***left and right inclination adjustments*** to the movement direction, in this way the soil is moved the ground from left to right terrace side on the forward direction. In Fig.4, can be seen one of blade indexing system, the leveling blade on which is weld an indexing plate (1) that revolves on a central ax positioned on a positing arm (2) and is fastened by an elastic safety bolt (3).

The ***inclination angle in the transverse plane*** - represents the angle of inclination of the terrace counterpane and is performed in order to retain the water from the precipitations and the upstream materials. The working position is ensured by positioning the bolt (4) in the corresponding holes on the indexing plate (5) with the wing nut (6).

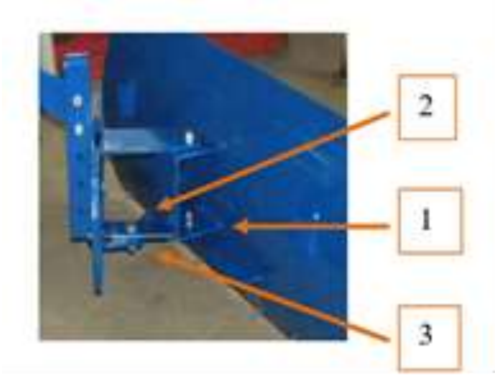

Fig.4 - Adjusting the left-right tilt angle to the direction of movement
1 - indexing plate; 2 - positioning arm;
3 - pin with elastic security peg

Fig.5 - Adjusting the angle of inclination in the transverse plane
4 – indexor screw; 5 - indexing plate;
6 - wing nut;

Drilling power by Motocultivatour, named BM, present an indexing position system of the auger in order to generate vertical holes, the gear box positioning plate (1) is rotated and position on a certain angle using a screw and a nut (2, 3), as it is presented in Figure 6. The ***drilling depth*** can also adjusted and maintained during the afforestation process, by a stroke limiter (4) that is placed on the first or second opening (5) respectively at 300 mm and 400 mm, see Fig. 7.

Fig.6.- Adjusting the angle of inclination of the left-right drill bit maximum 30 ^{0}.
1 - positioning system; 2 – screw ; 3 - nut;

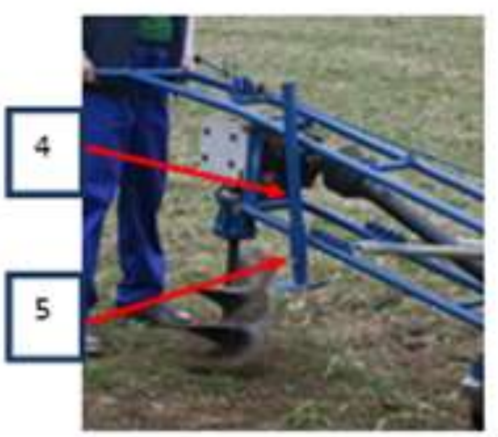

Fig.7.- Adjusting the working depth of the drill
4 – position stopper; 5 - assembly elements;

The drilling proces is achieved by auger own weight and by operator force. For heavy soils that have in general high drilling resistance, the operator will apply a superior force but the auger speed will be reduced, because can be realised work accidents. For light soils - with low drilling resistance, the auger can work at maximum speed but the operator must pay attention to the auger position and in this case hase a higher drilling perforamance. In this case the auger will be provided with smooth cutting edge and in the first case (havey/degradated soils where can be present pices of stones) knife-type blades will be used.

The safety power transmision coupling included in the drill transmission protects the PTO for hard objects (stones, roots and so on) that could be incorporated in soil. If the drill encounters such bodies, turn it off and remove it from the ground. It is not allowed to tightening the coupling discs because it cause accidents. The productivity of the drilling equipments depends on various factors such as: soil type, the pit diameter and depth, the terraine slop and dimensions.

The afforestation process is appropriate to working conditions for degraded land and meets the following requirements:

RESULTS

In this chapter will be presented the experimental research data of BM equipment because is the most important element that presents a high innovation level. In table 1 was centralized the energetic parameters.

Table 1

Energy indices

Energy indices	**Drill diameter**			
	300 mm		400 mm	
	0º	15º	0º	15º
Actual time needed to dig a hole [s]	13	14,3	13,5	14,5
Number of holes realized in an hour [holes/hour]	272	261	265	245
The amount of ground actually dug in a minute [Kg/min]	547	525	582	596
Fuel consumption per hour [l/100 holes]		2,7-3		3,5-3.8
Max power consumed at power outlet [HP]		13		15

From the data presented in Table 1, it has been found that with the increasing inclination of the field's slope, the number of holes decreases, irrespective of the diameter of the drill used. The amount of ground ditched for diameter D 300 mm decreases slightly with increasing inclination of the field's slope, unless the diameter of the drill is D 400 mm, when it rises.

Thus, as the diameter of the drill used is higher, the larger is the amount of ground dredged. It is also noted that for the same drill diameter, the time required to drill a hole increases insignificantly with increasing slope inclination, and for different drill diameters the time differences are insignificant.

Table 2

Qualitative work indexes

Qualitative work indexes	**Drill diameter**					
	300 mm			400 mm		
	The slope of the land					
	0º	15º	20º	0º	15º	20º
The average diameter of the hole [mm]	337	335	331	425	425	425
The average hole depth [mm]	360	340	330	451	432	410
The average value of the maximum spread of soil [mm]	356	540	530	435	660	850
The amount of soil left in the hole [%]	4,6	4,1	5,3	11,5	11,7	8,7

For those two augers the mean hole diameter is almost identical regardless of the inclination of the field's slope, and the mean depth of the hole drops slightly with the slope increase.

The average value maximum spreading of the soil increased significantly with the increase inclination of radius the field's slope of D 400 mm, and for a smaller diameter of the drill, the maximum radius increases up to the inclination of the slope of 15 °, after which it decreases.

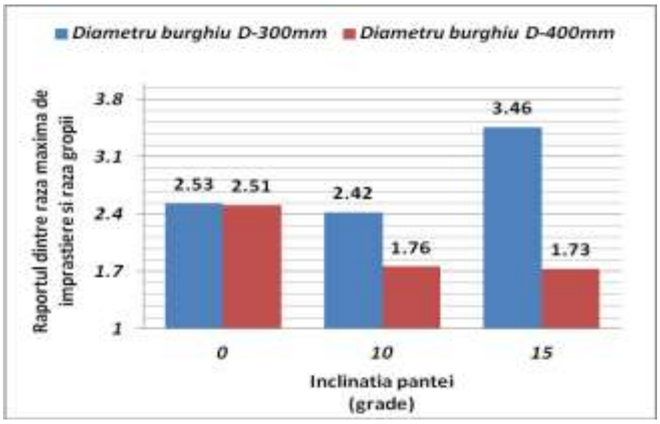

Fig. 8 - The ratio between the maximum scattering radius and the hole radius, depending on the slope inclination and the drill diameter

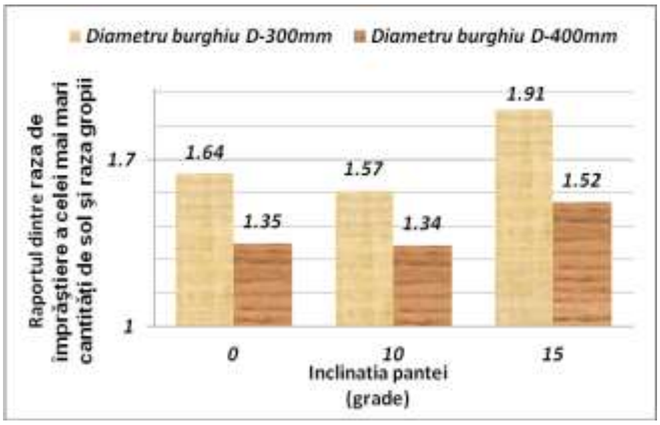

Fig. 9 - The radius ratio of the largest scattering soil quantities and the hole radius, depending on the slope inclination and the drill diameter

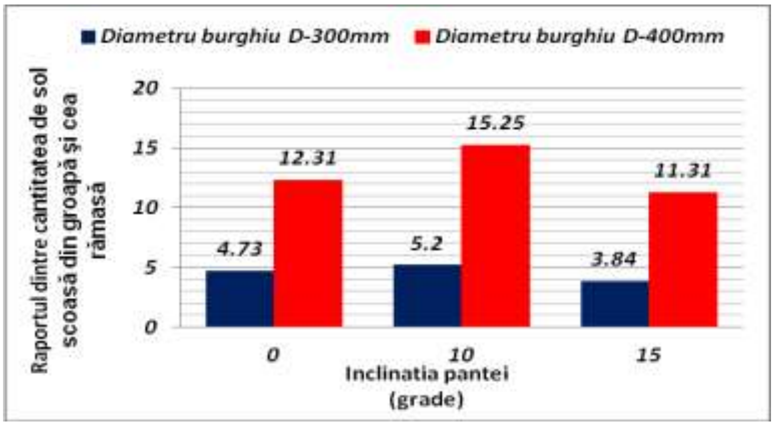

Fig. 10 - The ratio between the amount of soil removed from the hole and the remaining one, depending on the inclination of the slope and the diameter of the drill used

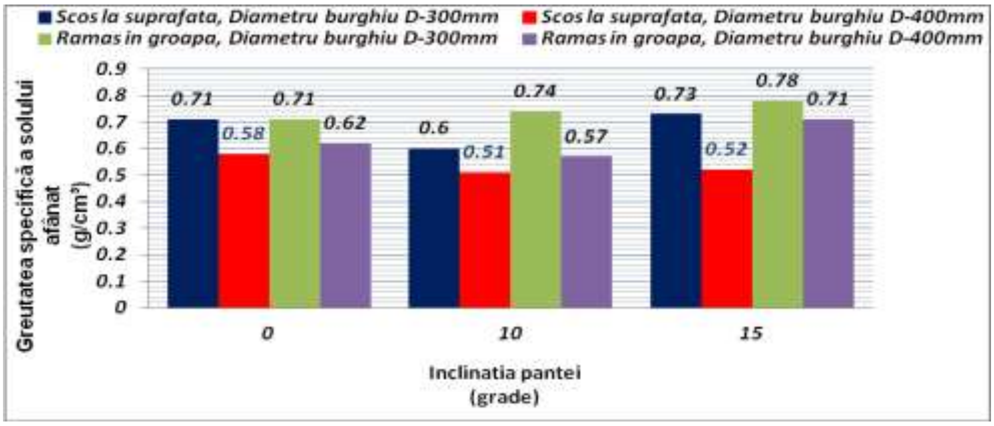

Fig. 11 - Specific weight of loose soil [g/cm³] depending on slope inclination and drill diameter

One respected condition is that the equipment's gauge used both for trailed but also powering the active elements, respectively: the soil preparation milling machine, the leveling blade and the drilling equipment, must have small gauge but are powered by a strong motocultivator that has the capacity to avoid the drawbacks caused by the deterioration of the terraces made on the sloping terrain.

CONCLUSION

The innovative afforestation technologic process is appropriate to work in degraded land and meets the following requirements:

- preparation of degraded soil on the terrace:
  - soil de- compaction and shredding for reduced working surfaces;
  - working widths and depths are appropriate small terraces, respectively 0.6 ÷ 2 m and 6 ÷ 25 cm.
- leveling degraded soil and counter-slopes generation:
  - soil modeling and leveling in accordance with climatic conditions;
  - removal of operating pitches bigger then + 25 cm;
  - the leveling blade can be easily adjusted in accordance with technological working conditions using two position indexing systems that can be combined (working length, inclination angle, number of passes and so on).
- execution of specific planting holes:
  - the planting holes generation for nude seedlings (lxLxH) 0.3x0.3x 0.3 m on processed soil;
  - the planting holes generation for bale seedlings (lxLxH) 0.4x0.4x0.4 m on processed / grounded soil;
  - planting in holes of seedling raised or placed saplings in containers (polyethylene bags and so on).

The advantages of this innovative technology are: earth processing equipment's with reduced gauge that can be easily interchangeable powered by a powerful motocultivator; low human resources and secure working conditions (avoiding terraces deterioration in varied environmental conditions).

The objective of this project that has been sucesfuly ended is to :

- reducing construction costs by 60% compared to planting on terraces supported by fences;
- reducing labor costs by approx. 30% compared to classical technology;
- increased productivity by approx. 30%;
- reducing the operator's effort and the working time required to carry out the work;
- increasing the number of economic agents and people benefiting from the results of this highly innovative project;
- high degree of adaptability to different soil types and agro-technical requirements of saplings;
- the technology can be adapted to a wide range of rehabilitation works for degraded land (alluvial, landslides, clogs and so on);
- increasing employment in rural communities, disadvantaged and degraded areas and so on;
- reducing the pollution of environmental factors (air, water, soil) through controlled rain, dust and wind management with beneficial effects, to improve the health of the population;
- encouraging landowner of degraded sloping lands to move away from the forest, implement innovative technologies for their rehabilitation and stop erosion and landslides;
- improving the climate effects, restoring biodiversity in the affected areas and combating the expansion of soil degradation phenomena (desertification, landslides, erosion and so on)
- recovery of degraded sloping land by the planting valuable species of shrubs and trees, resistant to a heavy climate, with vigorous growth and yield of the more valuable wood material with a high regeneration ability and resistance to pests.

ACKNOWLEDGEMENT

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STATE OF THE ART IN RESEARCH REGARDING TO SEEDLINS PLANTED EQUIPMENT
/
STADIUL ACTUAL AL CERCETARILOR ECHIPAMENTELOR DE PLANTAT PUIETI

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Keywords: *seedlings, planting equipment, arm, operator.*

ABSTRACT

The importance of trees in our lives and the environment is invaluable. Unfortunately, the life cycle of these trees is limited by the destructive footing of nature, people, the economic environment, etc., which is why planting saplings is a necessity. This is normally done with specialized planting equipment that replaces manual planting, leading to an increase in planting speed and economic yield. In this paper there are presented some aspects regarding the constructive solutions of planting saplings currently used for afforestation, forest protection curtains, tree nurseries, etc.

REZUMAT

Importanta copacilor in viata noastra si a mediului inconjurator este nepreţuită. Din păcate, ciclul de viaţă al acestor copaci este limitat de foţa distructivă a naturii. Oamenilor, mediul economic, etc., fapt pentru care plantarea puietilor reprezintă o necessitate. Acesta se realizează în mod normal cu ajutorul unor echipamente specializate de plantat care înlocuiasc plantatul manual, conducând la o crestere a vitezei de plantare si a randamentului din punct de vedere economic. In această lucrare se prezintă câteva aspect privind soluţiile constructive de echipamente de plantat puieti folosite in prezent pentru impaduriri, perdele forestiere de protectie. pepiniere de pomi. etc.

INTRODUCTION

The forest is an extremely complex structure with an essential activity in the regeneration of nature, it contributing alongside the seas and oceans to maintaining atmospheric gases in a life-friendly proportions. Thus, one hectare of forest fixes annually between 6 to 10 tons of carbon dioxide and releases between 12-20 tons of oxygen and essential oils which are beneficial to the human and animal respiratory system. Forests have an environmental role in environmental protection, so 50% of Romania's forests are classified as water, soil and climate protection categories. Under the natural conditions specific to our country, the main cause that generated much of the degraded land is the massive reduction of the surfaces. (Almasan et al.. 1981; Draghia et al.. 2010). To this is added the inadequate use of large areas of land after removing the protective shield of the forest. All these aspects, taken as a whole, led to the adoption of national strategies harmoniously framed in the global and European strategies, for the rehabilitation of the forest fund for the sustainable management of forests.

Thus, in our country after 1989 the forest fund has undergone important changes due to the massive and uncontrolled cuts of the forests that led to erosion and landslides, the increase of the flood danger. In order to prevent this situation, the measures that can be taken in this respect are the forestation and reforestation in the medium and long term of the forest land. Currently, the total area of Romania's national forest fund is approximately of 6.5 thousand hectares. Areas covered by forests account for over 97% of the national forest fund. The distribution of forests on relief forms is the following: mountain 59.70%. hill 33.80%. plain 6.50%. (Costache et al. 2010). The largest wooded areas are in the mountains and hills, where mechanized possibilities are currently restricted. However, saplings with mechanized means are well suited to the establishment of forest protection pads which are mostly located in areas with low terrain and therefore mechanized planting is the most recommended and much more economical. Planting involves the use of saplings as forestry material and is the most commonly used forestry method in our country, in over 98% of the area forested annually in the last decades. (Ianculescu et al.. 2007).

Advantages of installing wood species through plantations are numerous:

- in some cases planting is the only possibility of artificial vegetation installation;
- seedlings ensure, in many situations, better crop success, from the first year of planting;
- crops are more resistant to adversities than those obtained by direct seedling due to the size of saplings used in planting compared to plants produced by direct seedlings;
- plantations can be made in the most varied conditions, on inclined terrain, in arid areas, on fields exposed to solar radiation, in cold and windy resorts, on fields with very abundant grass vegetation;
- seed economy is achieved compared to direct seed;
- in the first year of installation, planted seedlings are rarely exposed to deforestation compared to those obtained by direct seedlings;
- in many species, planting is easy and ensures good success;
- some species can not be installed by direct seedlings, frequently occurring in plantations (Euro-American poplar, selected willow. etc.).

Plantations also have some disadvantages:

- Saplings transplantation is a critical moment in their lives, primarily through the physiological imbalance that may arise between the water absorption capacity of the soil (the juvenile juice has a small volume of roots) and sweating, the airborne part not suffering from major transplantation (Draghia et al.. 2011).
- Planting saplings are intended for mechanization of the works of setting up crops by planting in lands with pre-prepared soil, chopped and devoid of crows, vegetal remains and weeds. Mechanized planting can be done on unprocessed land or on partially or totally processed land. In unprocessed land the saplings are planted in pits made with tractor-driven drills (fig. 1) or with specialized drilling equipment (fig. 2).

Fig. 1 - Drilling machine for drilling holes mounted on tractor[13] **Fig.2 - Drilling pits equipment** [13]

Specialized planting machines are used for planting (fig.3). Saplings are designed for the mechanization of planting works by planting in set land with pre-ground, loose and weed-free soil. A planter is generally composed of: a frame to hold the knife, the coulter, the compaction wheels, the operator's seat, and the brood-stocks.

Fig.3 - Planting machine in working [14]

The importance of the article is due to the necessity of approaching the problems related to the mechanized planting of the saplings. due to the necessity of the restoration of the forest fund and the creation of protection curtains in Romania. Increasing the degree of mechanization of forestation works leads to the reduction of labour force demand, labour productivity and the achievement of high quality indices.

For the next period an increase of the area occupied by forest vegetation is foreseen, through forestation in degraded lands unfit for agriculture and by forestation in order to achieve the National System of forest protection curtains.

MATERIAL AND METHOD

At present there are several types of seedlings that consist in principle of a planting device that is behind a tractor, where an operator destroys the saplings one by one in the planting system of the saplings, which then arrives one at a time at an equal distance between them in a sufficiently wide and deep ground opening, made by a disk-shaped wheel, followed by a broader and finally two wheels which are fixed at an angle to force the furnace to close around the brood and gather the soil around it (Fig. 1). Some equipment also has a herbicide application device. The weight of the operator helps in some variants of planting saplings to appropriate soil compaction. (Zbârnac et al.. 1986).

Saplings planting equipment is of three types as tractor attachments: carried (with three-point attachment, the machine can be raised from the ground via the hydraulic system of the tractor), semi-trailer and towed. In order to obtain a quality forestation, the following steps must be taken: preparation of the land, selection and care of planting material, planting and sowing after sowing.

Saplings planting in their composition are of various shapes: prismatic with sharp tip, prismatic with obtuse tip, flat disc with flat discs, etc., the sapping devices being of the type with adjustable blades for use with devices of the type with metal drums with wheels with tires arranged at a certain angle.

The planting apparatus can be rigid, chain-mounted, track-type or elastic discs. From the point of view planting, equipment is of the following type:

- which only open gullies in prepared ground and planting is to be done manually;
- opening gullies in prepared ground and executing planting with a manual feeding plant;
- opening gullies in prepared ground and performing planting with a semi-automatic power plant;
- opening gullies in prepared ground and performing planting with an automatic feeding plant;
- which processes the land in 0.6m strips at a depth of 0.35-0.40m. with simultaneous planting and manual feeding of the plantation. The planting apparatus speed varies depending on the field conditions, the variety and size of the seedlings, the operator's expertise and experience, reaching a figure of between 400 and 1000 seedlings per hour.

RESULTS

As planting-sowing operation is generally performed with one equipment, it is almost always necessary to make a ditch, trench, or pits followed by the planting of the juvenile itself and that the success of the planting depends to a large extent on the operation of the dwelling for the juvenile for which we will present some of the equipment that performs this operation. Equipment must be presented because many of their work parts are also found in the machinery and planting equipment component (Wangyuan et al.. 2016). For the implementation of the afforestation techniques, a wide range of machinery and equipment is required; the best known in the field of this equipment being a series of companies specialized in the field of: Finland, Austria, Germany, the Czech Republic and the United States.

In the planting equipment, sowing directly into the furrow (Figure 4), the operator puts the seedlings directly into the furrow. in Figure 5 there is presented a model of planting equipment comprising a mechanical arm that distributes the sowing into the furrow, the operator putting the seedlings on the planting arm.

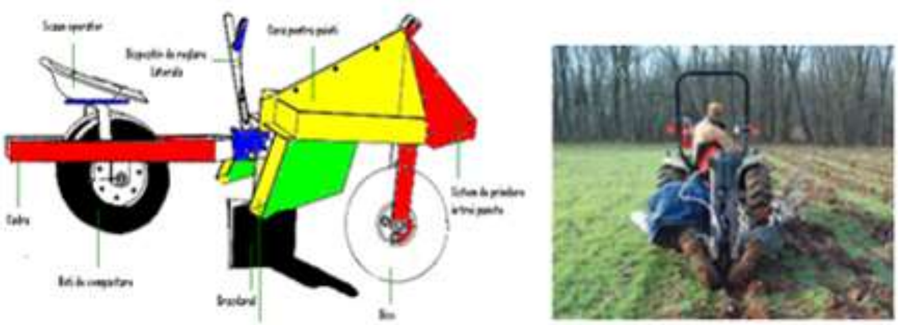

Fig. 4 - Equipment for direct planting in furrow [9]
a) draft b) view

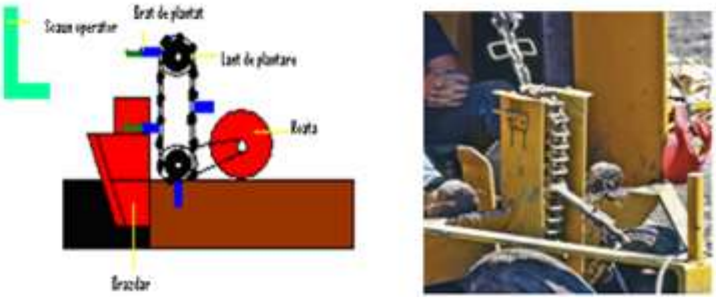

Fig. 5 - Equipment for planting with chain [9]
a) draft b) view

Figure 6 shows another constructive variant used to obtain high seed density and Table 1 presents some technological requirements.

Table 1

Technical parameter	**Distance among rows [m]**	**Distance among plants [m]**	**Furrow planting**		**Seedlings**	
			Furrow width [mm]	**Depths furrow [mm]**	**Variant 1**	**Variant 2**
Technical require	1.5	1	200-300	300-400	Furrow height >1m The diameter of a root yarn>2 mm	Seedlings height >0.8m The diameter of a root yarn>2 mm

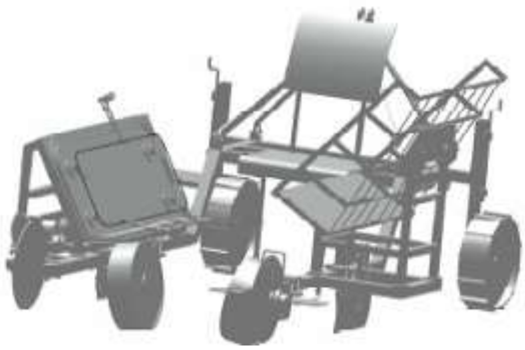

Fig 6 - Planting equipment with mechanic automatic arm [10]

The technical characteristics of this sowing plant are: length - 2017 mm. width - 1214 mm. height - 965 mm. weight - 210 kg.

Figure 7 presents a sketch of saplings planting equipment which comprises the following: 1 - frame. 2 - seat. 3 - sowing support system. 4 - coating wheels. 5 - disc. 6 - peasant. 7 - seed pots. 8 - Depth adjustment device. 9 - Transmission system. 10 - Automatic mechanical arm

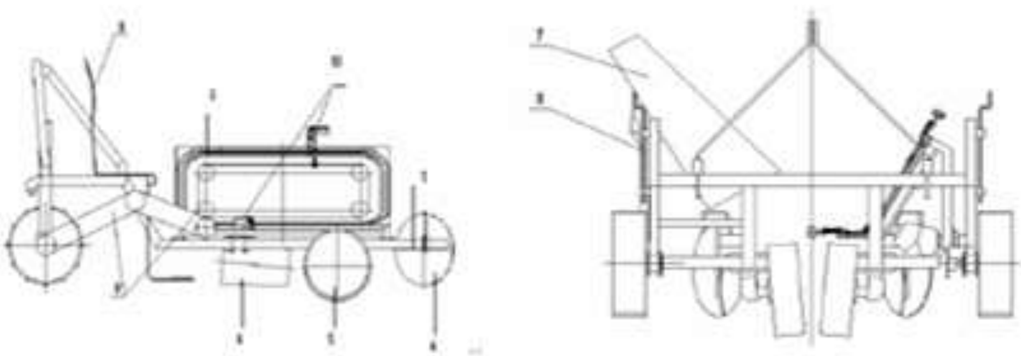

Fig. 7 - Parts of automatic planting equipment [10]
a) lateral view; b) back view

The automated mechanical arm part of the various variants of planting seedlings is designed by simulating the human hand gripping mechanism. in Figure 8 there is presented a model of such arm consisting of the following components: 1 - chain grip. 2 - upper roll . 3 - arc. 4 - connecting rod. 5 - upper truss. 6 - brood. 7 - lower truss. 8 - lower cylinder.

Fig. 8 - Automatic mechanic arm [5]
a) Mechanic automatic arm view; b) The kinematic scheme of the mechanical arm

Another constructive variant of the saplings plant (Figure 9) is the elastic disc version.

Fig. 9 - Equipment for planting saplings with elastic discs [14]

Disc harrows are made up of two elastic discs that by rotation will reach a portion of the length of their tangential circumference due to the construction variant, either by rollers or by the tilting of the trees that support and trains the discs.

The Egedal Hydromatic type machine (fig. 10) - is a machine equipped with an anchor-type coulter and inclined wheels for grounding and compaction around the planted juvenile. Compared to the models presented so far, where the operator introduces the juvenile into the gully in a position and at a random depth, with the disadvantages of the unevenness of the resulting plantation, in this model the juvenile is positioned in a planting mechanism with arms and tweezers that make the placement of the brood in the gutter. The advantage of machines of this type is that it allows achieving an increased precision for depth and planting distance between seedlings per row.

Fig.10 - Egedal Hydromatic machine type [13]

The RPK-S type machine (fig. 11) - is intended for planting small saplings on two rows, it is of the type worn on power tractors ranging from 45 ... 65CP. It has as an operating tool an anchor type coulter for opening the drain at a depth of approx. 20 cm.. Gully where the seedlings are automatically placed, then covered with soil by means of two finishers. The planting mechanism is made up of an easy-to-demolish barrel, in which the seedlings are manually placed, a chain conveyor equipped with juveniles and the transmission. During operation, each wing on the cover disc acts on the seedling drum and rotates it one step, while a chain palette takes the juice and carries it to the rig where it is released.

Fig.11 - RPK-S machine type [9]

In Romania, most forestry afforestation and forest maintenance works are executed manually, with high human labor consumption and expensive expenses. In our country, at INMA, was made the MPF1 forest seedlings plant (Fig 12a) made in a compact form, being of carried type designed for fixing in 3 points. It consists of: frame (1); transport train (2); coulter (3); planting mechanism (4). compaction wheels (5); the hydraulic installation (6); saplings (7); tractor triangle (8).

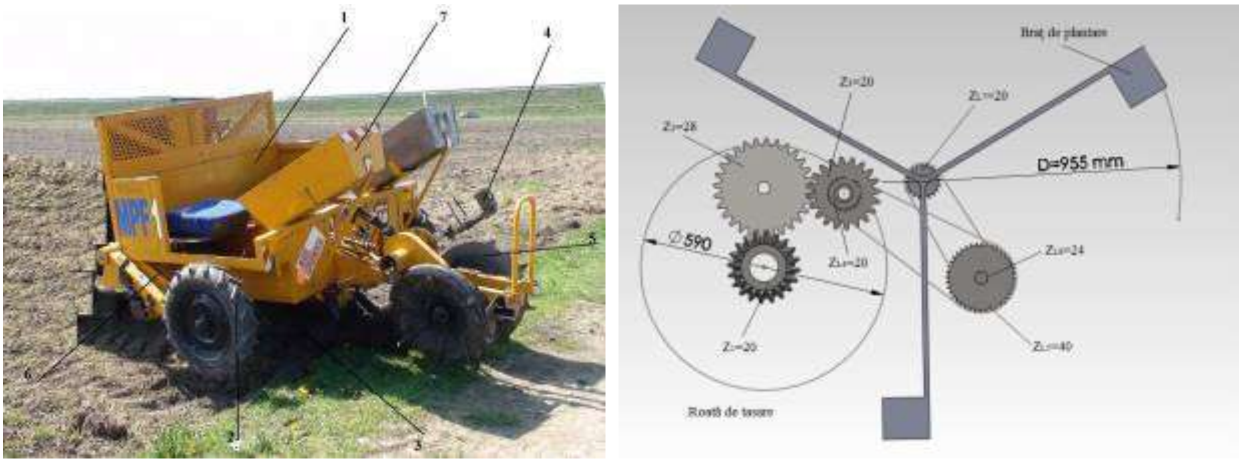

Fig. 12 - MPF1 seedlings planting machine [3.4]

a) Overall view of MPF1seedlings planting machine b) The kinematic scheme of driving the planetary arms

The planting machine MPF1 is made up of a disc on which the blades are mounted. The theoretical peripheral velocity of the planting arms is determined from the kinematic drive scheme (Figure 12b), starting from the drive wheel, transmission and finally the planting arm.

For ideal operation, the peripheral speed of the juvenile root should be equal to the feed rate of the aggregate or to the peripheral speed of the drive wheel so that when the brood is released into the soil the difference between the two speeds zero, while the drive wheel runs without skidding, thus ensuring a position as close as possible to the vertical of the planted juvenile. while respecting the planting distance between the proposed seedlings (Li et al.. 2009; Yonghua et al.. 2015. Draghia et al.. 2010). The peripheral speed of the drive wheel is calculated with relation (1), considering the wheel speed = 1

.

$$V_{pa} = R \cdot \omega_a = \frac{R \cdot \pi \cdot n_a}{30} = \frac{0{,}295 \cdot 3{,}14 \cdot 1}{30} = 0{,}031 m/s \tag{1}$$

In order to observe the condition of equality between the two peripheral speeds, there is a combined gear and chain wheel transmission between the drive wheel and the planting wheel disc. (Fig. 9b), which perform a reduction ratio. Thus, the speed of the disk with arms is determined with the relation:

$$n_d = n_a \cdot i_{tr} = n_a \frac{Z_{L4}}{Z_{L5}} \cdot \frac{Z_{L6}}{Z_{L7}} = 1 \cdot \frac{20}{40} \cdot \frac{24}{20} = 0{,}6 \tag{2}$$

The peripheral speed of the disk with arms is determined as follows:

$$V_d = R\omega_d = \frac{R \cdot \pi \cdot n_d}{30} = \frac{0{,}477 \cdot 3{,}14 \cdot 0{,}6}{30} = 0{,}031 m/s \tag{3}$$

If the working speed is higher than the peripheral speed of the planter, at the level of the part that will remain in the soil, the planting distance will be higher than the one set and the juvenile will be tilted from the vertical towards the front of the equipment. If, on the contrary, the speed of the equipment is lower than the peripheral speed of the appliance, then the distance between the seedlings per row will be smaller and the juvenile will be inclined towards the back of the equipment.

The traction power For the MFF1 forest seedlings is determined by calculation based on the displacement velocity vl of the aggregate and the traction force Ftr = Rtr of the machine by means of the relationship (Draghia et al.. 2011) (4)

$$P_{tr} = \frac{F_{tr} \times \dot{v_l}}{1000}, kW \tag{4}$$

where F_{tr} is measured in N and v_l în m/s.

The power required to drive the plant Pa. is the product of the moment transmitted by the wheel and its speed according to the relationship (5)

$$P_{tr} = \frac{M_t \times \dot{n_r}}{1000} = \frac{(F_t + F_{aV}) \times R_r \times n_r}{1000}, kW \tag{5}$$

in which: F_{aV} – vertical component of the the forces in the pushing force springs. Rr - the driving wheel radius.

CONCLUSIONS

Romania is one of the 110 countries in the world where there are areas potentially affected by desertification as a result of frequent, long and severe droughts, mainly due to imbalances in climate characteristics but also to the severe reduction of the vegetation area forestry in lowland regions. It can be appreciated that desertification, drought and aridity have a determination in time and space, being caused mainly by climatic variations and human activity. Lack of precipitation for long periods of time causes negative effects on vegetation, soil and hydrological resources and in dry-suburban areas, manifested by:

- reducing the vegetation-covered areas, which leads to the intensification of solar radiation and implicitly to the growth of the albedo, the amplification of the effects of strong winds, micro-climatic imbalances etc .;
- the depletion of the upper horizons of soil in organic matter (humus) and nutrients by diminishing or disappearing the refreshment source (bioaccumulation);
- soil erosio,. especially by wind, on soils with sandy and even loose soils, by loss of cohesion;
- diminishing the mobilized water resources.

Protective forest crops and curtains as a means of defending climatic adversities, soil protection against erosion and landslides, protection of socio-economic objectives and communication routes have been and are in the attention of all countries with developed agriculture, where crops, soil and human settlements suffer more or less from the influences of harmful winds, droughts and surface erosion.

All these aspects lead to the necessity of carrying out the planting operation of the forest seedlings, especially by mechanized means, which imply the research of appropriate techniques in the afforestation technologies, in which the technical equipment of planting is of prime importance.

The planting operation of forest seedlings is a basic work in the restoration of the forestry fund and for the implementation of the policies formulated at the national level, it has become necessary to develop and improve some innovative technologies for mechanization of the planting of the saplings with all the implications of nature qualitative, economic, social and environmental impacts.

In conclusion, the saplings are intended for the mechanization of the planting of crops by planting in lands with pre-prepared soil, loose and free of crows, vegetal remains and weeds. Forest planters are intended for the execution of the trench and fixation of the material to be planted in the soil in the vertical position.

Planting saplings are generally restricted to land with a maximum gradient of 20%, planting operations being often limited by soil condition (if the soil is too wet the equipment can not be used and if the land is too dry, seedlings do not survive). Mechanized planting of seedlings is much more economical and productive than manual planting, the yield of planting equipment depends on the model and type of machine used, the planting material (seed sizes) and the quality of the soil preparation.

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THE NITRATES NUTRITION STATUS ASSESSMENT AND MANAGEMENT OF THE HORTICULTURAL CROPS IN THE STEPPE ZONE OF UKRAINE / *ОЦІНКА ТА РЕГУЛЮВАННЯ ВМІСТУ НІТРАТІВ У ПЛОДО-ОВОЧЕВИХ КУЛЬТУРАХ В СТЕПОВІЙ ЗОНІ УКРАЇНИ*

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Keywords: *vegetables, fruits, berries, nitrates, norm, maximum permissible concentration, yield, vermicomposting extract*.

ABSTRACT

The main aims were: a) to prepare a database of the determination of nitrate in vegetable and fruit production; b)to identify plants – accumulators of nitrates and determine the number of samples exceeding maximum permissible concentration (MPC); c) to compare trials and doses of artificial nitrogen fertilizers and vermicomposting extract application in the field experiments with some vegetable and fruit plants. The results of the determination of nitrates in vegetables, fruits and berries, which are most often used in the human diet in steppe zone of Ukraine, are presented. Two foliar spraying with vermicomposting extract give the best results for cabbage cultivation then drip fertigation.The best result for pumpkin cultivation was recorded after vermicomposting extract treatment with a dilution of 1:150. The same trend was observed when determining the optimal doses for the greatest number of seeds and lowest NO_3 content. The lowest level of nitrate in pepper fruits was determined in trial with vermicomposting extract foliar spraying with a dilution of 1:100. The best dose-effect response for apple tree yield was fixed for trial with vermicomposting extract two time drip fertigation with dilution 1:50.

ТЕЗИ

Головні цілі: а) сформувати базу даних визначення вмісту нітратів у продукції овочівництва і плодівництва; b) ідентифікувати рослини – акумулятори нітратів і визначити частку проб з перевищенням рівню ГДК.; c) порівняти варіанти і дози внесення мінеральних азотних добрив і вермикомпостного екстракту у польових дослідах з деякими овочевими і плодовими культурами. Наведено результати визначення нітратів в овочах. плодах і ягодах. що найчастіше використовують у раціоні харчування людини в степовій зоні України. Дворазове оприскування капусти вермікомпостним екстрактом призводило до отримання кращих результатів ніж за умов введення під час крапельного зрошення. Кращий ефект при вирощуванні кабаку був відмічений при фертигації розчином вермикомпостного екстракту з розведенням 1:150. Та ж тенденція спостерігається у збільшенні кількості насіння та зменшенні вмсту нітратів. Найнижчий рівень нітратів у плодах перцю зафіксований за умов дворазового оприскування вермикомпостним екстрактом з розведенням 1:100. Кращий відгук доза-ефект пов'язаний із підвищенням врожаю яблуні за умов дворазового введення розчину вермікомпостного екстракту з розведенням 1:50 з крапельним зрошенням.

INTRODUCTION

Approximately 80% of dietary nitrates are derived from vegetable consumption. Sources of nitrites include vegetables, fruit and processed meats, which means that human exposure to nitrate is usually associated with intake through vegetables and to a lesser extent, with other foods and water (Temme. 2011). Nitrates are, besides being used as food additives, found in nature as part of the nitrogen cycle and play an important role during nutrition, growth and development of plants. Because of their cumulative properties, they are an important part of vegetables (Lucarini et al.. 2012).

Nitrate serves as a source for the production of nitrite and nitric oxide as well as other metabolic products. Nitrites are also produced endogenously through the oxidation of nitric oxide and through a reduction of nitrate by commensal bacteria in the mouth and gastrointestinal tract (Norman. 2009). Long-term use of contaminated with nitrates vegetables, fruits and water leads to development of chronic intoxication. In case when foods with a high content of nitrates both nitrate and their metabolites (nitrite and nitro-compounds) put to the human body in danger. Thus, a precise balance between nitrates income and outcome in the human body has not yet succeeded.

Nitrates are not only entering to the body from outside, but also formed therein. Regarding to the rules by of nitrates – 5 mg nitrates per 1 kg of body weight of a person for an adult person is allowed, i.e. 0.25 g – for a person with weight 60 kg (Ganchuk et al. 2012; Menard et al.. 2008). Acceptable standard for child is not more than 50 mg. A person takes easy the daily dose of nitrates in 15–200 mg. 500 mg is the maximum permissible dose and 600 mg is toxic dose for an adult person. Nitrogen – is an essential element for all life forms. In the process of the nitrogen cycle in nature during the breakdown of proteins and other nitrogen-containing substances, are excreted ammonia. Nitrification bacteria substances make oxidation to nitrates and those, in turn, are converted to nitrites. Under the action denitrification bacteria last turned back into nitrogen, which is released to the atmosphere. The nitrogen is supplied in the soil with various kinds of fertilizers, residues of plants, amonium and nitrogen nitrates salts, which are contained in rain water (Temme. 2011). Nitrates – are natural products of metabolism of all plants. They are vital to plants, because it is impossible without them to provide their normal growth and development. However, uncontrolled use of nitrogen fertilizers has led to the accumulation of unlimited level in their products of plant origin (Berova and Karanatsidis. 2008). The main factors that cause the accumulation of nitrates in vegetables, fruits and berries include meteorological and agronomic conditions of cultivation, the level of soil fertility, varietal characters of plants (Lammarino et al. 2014).

The fruit and vegetables grown in the south - eastern part of Ukraine contain toxic substances, depending on their species and varietal facilities (carrots, beets, pumpkin, peppers, tomatoes, rhubarb. gooseberry. etc.), as well as in their anatomical parts. These studies allowed identifying the safest crops and their varieties. The study of patterns of income and accumulation in plants nitrates is necessary for the proper reasoning for the development of activities to reduce their content in the finished product. Studies have shown that vermicompost plays a major role in improving growth and yield of different field crops. including vegetables and fruit crops. For example. the application of vermicompost gave higher germination, growth and yield of horticultural crops (*Vigna radiate L*.) compared with the control (Gutiérrez-Miceli *et al.*. 2007; Sallaku *et al.*. 2009).

Plants fertilized with vermicompost have shown greater ability to assimilate essential macro and micro nutrients and resulted in improved root development (Atiyeh *et al.*. 2001; Arancon *et al.*. 2006). Nutrients in vermicompost are present in readily available forms for plant uptake; e.g. NO_3, exchangeable P, K, Ca and Mg (Edwards and Burrows. 1988). Better plant growth and yield of different crops have been reported when vermicompost was combined with artificial fertilizer in a certain ratio. The main *aims* were: a) to prepare a database of the determination of nitrate in vegetable and fruit production; b) identify plants – accumulators of nitrates and determine the number of samples exceeding maximum permissible concentration (MPC); c) to compare trials and doses of artificial nitrogen fertilizers and vermicomposting extract application in the field experiments with some vegetable and fruit plants.

MATERIAL AND METHOD

Monitoring of nitrates was conducted in field experiments with species and varieties of vegetable and fruit crops grown in the Steppe zone of Ukraine. Field experiments were laid out in 4-fold repetition in terms of vegetable and orchards variety testing stations of Dnipropetrovsk region, in 2000–2004 and 2015-2016 years. Average samples of vegetables, fruits and berries were crushed and homogeneous. Then they were weighed and at 10 g of powdered sample or squeezed juice was added 50 ml of a 1 % solution of potassium alum to extract nitrate for 15 min. The control of nitrates content was carried out applying the potentiometric method with nitrate selective electrode (Products of fruits and vegetables, 1995).

Assessment of cases of exceeding maximum permissible concentrations (MPC) has been done taking into account several references (Ganchuk et al.. 2012; Menard et al.. 2008; Mitek et al. 2013). Pepper, cabbage, pumpkin and apple were selected as test plants to examine the effectiveness of different forms of fertilizers. Scheme of field experiments with vegetables included the following options: foliar spraying with nitrogen fertilizer (50g NH_4NO_3 per 10 liters of water) and vermicomposting extract (dilution 1:100). Ratio of fertilizer and water in case of drip irrigation using: 1:200. 1:150 and 1:100. The two apple varieties (Gala Red and Pinova) were evaluated in field experiments with drip irrigation.

Vermicomposting extract with ratio of fertilizer and water: 1: 100 and 1:50 two applied after time drip fertigation. Vermicomposting extract technology includes the following stages: mechanical decomposition of wastes to the certain parameters; crushing of crops wastes to certain fractions, fermentation of the ground raw material under the proper humidity and temperature, bioprocessing of the fermentated husk (sunflower, buckwheat or rice) by worms *Eisenia foetid*a on the special shelves, extracting of biohumus with water (Kharytonov et al.. 2009).

RESULTS

The results of determining the concentration of nitrates in fruits and berries are shown in table 1.

Table 1

Nitrate concentration in fruit and berries

Fruits, berries	Number of samples	Average meaning	Min – Max
Plum	7	50.4	23.9–81.9
Cherries	24	15.8	8.05–27.6
Apricot	6	45.6	20.3–82.0
Plum	4	40.7	28.9–51.7
Strawberry	5	42.0	34.9–50.5
Raspberry	7	33.3	16.2–91.4
Blackberry	17	22.8	14.4–28.7

The average value of nitrates in fruits and berries were in the range of 20–50 mg/kg. The content of nitrates was studied in our work fruits and berries belong to the group of low concentration. The results of nitrate assessment in vegetable crops are given in table 2.

Table 2

Nitrates concentration in vegetable crops, mg/kg

Vegetable crop	Number of samples	Average meaning	Min – Max	MPC	Number of samples. which exceed MPC
Radish	5	2727.6	2022–3596	1500	5
Beet	6	2886.5	1276–4527	1400	5
Carrot	6	485.0	161–1137	250	5
Pumpkins	6	669	291–1157	400	5
Potatoes	46	138.2	23–639	250	12
Cabbage	12	584.33	103–1833	900	2
Pepper	9	228.75	73–580	200	2
Tomatoes	19	44.1	16.5–82.0	150	0
Sugar pea	9	4.6	3.6–6.4		

The data of table 2 shows that 36 of the 111 samples tested for nitrate content exceed the maximum permissible concentration. The largest share of the maximum permissible concentration is observed in the vegetables: radishes, beets, carrots and pumpkin. In the determination of nitrate content in potatoes 12 samples from 46 exceeded the 1MPC, in cabbage 2 samples of 12 and pepper in 2 samples of 9 exceeded the 1MPC. There are also shown the results of measuring of content of nitrates of pepper fruits treated with solutions of mineral nitrogen fertilizers and vermicomposting extract shown in Fig.1.

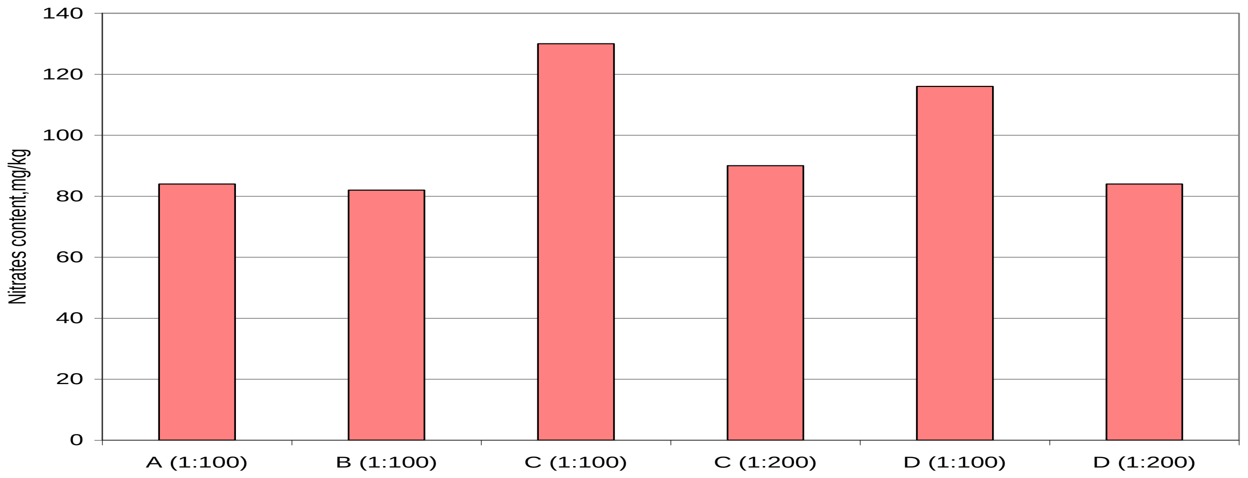

Fig.1 - The content of nitrates in fruits of pepper in different variants of the field experiment:
A- foliar spraying with nitrogen fertilizer (1:100) ; B - foliar spraying with vermicomposting extract (1: 100); C – drip fertigation with nitrogen fertilizer (1: 100; 1: 200); B - drip fertigation with vermicomposting extract (1: 100; 1: 200).

The highest level of nitrates was recorded in the cultivation of pepper drip irrigation in the cultivation of nitrogen fertilizers in the ratio 1:100. The same pattern is recorded and when vermicomposting extract has been applied. The lowest level of nitrate was determined in trial with vermicomposting extract spraying (B 1:100). In other words, these options provide higher environmental quality of the pepper fruits.

The data obtained in field experiments with cabbage variety “Langedijk” at vegetable variety testing station are shown in table 3.

Table 3

Vermicomposting extract application in field plots of cabbage

Trials	Average yield. ton/ha	Additionally. %
Control (water)	35.7	-
Drip irrigation (1:100)	43.4	21.5
Drip irrigation (1:200)	46.9	31.2
Foliar spraying (1:100)	48.8	36.6
LSD_{05}	5.1	

It was found that two foliar spraying with vermicomposting extract give the best results in terms of yields comparatively to control. The vermicomposting extract drip fertigation with a dilution of 1:200 gives higher application yield than trial with a dilution of 1:100.

The results of the experiments with the pumpkin variety “Valok” for the study of optimal dose of the vermicomposting extract are given in table 4.

Table 4

Vermicomposting extract influence on pumpkin yield and NO_3 content

Trial	Average fruit weight, kg	Seeds weight. g (in average of 3 fruits)	NO_3 content. mg/kg
Control	9. 45	263	225
1:200	10.30	272	158
1:150	11.00	294	164
1:100	10.00	264	172
LSD_{05}	0.84	50	

The best result was recorded after vermicomposting extract treatment with a dilution of 1:150. The same trend was observed when determining the optimal doses for the greatest number of seeds and lowest NO_3 content.

The results of the field experiments with vermicomposting extract (VCE) application in apple orchard based on two varieties testing are presented in fig. 2.

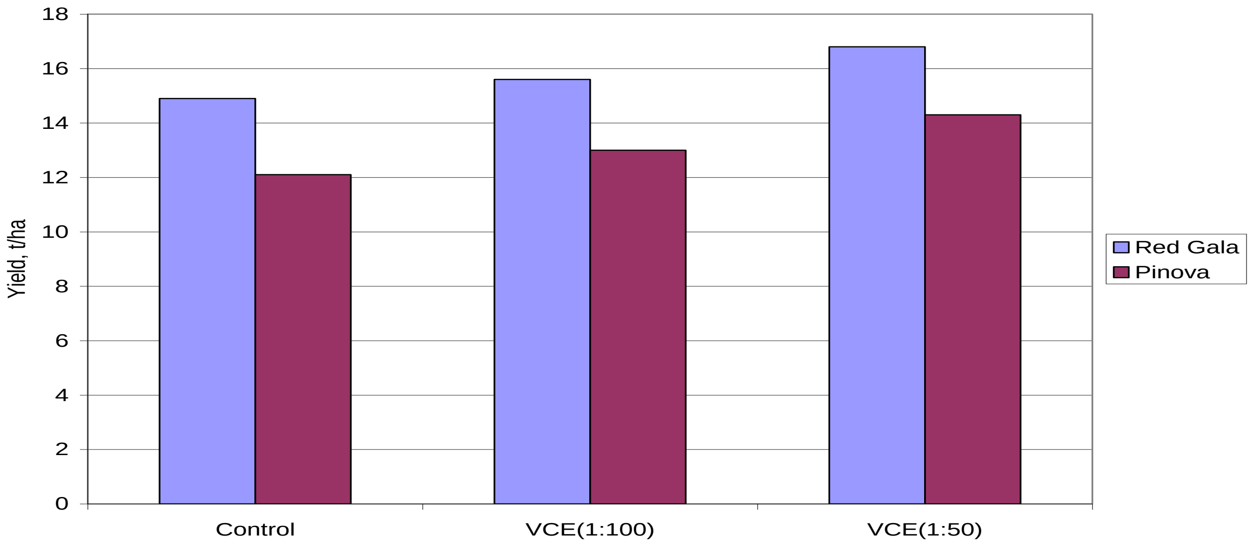

Fig.2 - The vermicomposting extract dose-effect search in apple orchard

The best dose-effect response for apple tree was fixed for trial with vermicomposting extract dilution 1:50.

CONCLUSIONS

The data obtained showed that 36 of the 111 vegetable samples tested for nitrate content exceed the maximum permissible concentration. The content of nitrates was studied in our work for fruits and berries belonging to the group of low concentration to 100 mg/kg. The lowest nitrate content we found in green peas.

The field experiments data showed the best result in case of vermicomposting extract application both from productive and ecological points of view. Thus, the application of the bioconversion products can provide reliable ways to environmentally friendly agriculture.

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CONCEPTION AND DEVELOPMENT OF TECHNICAL SYSTEMS FOR SUSTAINABLE AGRICULTURE
/
CONCEPȚIA ȘI DEZVOLTAREA SISTEMELOR TEHNICE PENTRU AGRICULTURA SUSTENABILĂ

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Keywords: *conception, technology systems, portal, CAD-CAE, methodology*

ABSTRACT

In the context of sustainable development in agriculture, INMA has carried out a series of researches on the design and development of intelligent technical systems with the main purpose of making them more efficient for agricultural works. In this regard, a methodology for conception of CAD - CAM models has been created, in order to conversion to models for structural analysis, studies on convergence of structural models and convergence for models of different types for the same phenomenon, case studies, etc. All these results were published on a portal for the design and development of technical systems "CAD-CAE-INMA" to facilitate innovation and technological transfer

REZUMAT

*In contextul dezvoltarii sustenabile in agricultura, INMA a realizat o serie de cercetari avansate de conceptie si dezvoltare, avand drept scop principal eficientizarea sistemelor tehnologice inteligente pentru lucrarile agricole, In acest sens, au fost create doua metodologii: concepţie a modelelor CAD – CAM în vederea conversiei la modelul pentru analiza structurala, si respectiv studiu convergenţei modelelor, studii de caz, model structural si matematic cu soluţie originala, studii de convergenta, precum si testare a convergenţei modelelor matematice ale unui fenomen in analiza structurală. Toate aceste rezultatele au fost publicate pe un portal destinat conceptiei si dezvoltarii sistemelor tehnice "CAD-CAE – INMA"**,** care sa faciliteze inovarea si transferul tehnologic.*

INTRODUCTION

Information technology represents a period of accelerated qualitative and quantitative development. The amount of new technology increases the quantity and quality of information and each other. The word "development" used in the previous sentence is not necessarily used in a positive sense, but in the sense of uncontrolled growth, such as the phenomenon of growing population in the world.

Such a "development" of information technology will probably generate a cyborg man, and the accumulation of information will become a disease that will affect irremediable the human species (William J. M., 2004)

In the case of this perspective, the phenomenon of specialization of the people in various fields and subdomains is a method of discharging, a valve to the impossible accumulation of information.

Thus, operations that several decades ago were made by one or two engineers with the help of technicians or designers, are made today, by stages, by different specialized teams (designers, structural analysis specialists, experimenters, virtual testers, etc.).

Sustainable development has been defined as the development process that responds to the current needs without jeopardizing the ability of future generations to respond to their own needs. In order to reach the goal of sustainable development, it is essential to harmonize three key elements: economic growth, social inclusion and environmental protection. These elements are interconnected and all are essential for the wellbeing of individuals and societies (United Nations, 2015).

The concept of sustainable development applied in agriculture represents the management and preservation of basic natural resources, animal and plant genetic resources, environment and orientation of agro-technological processes, so as to ensure the satisfaction of present and future generations (Radulescu C. V.and Ildiko I., 2015), The modern technical systems for agricultural works and food industry are very complex systems, which during the basic operations are also collecting information about the quality of the work and the evolution of some working parameters which influences the working operations (European Parliament, 2014),

The collected data is sent to a processing and command system, which, after a fast data analysis, takes short-term decisions for eventual changes of some command parameters of the working process. Such a complex system requires high-precision input data, such as mechanical, electrical, pneumatic, hydraulic, thermal, etc. The devices, the control and command processes and their design involve complex areas of science and technique, such as: mechanics, electronics, fluid mechanics, and thermodynamics. For this reason, the modern systems involved in agricultural and food industries are many of them designed within mechatronics, or even in a more complex framework (Lindblom J. et al., 2017).

In the context of those presented above, a very high precision in the design and achievement of the technical systems involved in modern working processes in agriculture and food industry becomes increasingly clear.

On the other hand, in these research and design condition, it is very important that the research-design-production activities to became more efficient. The role of mathematical modeling and simulation increases, in order to increase the accuracy and quantity of information, and also to reduce the high energy consumption and the labor force, which characterizes the research and the experimental verifications.

In order to perform such a role, fast and accurate transfer from the CAD model to the CAE model are necessary (there is no time to redesign the geometric model that meets the requirements of the structural analysis, it must leave from CAD modeling, satisfying the structural analysis conditions).

The main objective consists of creating a methodology that facilitates a continuous and correct workflow in the research-design-production chain, developed within the classical framework CAD-CAM-CAE. More specifically, it is intended to formulate principles clearly for the preparation of CAD documentation in the variants required for manufacturing (CAM) and for structural analysis (CAE). The methodology will deal with the organization of drawings that admit tolerances (gaps and interferences) for manufacturing (Fischer B. R., 2011).

The patterns associated to the drawings (geometric models) should be used in the CAE domain and should not have gaps (distances) and interferences, and if these still occur, what are the limits of CAE tolerance for these and their consequences (Armstrong C. G., 1994). Finally, another required problem, that is not usually addressed, is the convergence of structural models - necessity, tolerance, etc.

In this context, INMA Bucharest has developed methodologies that regulate and provide clarifications for the stages of these complicated processes, and very importantly, facilitate communication between the different working teams.

The scientific results obtained were brought to the attention of interested stakeholders (economic, research and university environment) by a specialized portal presented in this paper and will improve technological transfer and innovation.

MATERIAL AND METHOD

The methodology for conception of CAD-CAE models in order to CAE usage contains three methods. The first method refers to a process of development and / or remediation of CAD models in order to become usable in structural analysis (converting CAD models into CAE models).

The second method refers to the study processes of the structural models convergence. The third method presents a process of increasing the performance of the structural models by what is called the convergence study in models.

The methodology for studying the convergence of structural models or CAE models is a methodology that contains methods for estimating the convergence of structural models, CAE, respectively.

The methodology for studying the convergence of structural models contains two methods. The first method is based on convergence in the sense of mathematical analysis adapted to finite strings, which thus becomes a stopping condition for calculation. The second method is a more elaborated method and involves the development of several structural models of complexities, generally different and whose results are compared in different terms (Waltera A. et al, 2017).

The materials used to achievement the portal were the results obtained by INMA as a result of advanced research on conception and development, with the main purpose to make the intelligent technological systems for agricultural works efficient.

The portal was achieved using appropriate programming languages and databases such as: html 5.0, web 2.0,JavaScrip (Flanagan D., 2006) PHP and MySQL(Ulman L. E., 2003). Appropriate instruments and a flexible tree structure have been used for an easy usage and fast access to information.

The portal is an open platform to promote innovative ideas and technology transfer in the field of equipment designed for agriculture,food industry and forestry.

RESULTS AND DISSCUTION

The portal (accessible at the address: http://www.inma-cadcae.ro/) achieved for this purpose is managed and updated by the portal administrator based on a "user name" and a password ("Login Form"), as it seen in (Fig. 1).

The access to the "CAD-CAE-INMA" portal is provided for the general public, registered users and administrators on the following levels:

- ✓ Unregistered users - access to the sections of general interest;
- ✓ Registered users - access to the sections of general interest and sections containing specialized information;
- ✓ Administrator - accesses to all sections, including editing and managing them.

Users can access to menus and sections containing specialty information by creating an account on the portal main page ("User Registration") (Fig. 2).

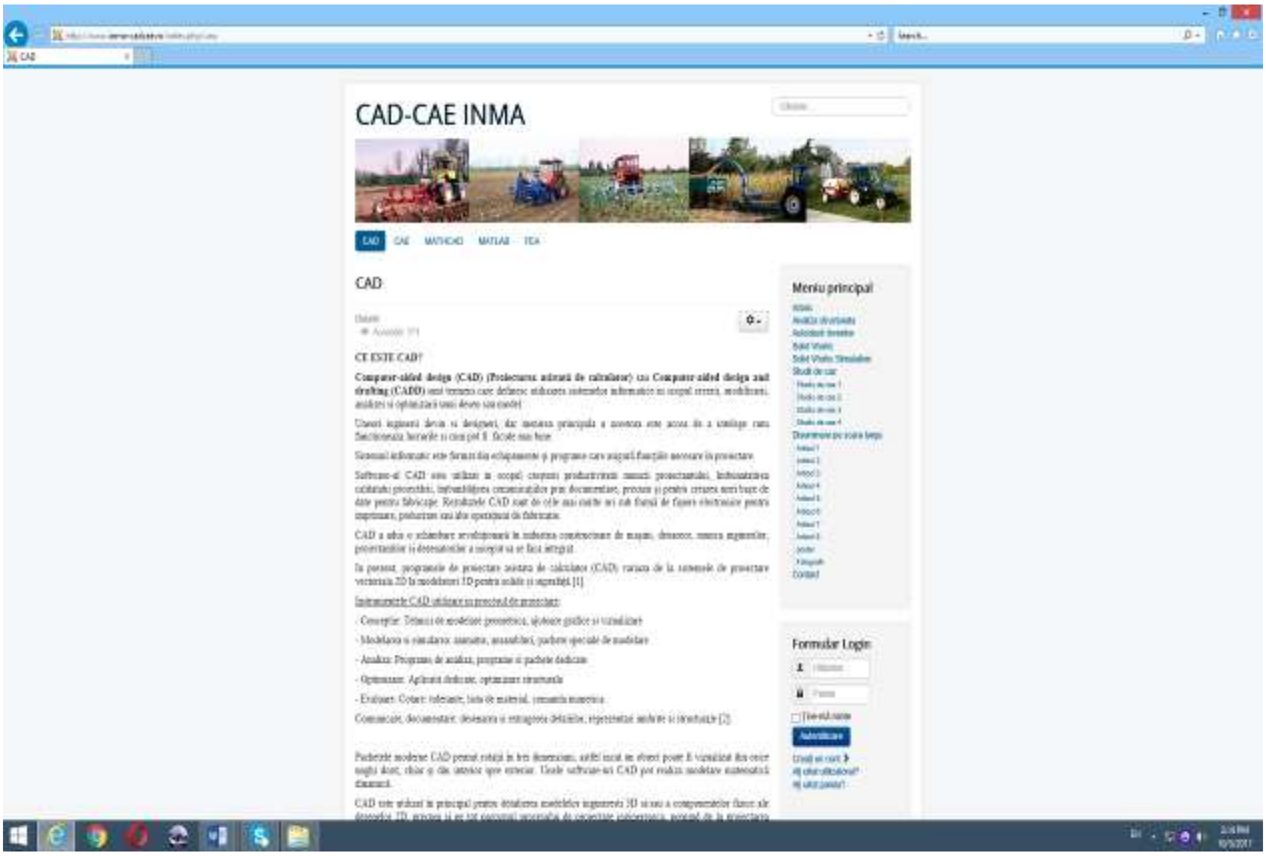

Fig. 1 - Login of the administrator portal with the help of a "user name" and a password

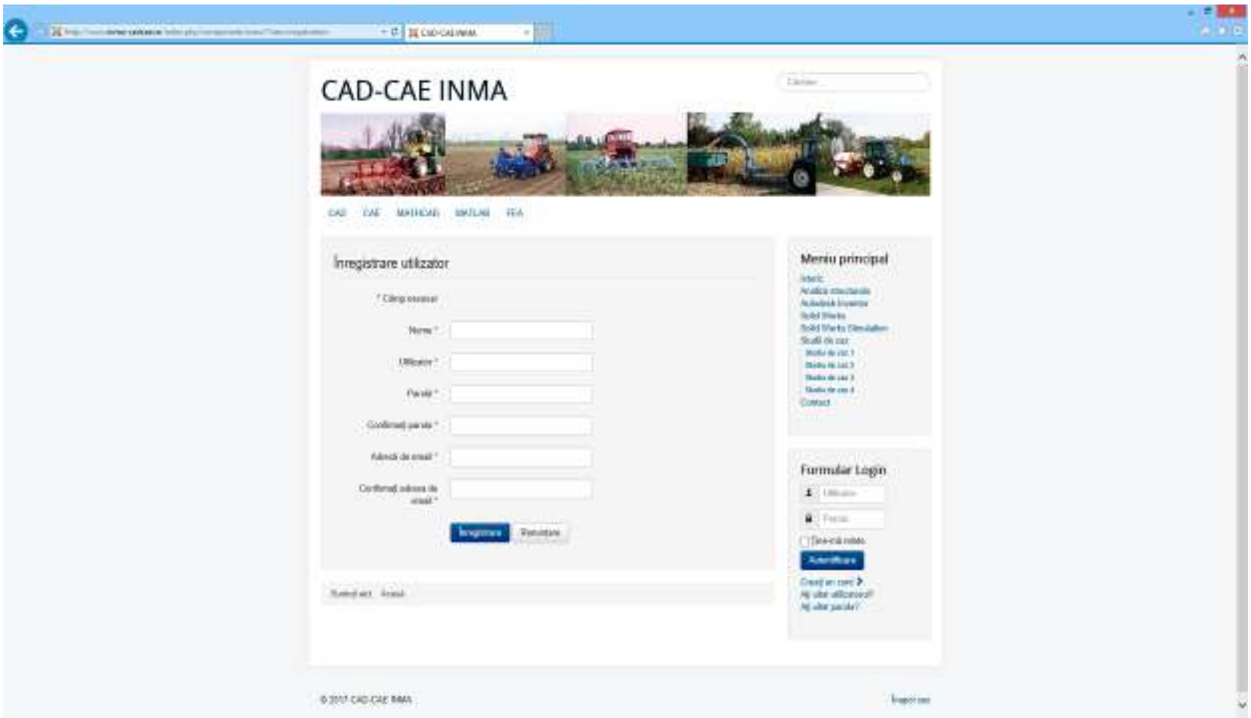

Fig. 2 - Create "User Registration" account

The portal home page contains:

- ✓ banner with agricultural machinery and equipment designed at INMA Bucharest. As functionality, this banner will be selectable, and at its selecting, regardless of the menu or the section where the user is located, the main menu will be loaded.
- ✓ The main menu with the next sections: "**Historic", "Structural analysis**", "**Autodesk Inventor**", "**Solid Works**", „**Solid Works Simulation**", "**Cases studies**" with the next subsections: "*Case Study 1*","*Case Study 2*","*Case Study 3*","*Case Study 4*", "**Dissemination on a large scale"** with the subsections: "*Article 1*"," *Article 2*","*Article 3*","*Article 4*","*Article 5*"; "*Article 6*", "*Article 7*", "*Article 8*", "Poster", "Photos", "**Contact**"

  The main menu is intended to provide access the users to the portal to all its sections. This will be accessible from all sections of the portal. The menu will indicate to the user the page he views by highlighting the button from the menu corresponding to the selected section.
- ✓ Horizontal menu with the following sections: "**CAD", "CAE", "MATHCAD", "MATLAB", "FEA".**

The articles resulted from the research achieved are presented in the short version, namely: title, authors, abstract, publication, pages, ISSN etc., as well as in the extended version by accessing "*More information at ...."* where the user has access to the full article in .PDF format.

The next images present significant portal elements. In this regard, various notions regarding the subject approach such as: structural analysis, CAD, CAE and FEA (Fig. 3 and 4) are explained in an accessible programming language.

Fig. 3 - "Structural analisys" section

Fig. 4 - "CAD" section

There are also presented some of the most widely used information instruments in the design of the technical equipment domain: Autodesk Inventor, Solid Works, Solid Works Simulation, MATHCAD, and MATLAB (Fig 5-7).

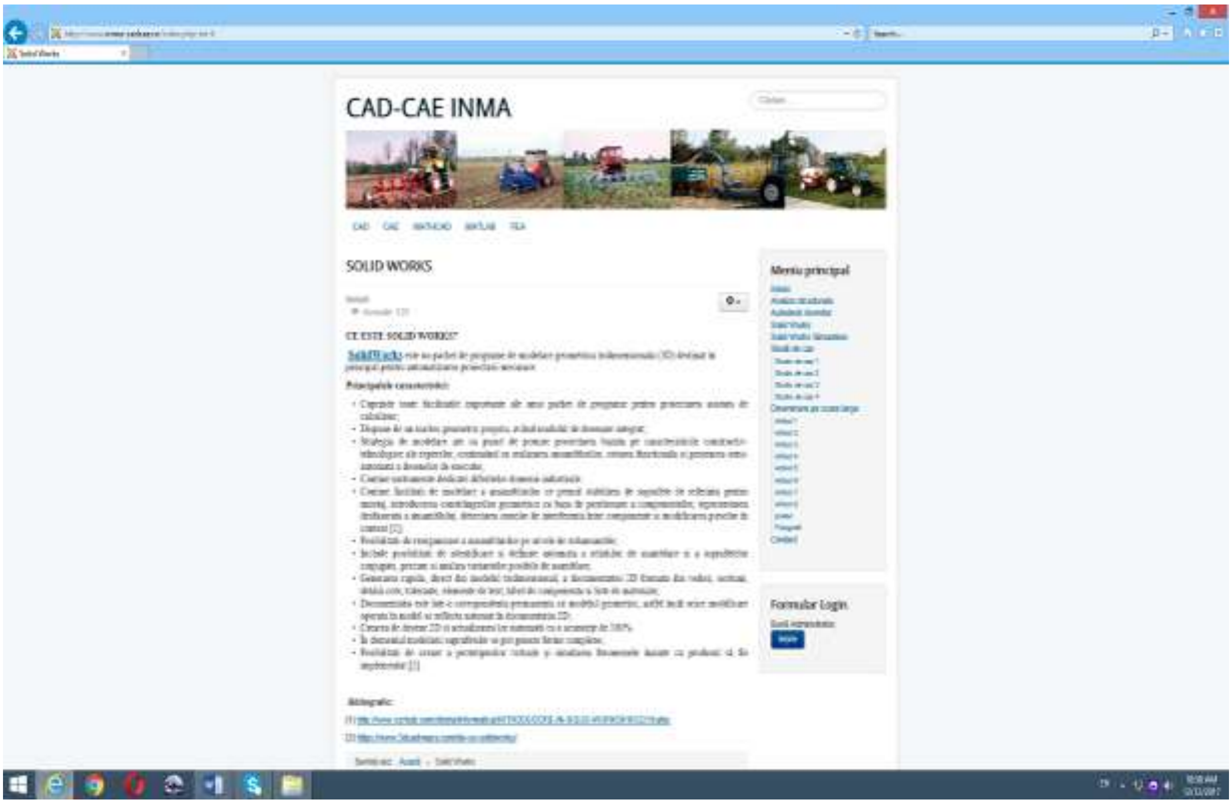

Fig. 5 - "Solid Works" section

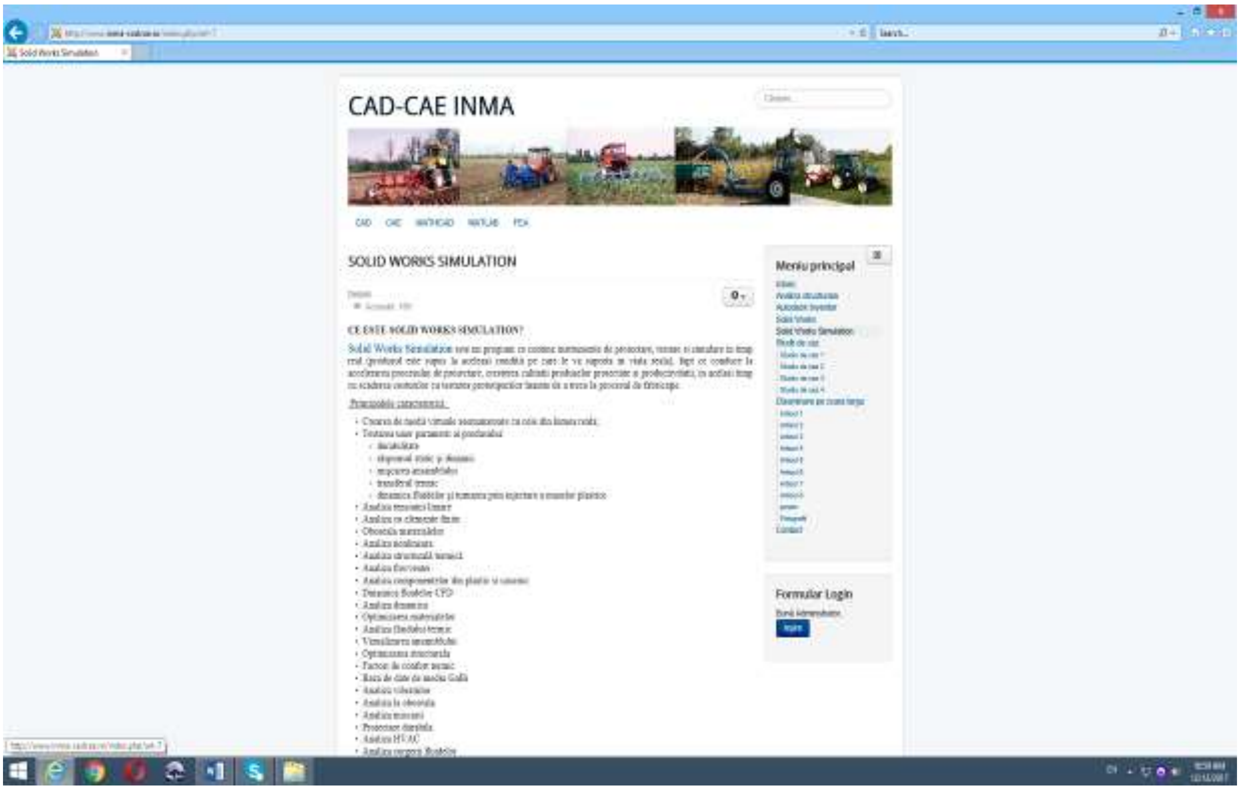

Fig. 6 - "Solid Works Simulation" section

Fig. 7 - "MATHCAD" section

A particular attention was paid to the case studies (**4** case studies) and the articles published within the project (**8** articles from which: **4 ISI, 1 BDI** and **3 published on scientific platforms**) were published on the portal. Here are some images with case studies (Fig. 8 - 9) and published articles (Fig. 10 - 13).

Fig. 8 - "Study case 3" section

Fig. 9 - "Study case 4" section

Fig. 10 - **"Dissemination on a large scale – Article 1"**

Fig. 11 - **"More information - Article 1"**

Fig. 12 - **"Dissemination on a large scale – Article 7"**

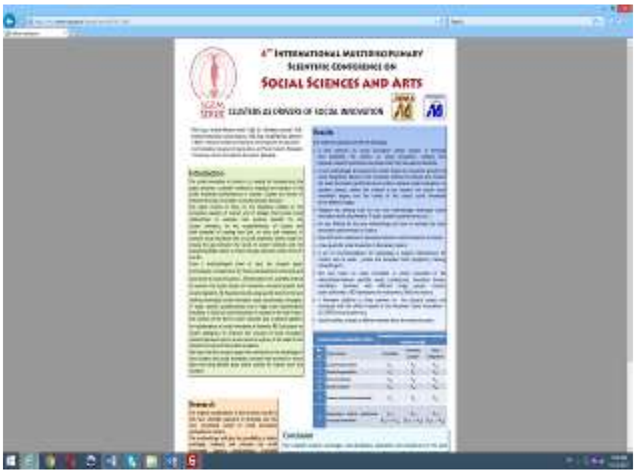

Fig. 13 - **"More information - Article 7"**

CONCLUSIONS

- All the results published on the portal are new and compatible with the national strategy in the context of sustainable development in agriculture and the European Union's strategy for research and innovation;
- The users of the portal are the companies that provide research, conception, design and production in the field of agricultural machinery and technical systems in general. The results published on the portal can be generalized in many other industrial fields (transport equipment, fine mechanics, etc.);
- The results can be exploited in university education in order to achieve a realistic image of the CAD world today, so that, the young graduates to be prepared for the integration into the contemporary structures dictates by the information technology (which knows a continuous quantitative and qualitative explosion);
- Applying the published results on the portal is likely to cause relaxation among the groups of specialists involved in the design-verification-optimization stages;
- The portal is easy to use and the information is accessible after a maximum of 3 mouse clicks. The structure of the portal is open and can easily be developed to encompass users' contribution to the field.
- The scientific results obtained were brought to the attention of interested stakeholders (economic, research and university environment) by a specialized portal presented in this paper and will improve technological transfer and innovation
- Since the launch, the user's interest in the portal information has materialized through the high number of hits that is visible online

ACKNOWLEDGEMENT

This work has been done within the next projects: "*Research on the development of innovative tools for lifelong learning, stimulating innovation and rapid technological transfer of research results in agriculture, forestry and food industry*" and "*Advanced computer and digital research of conception and development, in order to efficiency the intelligence technology systems for agricultural works*" within the NUCLEU 2016 - 2017 Program. Code PN 16.24, founded by the Government of Romania - Ministry of National Education and Scientific Research.

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PREVENTION REGULATION REGARDING WEED SEED SPREADING AND THEIR IMPACT ON AGRICULTURE AND ENVIRONMENT
/
REGLEMENTĂRI PRIVIND PREVENŢIA RĂSPÂNDIRII SEMINŢELOR DE BURUIENI SI IMPACTUL ACESTORA ASUPRA MEDIULUI ŞI AGRICULTURII

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Keywords: *prevention, weed seed, environment, agriculture, healthy feeder*

ABSTRACT
This paperwork intends to present the national and international regulations regarding the prevention of weed seeds spreading with a high impact on the environment and agriculture. Also, will be presented the weed classification system, some of the most important technical notions and general considerations on the influence of parasitic weeds on agricultural systems and the environment. This work has an particular importance from informational point of view, because it targets a wide range of economic agents who want to produce crops and ecological products from agricultural, vegetable, fodder and fruit growing field, and thus can be prevented the deeding material contamination risk used in crop establishment, which must be of high purity in order to avoid additional costs of combating them.

REZUMAT
În aceasta lucrare se doreste prezentarea reglementărilor naţionale şi internaţionale privind prevenţia răspândirii seminţelor de buruieni cu impact ridicat asupra mediului si agriculturii. De asemenea, se va prezenta sistemul de clasificarea a acestora, precum si cateva noţiuni şi consideraţii generale privind influența buruienilor parazite asupra sistemelor agricole şi a mediului. Aceasta lucrare are o importanta deosebita din punct de vedere informativ, deoarece vizeaza o gama larga de agenti economici care doresc să producă culturi si produse ecologice din domenii precum: agricoltură, legumicultură, furajării și a pomicultorii, și astfel se poate preveni riscul de contaminare a materialului semincer utilizat care trebuie să aibă o puritate ridicată pentru a evitarea costuri suplimentare de combatere a acestora.

INTRODUCTION
In Romania and in Europe, the importance of ecologic production and products is continuous increasing, but the ecologic crop lends are few, because an important problem is in this case the high weeding level *(Ciobanu, 2015*). The biologic invasion is recognised globally, as one of the grates to biodiversity, economic and human health.

The prevention of invasive organisms spreading in sensible areas, as well as the damages provoked, can be applied by using quarantine measuring that are settled at national and international level by specific legislation *(Ulea, 2001).* One of the most important organization that support the European states in prevention of dangerous organism's invasion is European and Mediterranean Plant Protection Organization – EPPO.

Controlling the parasitic weed spreading in agricultural and protected natural sites, is an important activity that EU encourage to develop at national and international level, in the same time as the economic exchange goods, between European member states, fact that strengthen the EU market stability, security and financial governance.

If it is taken in to consideration the fact that, the climate changes are hard to foresee and the extreme weather phenomenon that are more often, produce on the whole globe, which usually generate natural disasters, especially floods and wind storms, which are spreading large quantities of vegetation and insects. In scientific literature this phenomenon can generate contamination source that usually are constituted from: abandoned and uncultivated lends, especially form under develop regions (delimitation razor, railways areas, channel batter, untiled pastures and hay fields) the seeding material uncertified; inadequate manure storage.

Nowadays, the stable dejection represents a quarantine weed contamination source, because their seeds is presentment in fodder material that is eaten by the husbandry, passes through the digestive system and are eliminated but their germinator capacity is not lost. Usually in the digestive tube can be founded amaranth, bindweed, loboda, dodder seeds. The germinate capacity of the weed seeds is influenced by the animal species how's administrated, see Fig.1. [7] In goitre and maw pottery were found 600 seeds from 10 species, in some cases were noticed that if the seeds are present in digestive tube more than 24 hours the germinate capacity increase, especially for those seeds that have a thick tegument and that usually their germination takes a long time in normal conditions, because their protective layer is shrinking. [8]

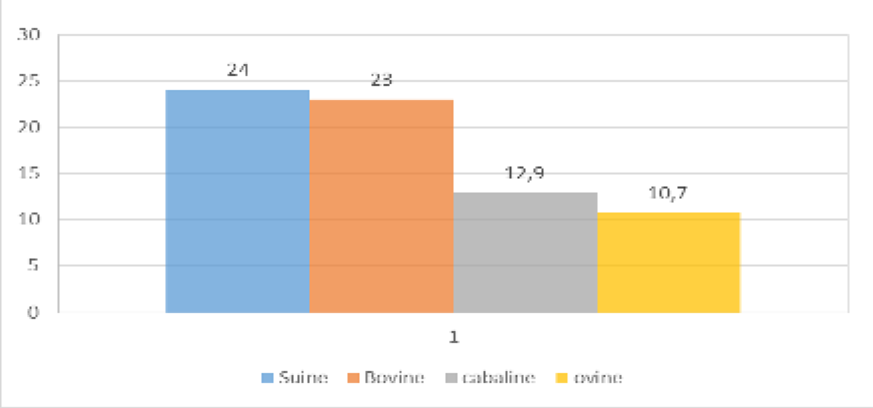


Fig.1 - The germinated capacity of weed seeds in animal dejection [2]

In order to eliminate this contamination possibility, must be taken prevention measures as: construction of dejection platform - in this way the weed seeds aren't incorporated in the soil or water flows and to assure all required conditions to ferment it and to reduce germination capacity of the weed seeds; to administrate fodder material with high quality, without weed seeds and sow one.

The identification and eradication of invasive weeds contamination source, before that this sites to become a wounds, must be an important activity not for protection authorities, but also for every citizen, that is necessary to awareness the importance to avoid accidental or intentional introduction and spreading, because once introduce in one site (agriculture lend, forestry and other natural sites) is hard to control and destroy the invasive hearths.

The weeds, from the agronomic and agricultural point of view, represent the totality outside plants from a crop, even if that plant is planted in other crop, this phrase can be interpreted as, pant that is not part from a main culture crop without seeding to be harvest [5]. In scientific literature, the weeds are defined also as:

- wild plants, without economic value, adapted to develop with culture plants, and reduce their growth and development;
- plants that growth in agriculture crops and cause a productivity decrees and a depreciation quality;
- Plants that take from the soil an important quantity of water and nutritive substances, without to have a productive contribution.

During their existence, the weeds had demonstrated a great adaptability to climacteric changers then the culture plants, having a great resistance to draught and diseases, to feed and develop faster, to multiply by multiple ways (seeds, studs, rhizome), to defend from insects, births and animals attack with multiple ways, to assure a great number of seeds in order to assure their existence compared with culture crop. [5] This amazing capacity to adapt and multiply, in spite the human efforts to exterminate them, create the proper environment to develop crop host for parasites and harmful insects, but also a propagation mean to pass from a field to another.

If we consider that, the weeds have a staggered undergrowth, their persistence can be for many years starting for the moment in which it stars their disproof, even when their development do not produce seeds, this process is estimated by the scientist to be unframed between 3 and 10 years [5]. For those that are regenerated by rots, rhizomes and other vegetative ways, the undergrowth power is high and their extension takes a long period of time. The most difficult environmental conditions that the quarantine weeds are present are the sandy and marshy soils, and this fact is doubled because their seeds are more resisted.

The damages caused by the weeds are great, and sometime can cause a complete crop damage. In Romania, were made estimations about the damaged that can be caused, in 1935 was made a study conducted in by Acad. Savulescu Tr., which shooed that the weeds financial impact is rising from 6 to 7 milliard of lei. The damages are greater if the agriculture is unilaterally and especially for grains and the wedding level is greater. [5]

The hoeing plant crop, when the weeding are made on time, reduce the wedding level, because it consist in creating a superficial layer of soil, known in the field literature as mulch. The fodder crop has an intermediary place, regarding the methods for weeds disproof, by earlier fodder lawn, it can be in favour to weed distraction, but also decrees the fodder quality.

In some of the cases, the agriculture products qualities is alternated, so can put in danger the human and animal health.

In the developed countries, from some decades, the ecologic agriculture crops register a great importance and are encouraged, and sometime are avoided traditional crop management activities that could contaminated the soil. From this point a view, the weed control and disproof is a complex process that include all integrated prevention methods.

MATERIAL AND METHOD

In Romania, a grate number of regulations and norms presents a great number of harmful animal species or Insects, microorganism (bacterial, micromicete) and fito-pageneous virus that are included in fito-sanitary quarantine. The weeds that are included in this category are usually vascular pants and this list is limited -see Table 1, as in UE member states (Karnkowski 2001). Some of this quarantine weeds are the subject of some of governmental trade conventions with trading countries. Also, many of this species like: Ambrosia artemisiifolia, A. psilostachya, A. trifida, Cuscuta campestris, Sicyos angulatus, Sorghum halepense etc., are already present on national territory so them can be in this moment the object to inforce the regulations required by quarantine weeds in order to do not represent a spreading source for neighbour countries, for this reason this species it is necessary to be included in prevention program applied at national level.

In the Tabel 1, are presented several information’s like: botanic family under abbreviation - Colum 1 (Acan. - Acanthaceae, Aizo. - Aizoaceae, Amar. - Amaranthaceae, Apia. - Apiaceae, Apoc. - Apocynaceae, Arac. - Araceae, Aral. - Araliaceae, Aste. - Asteraceae, Conv. - Convolvulaceae, Cras. - Crassulaceae, Cucu. - Cucurbitaceae, Cusc. - Cuscutaceae, Eric. - Ericaceae, Euph. - Euphorbiaceae, Faba. - Fabaceae, Halo. - Haloragaceae, Hydr. - Hydrocharitaceae, Lar. - Lardizabalaceae, Lili. - Liliaceae, Malv. - Malvaceae, Oeno. - Oenotheraceae, Oxal. - Oxalidaceae, Poac. - Poaceae, Poly. - Polygonaceae, Prot. - Proteaceae, Rosa. - Rosaceae, Rubi. - Rubiaceae, Salv. - Salviniaceae, Scro. - Scrophulariaceae, Sola. - Solanaceae, Visca. - Viscaceae); the plant origin – colum 2 (Afr.-Africa, AmC.- Central America, AmN. - North America, AmS. - South America, AsE. - Est Asia, AsV. - Asia West, As. - Asia, Austr. - Australia, Eur. - Europe, Md. - Mediterranean region, subtrop. – subtropical region, trop. - Tropical region); way for contamination – Colum 3 (acc.- accidental, hort. – introduction deliberate as crop in horticulture, scientific collection, etc.); category – Colum 4 (neo.- neophyte, plant introduced in recent times); the status of the plant (c. – occasional plant in Romania, i. – invasive plant in Romania, n. - naturalised plant in Romania).

Table 1

Plant species mentioned in fito-sanitary quarantine legislation from spontaneous Romanian flora *(Culita, 2012)*

Plant Species	*Botanic Families*	*Origin*	*Modality of spreading*	*Category*	*Status*	*RO legislation and norms*
0	*1*	*2*	*3*	*4*	*5*	*6*
Ambrosia Artemisiifolia L.	Aste.	AmN.	Acc.	Neo.	I	RO-1,2,4, 9
Ambrosia Psilostachya DC.	Aste.	AmN.	Acc.	Neo.	N	RO-1,2,4,9, EPPO-OL
Ambrosia trifida L.	Aste.	AmN.	Acc.	Neo.	N	RO-1,2,4,9 EPPO-OL
Cuscuta camestris Yunck	Cusc.	AmN.	Acc.	Neo.	I	RO-1,9 EPPO-OL
Euphorbia marginata Pursh	Euph.	AmN.	Hort.	Neo.	C	RO-1
Sorghum Halepense (L) Pers.	Poac.	Afr.	Acc.	Neo.	C	RO-9
Sicyos angulatus L.	Cucu.	AmN.	Hort.	Neo.	I	RO-1, EPPO-IAP
Bidens bipinnata L.	Aste.	AmS.	Acc.	Neo.	N	RO-1
Cenchrus incertus M.A. Curtis	Aste.	AmN.	Acc.	Neo.	N	RO-1,2,4,9 EPPO-OL

Plant Species	*Botanic Families*	*Origin*	*Modality of spreading*	*Category*	*Status*	*RO legislation and norms*
0	*1*	*2*	*3*	*4*	*5*	*6*
Cuscuta suaveolens Ser.	Cusc.	AmS.	Acc.	Neo.	C	RO-1,9 EPPO-OL
Euphorbia davidii Subils (tratata drept E. Dentata Michx.)	Euph.	AmN.	Acc.	Neo.	N	RO-1
Ipomoea hederacea (L) Jacq.	Conv.	Am. Trop.	Hor.	Neo.	C	RO-1
Polygonum pensylvanicum L.	Poly.	AmN.	Acc.	Neo.	C	RO-1
Sida spinosa L.	Malv.	AmS.	Acc.	Neo.	C	RO-1, EPPO-OL
Solanum carolinense L.	Sola.	AmN.	Acc.	Neo.	C	RO-1,2,4, EPPO-OL
Solanum rostratum Dunal	Sola.	AmN,C.	Acc.	Neo.	C	Ro-1,1,4,9 EPPO-OL
Solanum triflorum Nutt.var. ponticum (Prodan) Borza	Sola.	AmN.	Acc.	Neo.	N	RO-1,2,4, EPPO-OL
Solanum Triflorum Butt.var. triflorum	Sola.	AmN.	Acc.	Neo.	N	RO-1,2,4 EPPO-OL

Voroboev and his collaborator hade made a weed classification and several research activities regarding the new plants form a wide range of territories (*Vorobiev, 1951*). After the development conditions and crop contamination, the weeds are classified in two groups: non parasitic and parasitic weeds, the second group is devised in two types: parasitic and semi-parasitic weeds. The first type have now chlorophyll and rots, instead have suckers with which are feeding with nutrient substances produced by host plant , by the organs that are attached there are stem parasites (*Cuscuta*) and roth parasites (*Orobanche*). The second type have, green lives and roots, this can feed themselfes because there are capebel to realise the photosynthesis process, but in the same time there are also feeding from the host plant (*Alectrolophus major*). In table 2 is presented the multiplication process of the weeds that are identified on Romanian territory.

Table 2

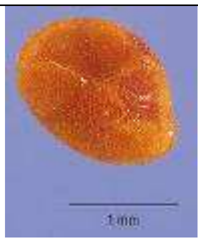
Variation of propagation rate in weeds [4]

Plant name / Weed grupe	Number of produced weed seeds
Amaranth / non-parasitic weed	500.000 ÷ 1.000.000
Broomrape / parasitic weed	100.000
Poppy / non-parasitic weed	50.000
Chamomile / non-parasitic weed	45.000 ÷300.000
Shepherd's purse / non-parasitic weed	40.000
Pelamid / non-parasitic weed	20.000
Wild mustard / non-parasitic weed	10.000
Dodder / parasitic weed	2.500 – 3.000
Odos / non-parasitic weed	800
Wheatgrass / non-parasitic weed	400
Common corn-cockle / non-parasitic weed	300

In Table 3 are presented the details of the quarantine weed seeds, in order to recognise and identify them easily when it is analysed the quality of cereals or seeding material, also this information's are essentially when are used.

Table 3

Details of weed seeds provided for by phytosanitary quarantine legislation

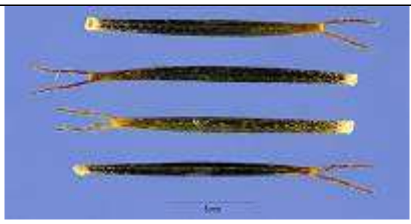
 **Ambrosia artemisiifolia [9]**	 **Cuscuta campestris [10]**	 **Euphorbia marginata [11]**	 **Cuscuta suaveolens [12]**

Ambrosia psilostachya [13]


Ambrosia trifida [14]


Sorghum halepense [15]


Sicyos angulatus [16]

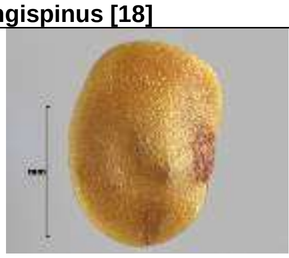

Bidens bipinnata [17]


Cenchrus longispinus [18]


Cenchrus incertus [19]


Ipomoea hederacea [20]

Polygonum pensylvanicum [21]


Solanum carolinense [22]

Solanum rostratum [23]


Solanum triflorum [24]


Euphorbia davidii Subils [25]

Sida spinosa [26]

As it can be noticed in Table 3, some of quarantine weed seeds have the external surface non-regular geometric forms and present asperities and cavities. Due to those physiological properties where develop several seed and cereal conditioning technologic equipment's to increase the purity level of cereals crop or seeding material, in accordance with quality norms and regulations, in order to be capitalise them at highest economic value on European markets.

The ecologic technologies presented in this paper uses an technical equipment with high grade of adaptability within performant conditioning seeding material, to eliminate the parasite weed seeds and to obtain high quality seeding material that provide high productivity, constant development with low investments (low management agricultural costs) and without affecting the environmental conditions (Ciobanu, 2014)

CONCLUSIONS

The ecologic technologies used nowadays, can assure the means to avoid the environment pollution forms by excessive agriculture works (damaging the soil structure), herbicide spreading and reducing its ferity (the weeds have the capacity to develop more quickly and to absorb all the nutrients form the soil, leaving only a small quantity for the crops). Using this technologies have a positive environmental impact:

- Avoidance to accumulate chemical toxic substances in the soil for fertilization or herbicides
- Avoidance to preserve quarantine weed seeds.

- Assuring high quality of agricultural products, of fodder and animal food products;
- Decreasing the air pollution level with: emission – reducing the soil processing actions; chemical substances - crop management treatments to apply herbicides and pesticides; dust – reducing the quantity of dust and dusty materials;
- Decreasing the soil imbalance by reducing the soil computation degree, generated by the passing of agriculture machineries, rational use of water and nutritive substances;
- Lowering the water phreatic layer contamination with chemical substances applied on crop management operations

ACKNOWLEDGEMENT

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[15] http://itp.lucidcentral.org/id/fnw/key/FNW_Grasses/Media/Html/fact_sheets/Sorghum_halepense.htm
[16] http://itp.lucidcentral.org/id/fnw/key/FNW_Grasses/Media/Html/fact_sheets/Sorghum_halepense.htm
[17] http://wisplants.uwsp.edu/scripts/links.asp?spCode=SICANG
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CONSIDERATIONS CONCERNING THE INFLUENCE OF CONSTRUCTIVE AND FUNCTIONAL CHARACTERISTICS OF ACTIVE ORGANISMS TO PELLETISED PRESSES WITH PLANE DIE
/
CONSIDERATII PRIVIND INFLUENTA CARACTERISTICILOR CONSTRUCTIVE SI FUNCTIONALE ALE ORGANELOR ACTIVE LA PRESELE DE PELETIZAT CU MATRITA PLANA

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Keywords: *pelletized, cast, press roll, pelletized press, lignin.*

ABSTRACT
In this paperwork is presented an complete analyses regarding the influence of die geometric configuration (diameter, thickness, width, the section of die channels, surface quality, applied thermal treatments) and the functional parameters (dimensions and number of the pressing rolls, the distance between them and die, roller shaft speed, etc.) upon the performance of flat-rolled pelleting presses. This research is a study of the main active parts, necessary to establish the optimal technical solution, to assure the pellets quality and lowering the material and energetic expenses.

REZUMAT
Lucrarea își propune o analiză cât mai completă privind influența factorilor constructivi (diametrul matritei, grosime, lațime, forma canalelor de presare, calitatea suprafetei canalelor de presare, tratamente termice aplicate) și funcționali (diametrul și numarul rolelor de presare, distanta dintre role, turația axului cu role, etc.) asupra performanțelor preselor de peletizare cu matriță plană. Acestă cercetare este un studiu ai principalelor organelor active, necesar pentru stabilirea soluției tehnice optime, în vederea asigurarii calității peleților obținuți și reducerea cheltuielilor materiale și energetice.

INTRODUCTION
The worldwide wood pellet market knows a great growth starting from 2006 (the wood pellets production was estimated 6 ÷ 7 million tons, not including Asia, Latin America and Australia) and in the last five years the biomass power source was used at a large scale. "In 2010 the global wood pellet production reached 14.3 million tons, including the above mentioned countries, while the consumption was close to 13.5 million tons thus recording an increase of more than 110% if compared to 2006" [13]. In Fig.1, is presented the spreading of wood pellet industry and the market impact in Europe and North America and its growing tendency.

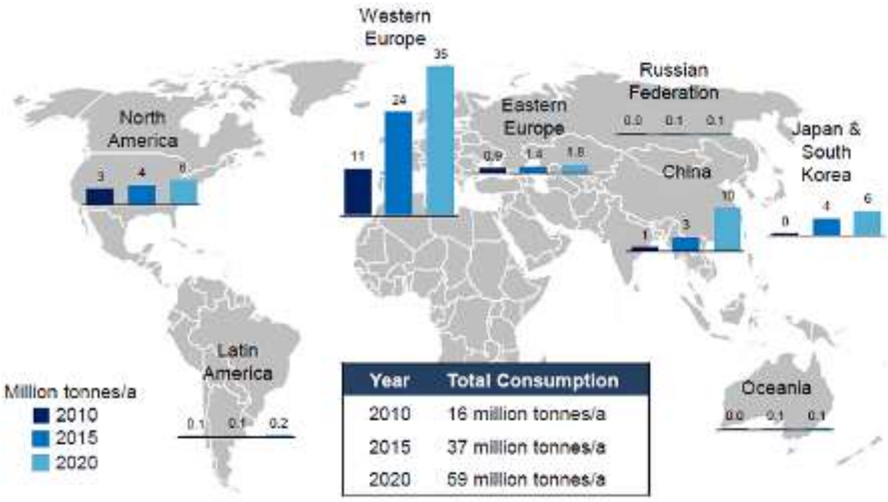

Fig. 1 - Worldwide wood pellet outlook [13]

This tendency is supported by the fact that there are environmental policies that encourage the consumption of renewable bio-fuels (power sources generated from agriculture, viticulture, forestry, forests and newer aquatic crops) that can be economically sustainable by greening and afforestation areas, which present calamity risk and a pollution factor, and also have a positive environment impact on the atmospheric ozone and carbon absorption.

Usually, the pellets are made from wastes from wood processing technology (sawdust, shavings, wood pieces, branches), from energetic trees and crops (willow, poplar, miscanthus, etc.), as well as from agricultural waste (straw, corn kernels, corn or sunflower stems, flax and hemp residues, vines, sunflower seed rape, rapeseed, etc.), and the products obtained are known, on energetic market, as an valuable ecologic power source and an alternative solution to classic fuels (natural gas, CLU, fire wood, etc.). The pellets made from agricultural waste and residues are known also as agri-pellets [6,7,8].

Using the pelletization technology is aimed to capitalize the wastes from wood and vegetable wastes from agriculture, forestry, cereal processing sector and from food industry, as an alternative fuels in order to replace firewood, which is widely used in Romania. In this way it is increased calorific power and increased storage capabilities, on the one hand, and on the other hand it also solves the problem of vegetable waste. Annually, thousands of tons of straw and vegetable waste are unexploited, by burning the land on which they are located, thus generating environmental pollution or burning adjacent lands.

The pellets production has a great specificity, the technologic process is accomplished without adding binder material on raw material, and in order to pass through press die the raw material must meet the following conditions: humidity, chemical composition and granulation. The processed bio-material has the pellets shape and can be used as bio-fuel in individual household plants which can function on the classic principle - combustion or as raw material for biogas generators - pyrolysis.

Most commune application in Romania, especially in farms and households in rural areas, the pellets are used to generate heat and for this reason their dimensions are within certain limits: pellet diameter 6 ÷ 8 mm and a length of 20 ÷ 40 mm.

On market are sold a wide range of pelletized presses and their operating principles, depends on the die type (flat and ring die) and on productivity (household usage, Q < 200 kg/h and semi-industrial utilization Q > 400 kg/h), Fig.2. The difference between them is the supply system, for household press have a manually supplying system and the semi-industrial ones are implemented in automated manufacturing lines, that have raw materials preparation equipment's (magnetic separators, sorting and milling machines, dryers, etc.) and pellets conditioning (for pellet cooling, sorting, etc.) and for their packing.

a-Flat die pelletization press and cylindrical rolls ;

b- Flat die pelletization press and conical rolls

Fig.2 - Most representative palletization press [12,15]

The main active organs of a pelletized press are the die and the pressing rolls. Their interaction during the equipment operation is carried out consisting in pressing the raw material through the die channels, as it is presented in Fig. 3.

The technologic process is doing so. The raw material that has a uniform granulation is dosed at the machine upper part *A* and generates a material layer on die surface in order to fills the space 6. The cylindrical roles *5* are driven in rotation movement by a central shaft that is placed in pressing chamber center. The central shaft generates a constant pressing force upon the raw material, force that is controlled by a precision hydraulic system 1, se detail from Fig. 3. During the operating process, the raw material presents a relative movement between die 5 and cylindrical pressing roles 2 and a mechanical milling due to friction and crushing forces between them.

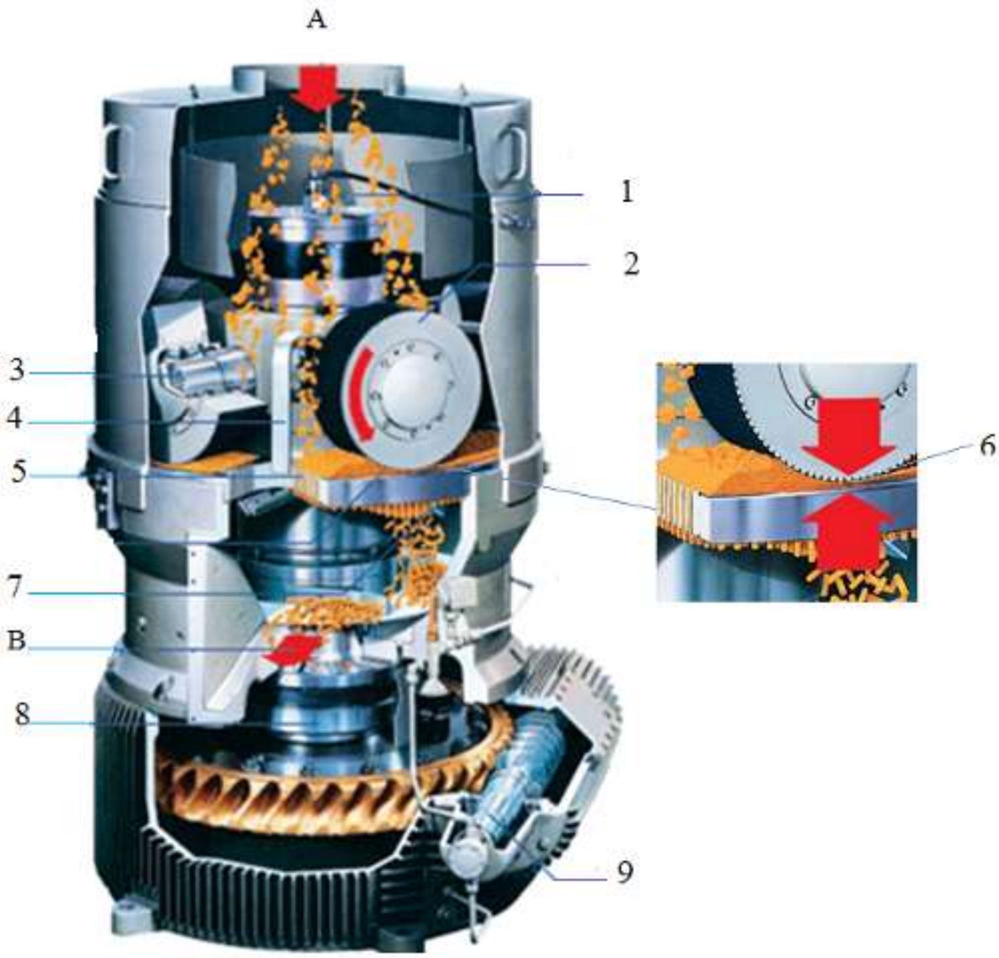

Fig. 3- KAHK peletisation press and its working process [16]

A - product inlet; B - pellet discharge; 1 - hydraulic roller adjustment device; 2 - cylindrical pressing roll; 3 - roller bearing; 4 - scraper; 5 - flat die; 6 - roller gap; 7 - cutting device; 8 - main shaft bearing; 9 - gear

The friction forces, also generates an structural modification of raw material due to thermal effect, the water contained is transformed in steam that lead to plastic deformation of the material (the paste it is composed of melted lignin blended with cellulose fibers) it is stuck on die surface and injected through its orifices. The new supplied material increase the raw material level and it is laminated at the same dimension as roller gap [3]. If the material hardly passes thou is openings and the paste is more fluid, it is possible that the paste do not pass throw and will be laterally displaced on the rollers side, for this reason it is required that the die openings surface roughness to be low and to decrees the flow resistance, their dimensions are usually between 1.5 ÷ 2 mm. At every pass under the rolls, the processed material it is clinging to the material injected at the previous turn, because the lignin is the main ingredient that it is lubricate at high temperatures 70 ÷ 80 ^{0} C and the cellulose fibers are modeled at even higher temperatures. With these successful bindings the pellets at a short period of time, come out as a whole body.

According to this observations, can be stated that the row materials that have a great quantity of lignin, as coniferous waste, it is transformed in a more fluid paste and for this reason the die opening are shaped with an convergent surface that has an greater inclination angle and a certain length. This values are usually established in accordance of each raw material and humidity [1, 2]. As an example, when it is used lime wood waste passes throw convergent opening with a greater length due to is low lignin content. In Table 1, it is presented the lignin perceptual content depending of the raw material provenance.

Table 1

The lignin content of some wood and agriculture wastes.

No. crt.	Material	Average lignin content [%]	No. crt.	Material	Average lignin content [%]
1	Fir timber	33.30	9	Poplar timber	23.75
2	Spruce timber	33.25	10	Birch timber	22.71
3	Pine timber	28.66	11	Hornbeam timber	21.13
4	Willow timber	27.64	12	Lime timber	20.67
5	Elm timber	28.56	13	Wheat straw	30
6	Sycamore timber	27.38	14	Oat straw	17,5
7	Acacia timber	27.13	15	Rice straw	14
8	Oak timber	27.08	16	Hemp straw	17
9	Beech timber	24.75	17	Jute straw	23.5

At the die outlet, the pellets enter in the cooling phase and the lignin solidifies the material, keeping its size and shape. If the raw material had a grate humidity, the water do not boils when it is evacuated from the die opening, it is depressurized and the water is sudden vaporized. In this way the pellet structure it is damaged and the technological process cannot guaranty the pellets quality. If the humidity is to low, the steam generated is not sufficient to prepare the raw material to pass in the plastic regime, and the paste quantity is reduced, the melted lignin it's not enough, and the previous battles do not stick and the pellets come out short and frail.

From the above presentation results that, the die geometry depends mainly from lignin waste material content and the pelletization technology must be provided with a set of adaptable die's able to various types of wood and crop residues, but also a system for controlling the working parameters.

In more advanced pelletizated technology, before processing, the raw material is it is further heated up to 120 - 130 °C without getting wet, using dry steam. This heating allows the lignin to enter in the liquid state, increasing adhesion between solid biomass particles by creating favorable conditions for cohesion and adhesion.

Most pellezation technological process, require a row material humidity between 10 - 15 % and must be controlled that to assure a uniform working parameters. So, if we control the row material properties (humidity, granulation, etc.), the adequate geometry configuration of the active working parts, the optimum working parameters, will be obtained high quality pellets (high mechanical durability, high caloric power, high bulk density and low abrasive element content), see Fig.4.

Fig. 4- Types of pellets made from different vegetable wastes [17]

MATERIAL AND METHOD

As it was presented in the above chapter, the pelletization process is influenced by material properties, the die design and the cylindrical pressing roles design. In this view, it is made a mathematical model of the active parts, their characteristics and their influence in the pelletization press working process.

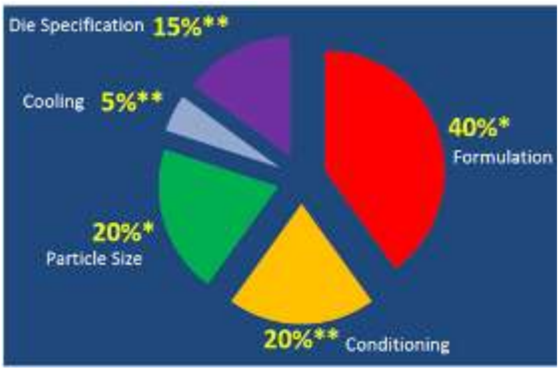

Fig. 5 - Factors that influence the pellet Quality [14]

From technological point of view the die design and manufacturing has the greatest role in the pelletization process, see Fig.5, and for this reason in the most prestigious theoretic studies are made in accordance with the next constructive parameters: die with, pressing openings position and their shape- die configuration, the quality opening surface, the material from which are manufactured and the thermal treatment made. The flat die configuration it is achieved in order to cover the active surface and to have grate productivity (number of openings), form this point of view it is estimated the fraction of opening total surface and the total pressing roll contact surface, and the space between them must be chosen in order to assure the die resistance when it is applied the maximum pressing force, usually the distance it is of approx. 3 mm. At the most pelletization press made manufactured are provided with three type of die: die with openings placed in concentric circles at constant diametric distance, see fig.6.a; die with openings placed in concentric circles at variable diametric distance, see fig.6.b and die with openings placed on a row, see Fig. 6.c.

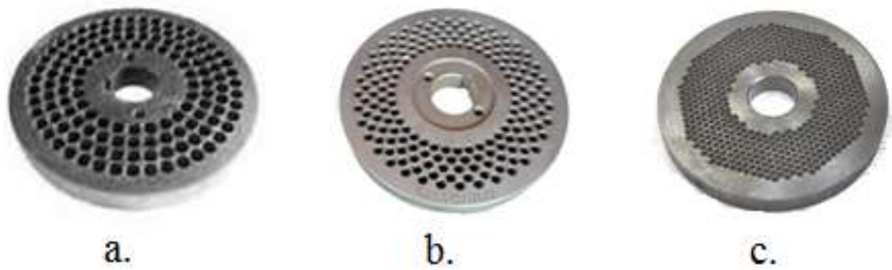

Fig.6 - Different die configuration - openings layout [18]

The die with is chosen in accordance with opening diameter, on pressing forces and the raw material properties. Usually, it is required that the material to pass thru die very hard in order to at the end of the process to obtain good quality pellets. For low power pelletizated press (P<15kW) are used thin die and for industrial usage are used thick dies. If the die has a large diameter it is possible to assure its rigidity by two ways, by increasing the distance between the openings at 4 mm and to increase its thickness *h* (35 ÷ 45 mm). In order to assure a high productivity, the pressing force is gradually increased by generating at the active die surface convergent surfaces that are established depending on row material type, see Fig.7.

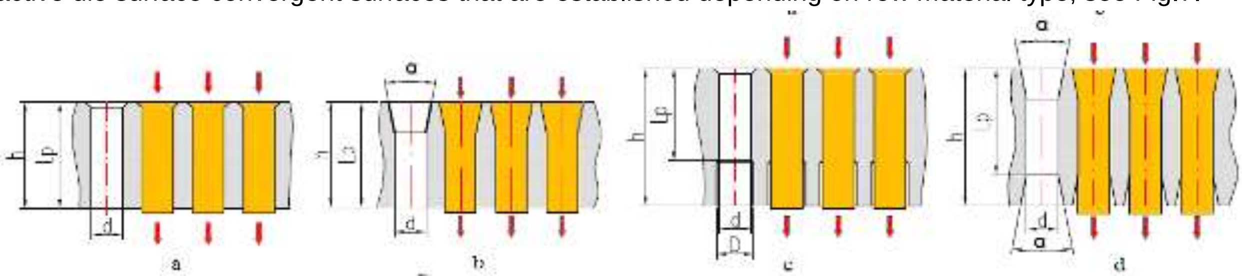

Fig. 7. Different openings and constructive parameters meet flat die [11]

a- Thin die with pressing openings that have a large inclined convergent surface; b- Thin die with pressing openings that have a small inclined convergent surface; c- Thick die with pressing openings that have a large inclined convergent surface; d- Thick die with pressing openings that have a small inclined convergent surface; h- die thickness; Lp- openings length;

For thin die (Fig.7.a and b) the thickness h is equal with pressing length Lp, after a number work hours the die is worn out requires its replacement. In Fig.7.c is presented a die that its thickness is greater (h> Lp) and for this reason its holes are provided with escape channel (D>d) that provide easy output of pellets from the die. In Fig.7.d is presented a thick die has the same geometry as previous case on bought sides in order to have two working surfaces.

Usually in scientific literature the parameter that define the configuration of pressing openings it is named compression coefficient *c* and it is defined as the fraction of opening length *Lp* and its radius *r,* see equation (1)

$$c = \frac{L_p}{2r} \tag{1}$$

In practical application this coefficient is establish in accordance with processed material type a high value of this coefficient generates: high working temperatures and a high electric power consumption and due to this fact are obtained high pellets quality and humidity and sometimes this working condition can cause pellets blocking in openings. A smaller compression coefficient cannot generate high temperatures - minimum temperature working, the engine has small power consumption, the pellets have a small density and the row material can be less humid. In this situation it is necessary sometime a preliminary heating system.

The forces generated during the material pressing when passes through an mold opening are presented in Fig.8, when: *x* - the distance between the micro unit and the exit; *dx* - the length of the micro material unit along the axial direction of the die hole; *Px* - the axial pressure of the material at *x*; *dV* - the volume of the micro material unit; *dPx* - the axial pressure difference of the micro unit; *dFx* - the axial force on the micro unit; dF_N - the radial force on the micro unit; *PN* - the radial pressure of the micro unit; dF_f - the axial frictional force of the micro unit. [10]

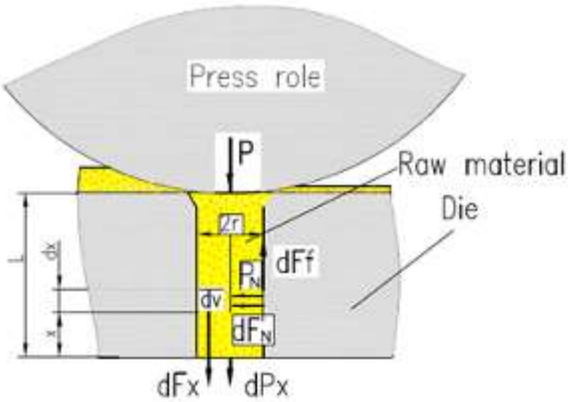

Fig. 8 - Forces generated during the material prelletization process.

The above parameters can be estimated using the mathematical expression (2) until (4), when: *f* - is the friction coefficient of raw material to opening surface.

$$dP_x = \frac{dF_x}{\pi r^2} \text{ [N/m}^2\text{]} \tag{2}$$

$$dF_x = \pi r^2 dP_x \text{ [N]} \tag{3}$$

$$dF_f = f P_N x 2\pi r dx \text{ [N]} \tag{4}$$

The applying the equilibrium condition on the opening direction (x) is presented in equation (5), in order to take place the pelletization process the pressing force developed by the roll must be grater then the resulted friction force, equation (6)

$$dF_x = dF_f \tag{5}$$

$$dF_x \geq dF_f \tag{6}$$

To establish the value of minimal pressing force, it is applied the Hooke low in eq. (5), in which are introduced the specific deformation relations and specific normal forces. After successive replacements and transformations on computing relations it is obtain the equation (7), where: P_{NO} - is the compaction force that depends on plasticity model; υ_{LR} - Poisson coefficient (the L represents the applied stress direction and R represents the transversal direction).

$$P_x = \frac{P_{NO}}{\vartheta_{LR}}\left(e^{4f\vartheta_{LR}c} - 1\right) \tag{7}$$

As it can see in eq. (7) the pressing force has an exponential variation by friction coefficient f and with opening length Lp that is present in compression coefficient expression.

Appling this equations it is possible to establish the die constructive parameters so that to pellets quality and the die durability to be assured. The last requirement can be obtained if the appropriate material is chosen and the thermal treatments, usually are for improvement alloy steels (40 Cr 10; 26 MoCr 11; 34 MoCr 11; 51 VMnCr 11; 40 CrNi 12; 30 MoCrNi 20; etc.) which can provide, after thermal treatment, good stiffness, hardness, tearing resistance and implicitly long life.

In most cases the thermal treatment it consist in hardening followed by tempering. The improvement alloy steels hardening depends on the type of steel, carbon content and geometric complexity, during this process it is obtained the martensitic stage, which presents an unstable, tough and fragile structure. For this reason it is inadequate to be applied a tempering process (in oil, water or air) that improve its stability and lowering its fragility. Usually, the tempering process is determined in accordance with die thickness, especially the period of time on which is assured a constant temperature to equalize the part temperature and after that its air cooled. In metallurgy, the main process parameter on which depends the mechanical properties maintenance and piece wear degree is tempering temperature, if this value is high, the stiffness and hardness decrees, but the internal stresses and fragility are lowering [19].

The pressing roles constructive parameters and their number, have a great influence of pelletization process, especially in the case in which is used a flat die. In practical applications, the number of pressing roles can be from 2 until 5, see Fig.9. Their number is limited by working space (the distance between the roles must be large enough in order to assure a constant supply material quantity) and the power actuation system (the power supply unit must generate necessary torque drive). This parameter is usually influenced by the: width, diameter and roller exterior surface configuration, but also by the type of raw material used.

Fig. 9 - The pressing role systems with 2 until 5 pieces [20].

As the number of pressing rollers is greater, passing role fervency over the pressing channel is higher, that leads to: production incensement but also the number of passes over the channels, achieve a greater activation lignin grade, a better particles bonding, therefore a better quality of the pellets obtained from a higher humidity material if the operation process is appropriate to these working conditions. The material pressing period depends by the time that a roll lies on a die hole, parameter that depends only on the roll speed, due to the fact that the number of pressing roles is high the fervency is increased, so it increases the material displacement speed through the hole, evaporates less water and hence the admissibility for dry material, fact that can be achieved also with two rollers if it is increased the rotation [9,10].

The rollers cannot exceed certain limits because at higher speed the pelletized material does not enter under the pressing rolls in the necessary amount and in this way it can thrown on the pressing walls due to centrifuge force, fact that leads to productivity decrees.

Taking in to consideration the above considerations it can be concluded that, the equipments with a large number of pressing roles must have a small central spindle. For example, in this case it has been experimentally proven that a two-roller press with a spindle speed of 90 rot/min has the same productivity as three role press that has a 60 rot/min speed, in the case where the constructive die properties and roles are the same. In bought cases the passing over frequency over the pressing opening is the same [4].

During the pelletization process between the pressing roles and die surface are generated geometric glide that lead to premature wear of the pressing parts, see Fig. 10 and this effect can be described from mathematical point of view using equation (8), where: ξ_g - is geometric wear; v_r - the role speed in median position, $v_{al\,max.}$ - the maxim wear speed ($v_{al\,max.} = v_{r\,max.} - v_r = v_{r.} - v_{r\,min.}$). The median contact point speed v_r point in which the geometric wear is zero is replaced and it is obtained the equation (9), when: b – roll with and R_2 – the median radius of the circular role trajectory.

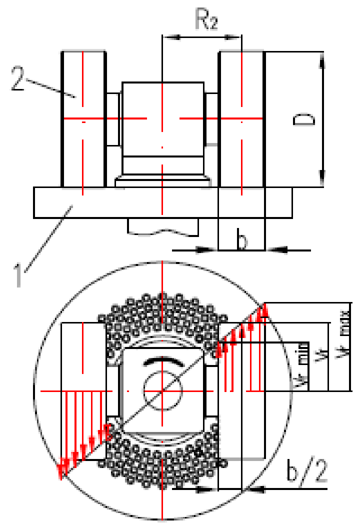

Fig.10 Geometric wear that are usually happen during the pelletization process

1 –pressing die; 2 –pressing role

$$\xi_g = \frac{v_{al\,max.}}{v_r} \quad (8)$$

$$\xi_g = \frac{b}{2R_2} \quad (9)$$

The equation (9) describes that:

- once with role width incensement the geometric wear is bigger;
- once with median radius decrease of the circular role trajectory the geometric wears are rising.

This phenomenon can be often in practical applications and can be identified when at the peripheral die surface and the exterior role age is more tear. In order to reduce the geometric wears it is necessary to use narrow roles to move on the die active surface and by replacing the cylindrical roles with conic one.

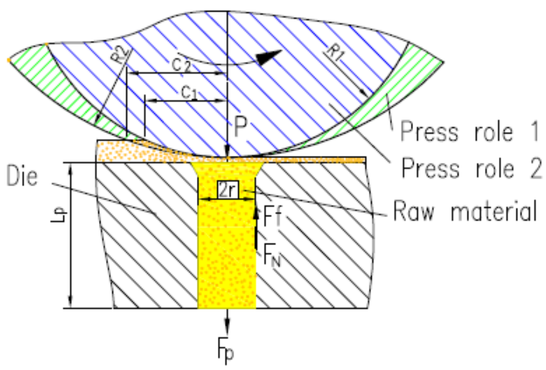

Fig.11 Roller diameter influence on contact surface between die and rolles

R1-roll diameter 1; R2- roll diameter 2; C1- the dimension of contact surface 1; C2-the dimension of consct surface 2.

Another working parameter that depends the pelletization process is the pressing role diameter , respectively the incensement of contact surface between the role and die, the greater the pressing roller diameter, the greater the contact surface, fact that is presented in Fig.11, and also a greater pressing force in order to supply a greater number of openings in the same time. In some of those cases, must be increased the pelletised material adhesion to the outer surface rollers are provided with holes or channels with different configurations, Fig. 12.

Fig.12 Different configurations of the pressing rollers outer surfaces.[20]

The influence of functional parameters are also studied in those equipments.

- In case in which, the distance between the rolls and the mold is higher, the processed material will pass under the rollers, will not be pressed into the holes and large wear will occur at the periphery of the die and at the outer edge of the rollers, in this case the pressing material is less, especially into the outer die holes and pellets evacuation is difficult, so the equipment production decreases and the wear worsens
- The adjustments between matrix and roller is required to be between 0,2 - 0,5 mm, otherwise the rollover phenomenon is produced, and in this case the die can be laminated and the material input is partial blocked in to pressing channels , preventing the material proper pressing in the holes. This phenomenon occurs less frequently in the d properly perform the thermal treatments dies;
- If the die temperature is maintained between 110 -120 ^{0}C and the pressing conditions are normal, the pellet temperature at the evacuation is 75-85 ºC.[5]
- If a roll works very slow or is block, it will: raze the processed material from the die surface, will partially interrupt the pelletization process amplifying the wear, rise the process temperature, the die and rolls will be overheated fact that can generate the material self-ignition (approx. 140-150 ºC, depending on the material consistency).

CONCLUSIONS

In this days the pelletization machines are used to assure the necessary thermic energy especially for rural communities that have enough resources to assure energetic autonomy, especially from agri-waste, wood waste or other vegetable crop waste. For large communities is better to associate and to acquire a large production technology in order to commercialize the excessive material. The raw material supplied must assure enough lignin to maintain the pellet quality and a certain humidity. This process must be ferry well controlled in order in order to avoid trouble shooting. In practice even if is correct chosen the right die can be identified the next trouble shooting:

- For a new pellet mill or new pellet die, it is not easy to form pellet. In this situation it must be done some mixture of fine sand within the raw material and with generous amount of oil. Recycling this mixture through machine for ten minutes and after that the pellet mill can enter in production process;
- When the production is ending or the pellet mill is turned off, it is necessary to be fed with oil materials in order to fill the die holes in order to prevent rusting and blocking.

  Due to the fact that this process is complex can appear very different problems that can be solved only with experience operators.

The flat dies have the advantage that have small size and light weight, easy to maintain and clean, most importantly, much cheaper than ring die, roughly speaking, the flat die is usually adopted by small wood pellet machine or homemade pellet machines for the low production cost and low purchase price while the ring dies are generally installed in the larger scale pellet machines for the high productivity.

The main disadvantages of presses with more than 2 rolls are:

- the need for a very robust drive motor with a high reduction ratio;
- requires a bearing with higher permissible loading capacity due to the fact that the pressing pressures are higher, fact that lead to higher costs;

- constructive difficulty of the roller shaft and a greater diameter in order to avoid the overloading fact that generates a greater torque and high manufacturing costs.

ACKNOWLEDGEMENT

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COMPLEX TESTING OF PROTECTIVE STRUCTURES OF OPERATORS IN AN OVERTURNING INCIDENT
/
TESTRAREA COMPLEXA STRUCTURIILOR DE PROTECTIE A OPERATORULUI IN CAZ DE RASTURNARE

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Keywords: *protective structure, tractor, ROPS.*

ABSTRACT

The rolling / roll over of the tractors is the main cause of accidents in agricultural and forestry exploits, so testing of operator protection structures is necessary in order to reduce the risk of injury in case of rolling / overturning. The present paper presents the procedure used for testing these equipments and the results obtained following the static tests of an operator protection structure in case of an accident, such as rolling or roll over (ROPS- Roll over protection structure).

REZUMAT

Rasturnarea/rostogolirea tractoarelor reprezinta cauza principala a accidentelor in exploatarile agricole si forestiere, astfel fiind necesara testarea structurilor de protectie a operatorului, in vederea reducerii riscului de accidentare in caz de rostogolire/rasturnare. Lucrarea de fata prezinta procedura de testare a acestor echipamente si rezultatele obtinute in urma incercarilor in regim static a unei structuri de protectie a operatorului in caz de accident: rostogolire sau rasturnare (ROPS - Roll over protection structure).

INTRODUCTION

The essential element of mobile / self-propelled equipment is represented by the protective structure, mostly because the safety and health of the operators who drive and handle the tractor, depends on the cabin's resistance. Knowing the fact that during the execution of different construction operations or during the various activities in the rugged forest areas, major risks or accidents may occur (accidental breaks, overturns, falls or blows), the proper testing of protection structures is essential in order to increase the safety of the operator in case of accidents [1 3 4].

Since all mobile machinery present the risk of rolling during their operation (depending on the environment, working area, the characteristics of the machine, etc.), it is necessary that the protection of the operator from the risks that may arise, to be a decisive factor in designing and developing of the protective structure. Thus, there have been established standards and norms referring to the safety of the operators, on the basis of which the manufacturers of the protection structures have to design models meant to ensure the safety of the operator [2 6].

MATERIAL AND METHOD

The cabin must be designed in such a way as to comply with the provisions of Directive 80/720 / EEC relating to maneuvering space, means of access to the driving position, doors and windows, also the role of the cabin is to ensure the safety and comfort of the driver that is serving a tractor designed for forest exploitation [1 5].

The tractor specifications for which the tests were carried out are as follows:

The protection structure for which the research was carried out was designed for the purpose of equipping it on a range of tractors with a maximum mass of 38000 kg. Thus, the mass of the tractor without the driver and with protective structure mounted, was considered to be 38000 kg.

The protection structure has the following specifications:

The cabin is made up of a frame of resistance, made of welded profiles and steel sheet cover, and the interior of the cabin is upholstered. The resistance frame is made up of two side walls assembled by welding on a base made of steel. The side walls are made of pipes, in the middle of which are assembled two reinforcing pillars, supporting the doors. By means of five sleepers made of the pipe, the two transverse walls are strengthened, thus forming a parallelepipedal structure. The roof is set to the frame by welding, and it is made of a steel sheet.

The cabin is fitted with two doors, one on each side. The right door, which also has the role of safety exit, is made of:

- Door frame;
- Door panel;
- Door glass.

At the bottom is a floor made of steel sheet, on the surface of which is mounted by means of a support, the chair of the driver.

Dimensions according to the measurements made after setting the seat reference point, are as follows:

- Localization of DLV:
  - 300 mm in front of the back panel
  - 350 mm DLV to the roof top.
- Height of the protective structure members above the seat reference point: 1266mm
- Height of the protective structure members above the tractor footplate: 1896mm
- Interior width of the protective structure 900 mm above the seat reference point: 1390mm
- Interior width of the protective structure, above the seat reference point at the level of center of the steering wheel: 400mm
- Distance from the center of the steering wheel on the left side of the protective structure: 1260mm
- Distance from the center of the steering wheel on the right side of the protective structure: 1300mm
- Doorways width:
  - At the top 716mm
  - In the middle 716mm
  - At the bottom 688mm

The cab was fastened to the test platform with the use of an universal and specific device system.

Knowing the cab's dimensions and the difficulty of carrying out the tests, the cab resistance tests were carried out in accordance with the provisions of 2009/75 / EC, ISO 8082-1: 2009 Directive and OECD code 4 on roll-over protection structures of agricultural or forestry tractors. Thus, the opening area inside the cabin was materialized by realizing a three-dimensional steel wire structure of ø 5 mm [4 5].

For the longitudinal test, the application point of the load (rear-to-front operation) is set at a distance of 1/6 of the width of the upper part of the protective structure. The measurement was made from the outside (right corner) to the inside (rear view), and the length of the beam with which the uniform load distribution was achieved, was 500 mm. (Fig.1)

Fig.1 -Montage realized on “HYDROPULSE” installation for cabin testing, when the load is applied longitudinal.

For the compression test, where the load was applied in front, the beam was placed on the uppermost crosspiece of the front of the protective structure (Fig.2).

Fig.2 - Montage realized on “HYDROPULSE” installation for cabin testing in case of lateral load application

In the case of a lateral load test, the load application point was on the upper edge of the protective structure, at a distance of 300 mm from the seat reference point, on the right side (rear view). (Fig.3.)

Fig.3 - Montage realized on “HYDROPULSE” installation for cabin testing in case of central crushing

According to the documentation, the reference mass of the tractor is 38000 kg, so for the compression test at the rear, the beam was placed on the upper rear crosspiece of the protective structure (Fig.4).

Fig. 4 - Montage realized on "HYDROPULSE" installation for HSM Hohenloher Heckscheibe - model 208F 20to cabin testing, in case of central crushing

For testing, a hydraulic cylinder was used for longitudinal and lateral drive tests, and for the crushing tests where the load was applied from up to down, two cylinders were used.

The test parameter values are shown below in table no. 1.

Table 1

Test type		**Testing parameters**		
		Name	**M.U.**	**Minimum values calculated according to D 2009/75/CEE and OECD code 4**
Horizontal plane	Rear longitudinal loading	Energy	J	53200
	Lateral loading	Energy	J	66800
Vertical plane	Crushing force	Force	kN	760

In order to carry out the research at INMA Bucharest - Testing Department, the research infrastructure of the simulated and accelerated Hydropulse testing system was used, with the following equipment:

- Traction-compression dynamometer, load cell from force measuring chain within Hydropulse installation, (40-400 kN), type FC, serial no 008/89 with measuring uncertainty 0.91%)
- Traction-compression dynamometer, load cell from force measuring chain within Hydropulse installation, (40-400 kN), type FC, series 009/89 with measuring uncertainty 0.91%).
- Deflection measuring system with inductive transducer, 0-500mm, resolution 0.1mm, manufacturer HBM, type WA500, series 052110040 with measuring uncertainty 0.010 mm
- Pentium calculator equipped with DAP 5200 E purchase card - Microstar Laboratories.
- U4 - 165 optical beam with 4 gradation sectors, 4-90 °, division 1 ', measurement uncertainty 2'00.
- Digital caliper, 0÷150 mm serial no. SR 44measuring uncertainty 0.07 mm
- Rolling tape measuring device Stanley, L=8 m, serial no 2, measuring uncertainty 0.5 mm + 10^{-4}L.[4]

RESULTS

The load tests were the following: left rear, rear crushing, left side load (rear view), front crushing.

The reference mass used to calculate the input energy and crushing forces, was 38000 kg.

The test parameters and their values are presented in Table 1 and have been established in accordance with the reference mass of the forestry tractor and with the standards in force.

F - force;
Δ - deflection;
U - energy;

$$\mathbf{U} = \frac{\Delta_1 * F_1}{2} + (\Delta_2 - \Delta_1)\frac{F_1 + F_2}{2} + \cdots (\Delta_N - \Delta_{N-1})\frac{F_{N-1} + F_N}{2} \quad (1)\ [5]$$

Further the permanent deformations obtained after the researches were carried out are presented, as well as the absorbed energy obtained during the testing.

- Energy absorbed during rear load application on the right side: 54927,54 J;
- Rear longitudinal applied force, on the right side: 380,10kN
- Energy absorbed during lateral load application, on the left side: 68028,21J;
- Lateral applied force, on left side: 397,88kN
- Rear crushing force, from above: 784,28 kN
- Central crushing force, from above: 791,40 kN

Permanent recorded deformations:

- Rearward: towards front
- - to left: 9 mm;to right: 11mm;
- At the front: towards front
- -to left: 7 mm;to right: 9 mm;
- Sideward:-In front: 15 mm;
- - rearwards: 15 mm;
- At the top: from above
- - In front: 65 mm; rearwards: 15 mm;

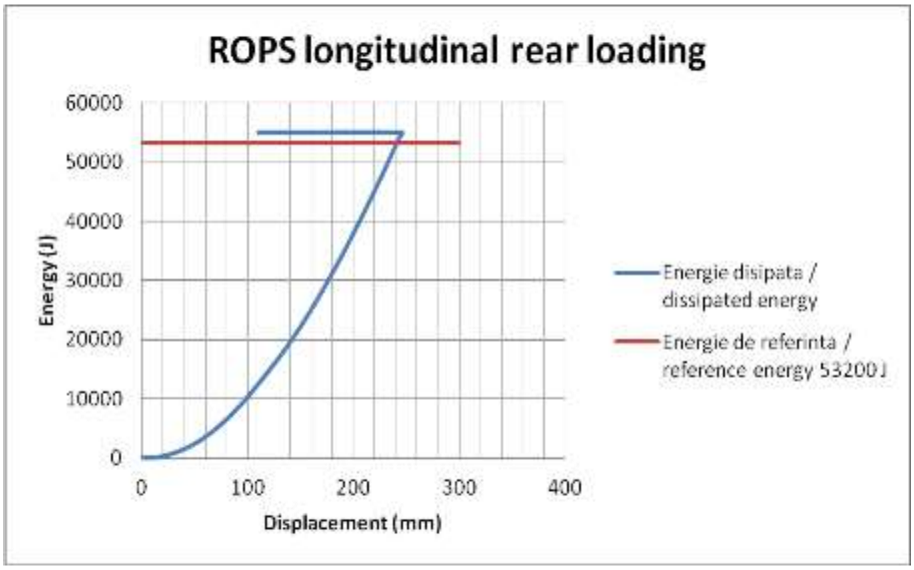

Fig.5 - Energy absorbed during rear load application – 54.927 kJ

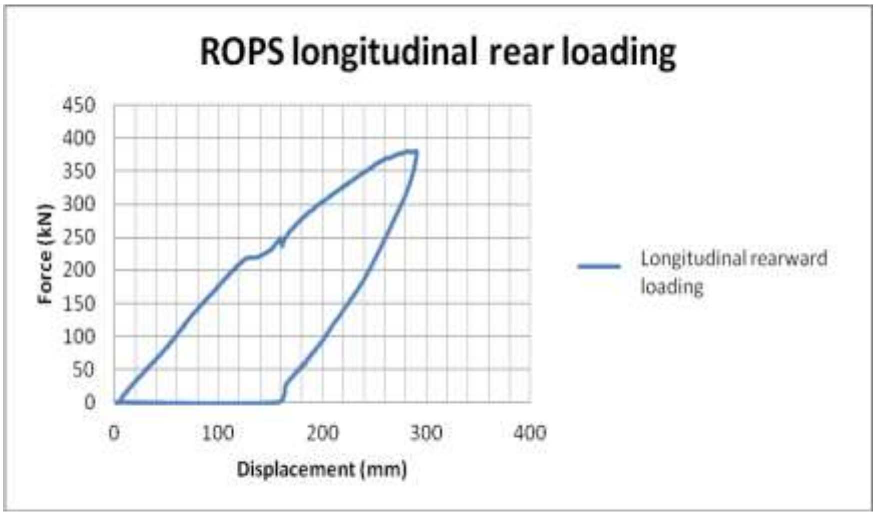

Fig.6 - Force / displacement diagram – Rear applied load

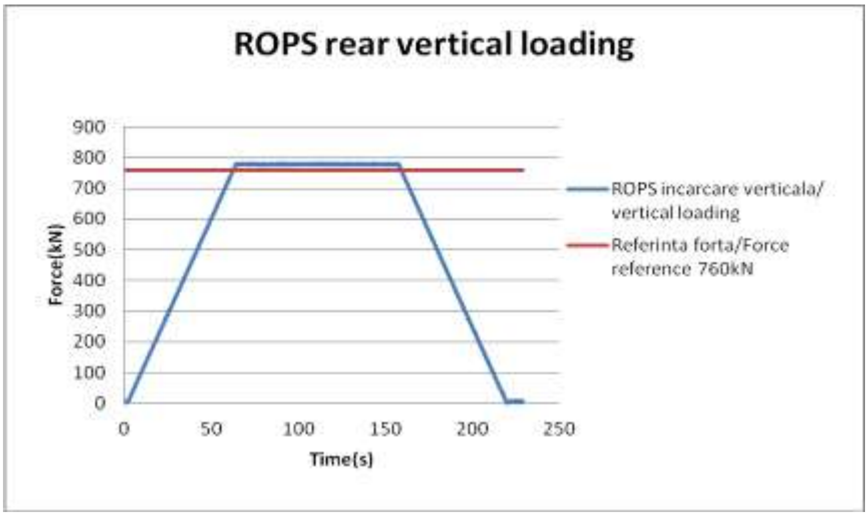

Fig.7 - Force / Time Diagram - vertical load applied to the rear

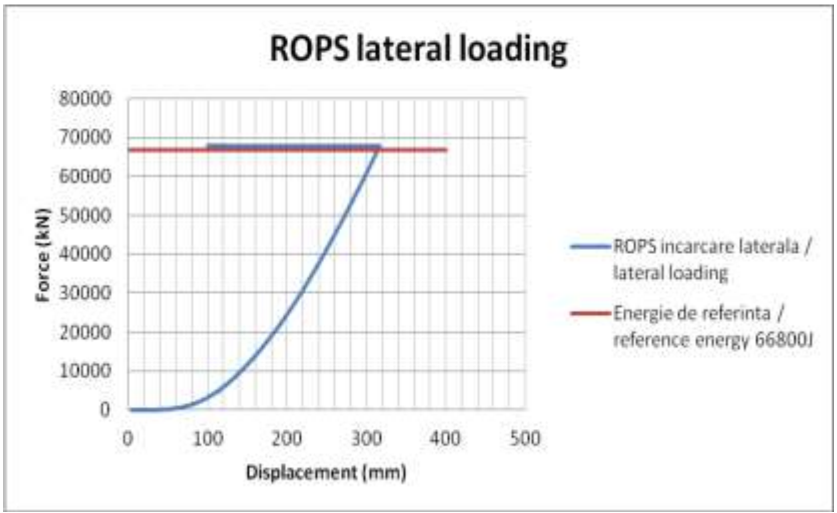

Fig.8 - Energy absorbed during lateral load application – 68.028 kJ

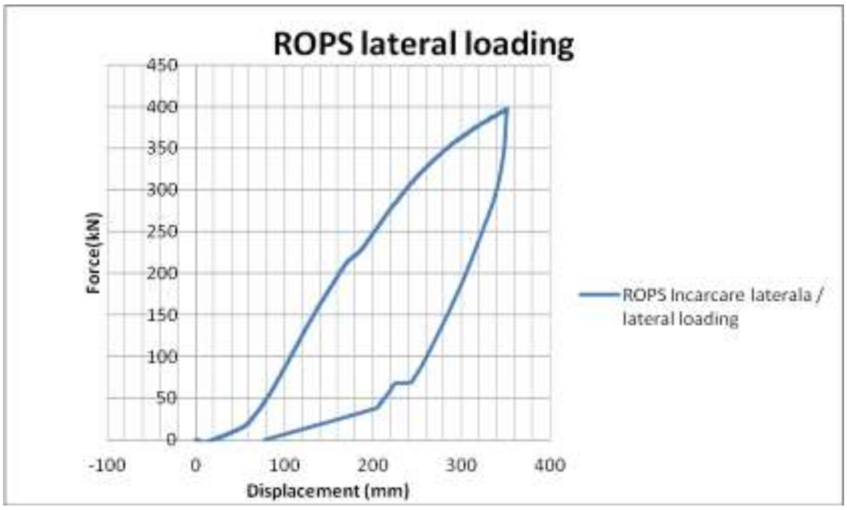

Fig.9 - Strength / displacement diagram - lateral applied load

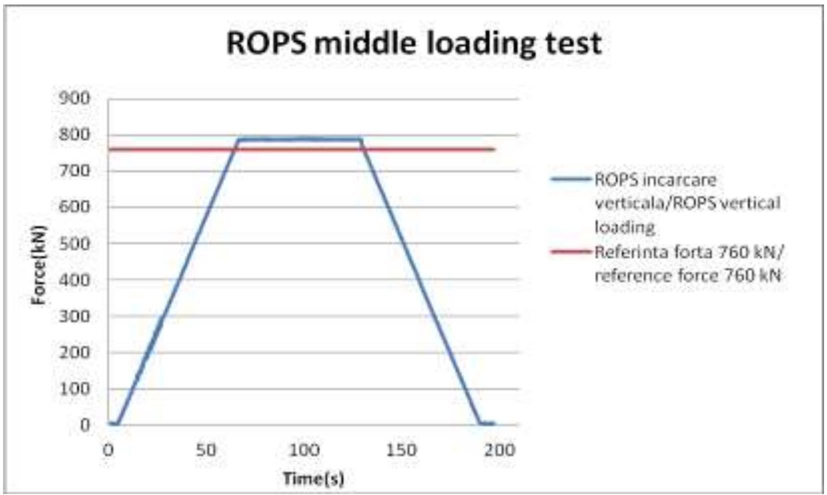

Fig.10 - The force / time diagram - vertical load applied in the center

CONCLUSIONS

Conducting research into the resilience of the protective structure that equips mobile machinery for forest exploitation is necessary and indispensable, in order to increase the safety of the operator. Therefore, the tractor cabin has the essential role of protecting the driver from possible hazards that may occur during its use, such as rollovers and overturns, accidents that in some cases may become fatal.

Thus, a series of researches have been carried out on the Hydropulse type installation. These had the purpose of verifying the take-up capacity of energies and forces for the values of the loads to which the protective structure was subjected, determined on the basis of the manufacturer's documentation corresponding to a reference mass of a 38000 kg tractor.

Following the made researches, it was found that the protective structure (cabin) did not show visible fractures or cracks. Also during the experiments, no part of the cabin has entered the clearance zone.

ACKNOWLEDGEMENT

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CONSIDERATIONS ON THE ECOLOGICAL EQUIPMENT AND MECHANIZATION TECHNOLOGIES USED IN CEREAL AGRICULTURE
/
CONSIDERATII PRIVIND UTILAJELE ȘI TEHNOLOGIILE ECOLOGICE DE MECANIZARE FOLOSITE ÎN AGRICULTURA CEREALIERĂ

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Cuvinte cheie: *chemical pollutionecological methods, organic products, organic agricultural practices*

ABSTRACT

Agricultural machines are designed to carry out a wide variety of ecological farming methods in order to increase the work productivity, while respecting high quality indices, reducing losses and costs on the cultivated surface with reduced physical effort and manual labor. These aspects reflect the global trend towards the execution of a large number of agricultural works in compliance with the ecological norms imposed on each of the tasks. These aspects are justified by the endowment of agriculture with machines and installations, the creation of new machines and types of installations, by extending them to all the works that can be mechanically executed.

The major questions and criticisms of the intensive modern agricultural practice refer to the fact that it: damages the soil structure; is harming the natural environment; creates potential risks of foodborne illnesses; • determined the reduction of food quality; is an energy intensive system; involves intensive livestock production systems that are ethically unacceptable - genetic mudifies.

Diseases, pests and weeds in this crop system can be combated by cultivating the most resistant varieties / hybrids, by appropriate crops, mechanical and physical methods of control, protection of useful fauna, etc.

According to these standards, organic farming has the following role: to produce high quality food in sufficient quantity; to work with natural systems; to maintain and increase long-term fertility of soils; to use as much as possible renewable resources in agricultural systems; to work as much as possible in a closed system; to ensure all animal living conditions to enable them to do all aspects of their native behavior; to avoid all forms of pollution that may result from agricultural techniques; to maintain the genetic diversity of the agricultural system and its surroundings, including the protection of the plants and wild habitats; to allow agricultural producers to obtain adequate income and satisfaction from their work, and also offering a secure job.

REZUMAT

Masinile agricole sunt destinate efectuarii lucrarilor de o mare diversitate din agricultura ecologica in scopul maririi productivitatii muncii cu respectarea indicilor calitativi ridicati,reducerea pierderilor si al costurilor pe suprafata cultivata odata cu reducerea efortului fizic si a muncii manuale.Aceste aspecte reflecta tendinta pe plan mondial privind executarea unui numar cat mai mare de lucrari agricole cu respectarea normelor ecologice impuse fiecarei lucrari in parte.Aceste aspecte se justifica prin dotarea agriculturii cu masini si instalatii performante,crearea de noi masini si tipuri de instalatii, prin extinderea acestora la toate lucrarile care pot fi executate mecanizat.

Întrebările majore şi criticile practicii agricole moderne intensive se referă la faptul că aceasta: dăunează structurii solului; dăunează mediului natural; creează riscuri potenţiale de înbolnăviri prin alimente; • a determinat reducerea calităţii alimentelor; este un sistem energo-intensiv; implică sisteme de producţie animalieră intensivă care sunt etic inacceptabile – mudificari genetice.

Bolile, dăunătorii şi buruienile în acest sistem de cultură, pot fi combatute prin cultivarea celor mai rezistente soiuri/hibrizi, prin asolamente corespunzătoare, procedee mecanice şi fizice de combatere, protejarea faunei utile etc.

Potrivit acestor standarde, agricultura organică are rolul: de a produce hrană de calitate ridicată şi în cantitate suficientă; de a lucra cu sistemele naturale; de a menţine şi mări fertilitatea pe termen lung a solurilor; de a utiliza cât se poate mai mult resurse regenerabile în sistemele agricole; de a lucra cât mai mult într-un sistem închis; de a asigura toate condiţiile de viaţă animalelor pentru a le permite să îndeplinească

toate aspectele comportamentului lor înăscut; de a evita toate formele de poluare care pot rezulta din tehnicile agricole; de a menţine diversitatea genetică a sistemului agricol şi a împrejurimilor sale, inclusiv protecţia plantelor şi a habitatelor sălbatice; de a permite producătorilor agricoli obţinerea unui venit adecvat şi satisfacţie din munca lor, inclusiv de a asigura un loc de muncă sigur.

INTRODUCTION

Organic farming means that the crop system that aims at capitalizing and preserving productive organic systems without resorting to synthesis chemicals. Organic farming is a method of production that takes into account traditional knowledge and integrates scientific advances in all agronomic fields.

One of the main goals of organic farming is protecting the planet's biosphere and resources. The principles of organic farming are based on maximizing local resources and minimizing economic and environmental risks. The organic production method differs from the conventional one by avoiding the use of chemical fertilizers and pesticides and promoting sustainable, balanced production systems, in order to prevent the pollution of the crop and the environment. The basic rule of organic farming is that natural inputs are allowed, while synthetic ones are forbidden.

The current importance of organic farming results have the following advantages:

• Less polluted air, water and agri-food products, by expanding organic farming, also the air has a better quality mainly because it no longer uses chemicals. The use of pesticides causes a lower risk of contamination of agricultural products. Organic agricultural products are healthy, safe for human and animal consumption. In order to prevent future contamination and pollution of the environment in Romania, they have settled national legislation on the production, processing and marketing of products organic farming, in accordance with international norms, namely Government Emergency Ordinance no. 34/2000, respectively Law no. 38/2001; H.G. No 917/2001 for the approval of the methodological norms for the application of these regulations. In order to implement the provisions of these regulations, the National Authority for Ecological Products (ANPE) operates as a specialized service within the Ministry of Agriculture, Food, Forestry and the Environment, which ensures compliance with all specific legal provisions and ensures control over organic production methods in agro-food products.

MATERIALS AND METHODS

Particular reference has been made to fertilizers and herbicides spreading machines as they greatly influence the ecology of the crop by spraying materials and solutions in order to avoid as far as possible the deterioration of the products of these crops in terms of animal and human consumption.

All these machines must be designed in such a way that both the agricultural land where they are used and the integrity of the products used in the intersecting crops are protected from the environmental point of view.

Agricultural machinery systems means all the types of agricultural machinery necessary for the mechanization of the agricultural production process has to respect all the ecological work for a healthy agriculture.

In this regard, it will be attempted to avoid using polluting methods together with the machines they serve in order to avoid further degradation of these agricultural areas in the future.

The food and therapeutic value of vegetables will increase as they grow in organic farming. Products obtained in this way are environmentally friendly and do not contain nitrate residues or pesticides and are healthy for food consumption.

In the field of weed control and pests, INMA Bucuresti is studying a method of eliminating them from crops by a method of stopping steam and delaying vegetation of weeds in crops. By this method the development of basic crops before weeds is carried out without leaving space for further development.

A traditional method of combating weeds in the mechanized method is used by cultivators in sowing plants where they are digged in a row.

RESULTS

CLASSIFICATION OF AGRICULTURAL MACHINES IN FUNCTIONING THE WORK

Agricultural machines differentiate between each other according to several criteria: by the work they perform, by the way the working process is executed, by the way of the action.

The most used classification of agricultural machinery is made by the way it works:

-Machines for soil works (cultivators, levellers, mills, plows etc.)

-Seeding and planting machines

-Farm machines

-Machines for pest control

-Machines for harvesting

-Machines for processing agricultural products.

Agricultural spreading machines are used for spreading on the soil surface or incorporation into the soil uniformly and in certain quantities with the help of some pests or the spreading speed of the spreading aggregate. By the fertilizer application method, the machines to be handed out are the following:

- spreading fertilizers
- fertilizer incorporation equipment

According to the working mode the fertilizer spreaders (manure spreaders) are also grouped into:

-Manure spreaders with dispensers and dispensing devices available over the entire working width;

-Manure spreaders with centrifugation;

-Manure spreaders with pneumatic distribution (mechanical dosing, air transport and spreading).

The "Kuhn" solid fertilizer spreader has a long use for both field crops and many other crops with high precision and efficiency and high comfort.

Fig.1. Sprayers and liquid fertilizers

Agricultural machines with the highest degree of pollution are the sprayers, Fig.1. It is needed to eliminate these toxic substances and replace them with friendly and intelligent substances that distinguish plants that need to be protected from harmful plants.

Sprayers are intended for application by spraying of liquid pesticides as solutions, suspensions, or emulsions in fine drops and in quantities determined on the surface of plants, soil, etc.

They are categorized by the mode of operation and the energy source used:

-operated by human force (in front or in the back)

- Mechanically trailed spraying machines (towed or worn on tracks, planes, helicopters).

By destination, sprayers can be: for field crops, for vineyards, for orchards or universal crops.

After spraying of solutions, suspensions or emulsions: with mechanical spray, hydraulic spray, pneumatic spraying and combined (hydropneumatic) spraying,

The best self-propelled sprayers are those that cover very extensive single-pass surfaces, through precise, no-loss dosing, thus reducing production costs.

For a faster movement of the machine on uneven ground, an independent pneumatic suspension on each wheel has been built to speed up to 40 km / h.

Accurate application of ecological treatments and distribution through automatic ramp and height control while maintaining a constant working height of the workpiece, is done by means of "Boom Trac" sensors, Fig.2

Fig.2 "Boom Trac" sensors

The sensor control is controlled using the "Green Star 32630" screen Fig.3. and the "Hydro Handle" control lever Fig.4. They are necessary for easy and precise operation but also a high comfort for the user to control the working speed, the height and inclination of the arm as well as the individual sections of the arm with one hand.

Fig.3. "Green Star 32630" screen

Fig.4. "Hydro Handle" control handle

CEREAL PLANTS HARVESTING

The optimum wheat harvest time is at full maturity when the grain humidity reaches the value of 14-15%. During this period the harvesters work with reduced grain losses and with a small breakage rate, and the harvesting equipment settings run without difficulty. The grain storage under these conditions is done without the need for additional drying interventions resulting in an important energy saving. The optimal harvesting time of a wheat is about 5-8 days.

Wheat strands are harvested, in one pass, with the use of self-propelled universal combines. During a harvesting working day, the parameters of the humidity varyes, which makes it necessary each time to restore the combine in order to avoid excessive losses. The mechanic must observe the recovery recommendations of the combine adjustment whenever necessary during a working day . A correct harvest is done in the evenly developed and uninhabited fields, made directly with the combine.

Fig.5. Combine harvester for barley

BARLEY HASVESTING

The adjustments to the self-propelled combines harvesting barley crops Fig.5. are similar to the ones from wheat, with the difference that the trellis machines are specific to these cultures, with characteristic periods of each crop. Their harvesting is made in a shorter period than the culture grain (2-3 days) to avoid shake losses during harvest.

Harvesting takes place at the beginning of full baking, when the moisture content is below 16% for a more efficient storage. In seed barley and beer moss, harvesting in this phase also contributes to germination.

CORN HARVESTING

Corn harvesting can be staggered over a long period of time without harvest losses, losses can occur when the harvest period is extended too much by straining stems, due to diseases and pests or due to climatic, wind, rain, and so on

Corn harvesting methods. The maize can be harvested in the form of grains. The harvesting method is chosen by the farmer according to the method of storage.

If cob harvesting is chosen, then the storage has lower costs than grain harvest, in this case higher costs are incurred with drying and storage technology.

Harvesting in the form of chopped cobs can be done manually or mechanically. Taking into account the high cost of manual harvesting, more and more farmers choose mechanized harvesting that can be made with several types of machinery, harvesting corn on two rows, and chop the stalks and scatter them on the ground, to be incorporated into the soil.

Fig.6. Combine corn harvester

Harvesting corn in grains is done with grain cereals other crops harvester and, the berries are harvested in bunkers, and the stems remain on the ground or can be harvested and used in animal feed.

Fig.7. Combine harvesting corn as grain

After the harvesting of the crop and the release of the straw land, vegetal remains or other products left behind, which could prevent the works of the soil, the demi-misty work is executed. Disinfestation is especially recommended if the cut can not be done within about 2-3 weeks of land release. By means of disinclination:
- destroying, chopping and incorporating vegetal remains into the soil, including weeds to promote their decomposition and mineralization;

- reducing evaporation water losses and facilitating the accumulation of water from the rainfall;
- creating optimum conditions of temperature, air and humidity;
- Incorporation of weed seeds and stimulation of their emergence until autumn when they can be buried through the plow;
- fragmentation of underground vegetative organs by which some perennial weed species grow, for their exhaustion;
- destroying soil pests (rodents, insects, larvae);
- leveling the soil and creating better working conditions for the machinery who will continue to work.

The deep autumn scenery is one of the most important works of the soil that consists in turning, shredding and mixing a thicker layer at the top of the fertile soil profile. Through this work, strong soil leaching and aeration is achieved, which leads to the improvement of the physical, hydro - physical state and its aeration condition, a necessary condition for the activity of all the factors that mediate the transformation of the organic matter from the soil into accessible forms for the plants. The slurry incorporates and mixes vegetal remains and organic fertilizers into the soil. Due to the overturning of the furrows, a large part of the weeds are destroyed by plowing. Many seeds of weeds are forced to germinate more quickly, and the rest of the seeds are introduced into deeper layers, from where they can not germinate.

The depth of the plow depends primarily on the thickness of the fertile soil layer, the soil texture and the degree of compaction on the profile. On the deep soils it is 30 to 35 cm deep, and on soils with thin fertile layer or on light soils and loose the depth is 20 - 25 cm.

One of the plants with particular importance is the corn, due not only to the productive potential but also to the multiple uses of the grain, namely:

* In human food, especially in the form of flour from which various culinary preparations are obtained, as the beans from which it is prepared flakes and less rarely as non-boiled or ripened grains;
* In animal feed is used either in the manufacture of compound feed or in the form of mature and urue grains or grains which have been pulled into pulp or flakes and silage;
* In the industry maize grains have many and varied uses. From 100 kg of berries, from which the embryos are separated: 77 kg of flour; 44 liters of spirit; 63 kg of starch; 71 kg of glucose; 1.8 - 2.7 edible oil; 3.6 kilograms of embryos.

CONCLUSIONS

For an ecological culture, traditional techniques need to be adapted in a modern and efficient manner, due to the fact that romanian farmers want to penetrate a growing market segment, namely the valorisation of organic and ecological food products, because the economic benefits from their marketing are superior to the commercialization of industrial products due to their nutritional value is higher.

Farmers in Romania, in accordance with National Development Strategies, are encouraged to set up and promote this type of agriculture by receiving state subsidies, thereby encouraging the increase the number of “organic farmers”.

Both the main products and the secondary products resulting from organic farming are valued at advantageous prices on the free market, increasing the number of farmers who use ecological methods in the production process.

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DEVELOPMENT OF AN AUTOMATIC TECHNICAL SYSTEM TO TREAT THE CRIMPED GRAINS FOR ENSILAGE
/
DEZVOLTAREA UNUI SISTEM TEHNIC AUTOMAT DE TRATARE A MATERIALULUI FURAJER APLATIZAT IN VEDEREA INSILOZARII

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Keywords: crimped grains, treatment system, ensilage, automatic system

ABSTRACT

In this paper are presented the development principles of an automatic technologic system to treat crimped grains for ensilage. This systems are very important, because the Romanian farmers are interested in the new discoveries in this field in order to improve the animal products quality and to trade them on a good price, more than that, the agro-farmers are willing to acquire latest performant technologies to capitalise the agriculture products harvested. A newest development trend in fodder segment that presents good results, is that to crimped the corn fodder and to ensilage it in tunnel bags, from technological point and due the corn high humidity, the fodder must be treated in order to conserve it in proper conditions on long period.

REZUMAT

În această lucrare, se prezintă principiile de dezvoltarea a unui sistem tehnic automat de tratare a materialului furajer aplatizat în vederea în silozării. Aceste sisteme sunt foarte importante, deoarece fermierii romani sunt interesați de noile descoperiri în acest domeniu, pentru a îmbunătății calitatea produselor animaliere și să le comercializeze la un preț ridicat, mai mult decât atât, agro-fermierii doresc să achiziționeze tehnologii performante de ultimă oră, care să poată valorifica produsele agricole recoltate. O tendință de dezvoltare de ultimă oră, în domeniul furajer ce are rezultate foarte bune, este cea de a aplatiza porumbul furajer si de al însiloza în saci tip tunel, datorită procesului tehnologic și a umidității ridicate a porumbului, materialul furajer trebuie să fie trat pentru a se depozita în bune condiții pe o durată îndelungată.

INTRODUCTION

The most commune success grain crimping technology operates in the field conditions and the fodder corn is supplied directly from harvester, as an example here are mentioned only a few manufacturing companies that develop wet cereal crimped equipment's: ROMILL and Eurobagging – Ceh Republic, Murska - Slovenia, Martiney and Staneck – Argentina. This equipment's are designed to transport important quantities of treated crimped cereals toward output opening in order to be ensilage in big bunkers or in silo bags.

In order to preserve fodder corn nutritive content and to avoid deterioration that can occur due to the fact that, the grain is harvested directly from the field and can contain impurities, microorganisms, dust and spores, and to avoid degradation and contamination, the wet crimped corn must be treated for bacteria, moulds, and also to applied conserves, substances that mostly are fluids with suspensions. In most cases, the treatment solution manufacturers mention the required solution concentration (liquid or powder ratio that is mixt with water) that must be administrated.

As an example, the Kemira Company - one of the most known companies in this industry, based on organic acid of highest quality, indicates that the ensilage crimped cereals must be administrated a combination of: Kemira Bacteria Control – powder/liquid product; Kemira Mould Control - powder/liquid product and Kemira KemiSile/AIV – liquid product. In Table 1, are presented the solution concentrations in accordance with processed material humidity.

Table 1

Solution concentration that must be administrated on crimped grains

Grain Humidity (%)	Solution concentration (l/t)		
	Kemira KemiSile/AIV	Kemira Bacteria Control LF4/LF2	Kmira Mould Control LF4L
35-45	3 l/t	5-10 kg/t 2-10 kg/t*	-
30-35	4 l/t		15 l/t
25-30	5 l/t		12,5 l/t
20-25	-		10 l/t
15-20	-		7,5 l/t
15	-		5 l/t

* Values established in accordance with water purity;

In accordance with latest trends, the INMA researchers are developing a innovative wet grain crimping technology, as is presented in Fig.1 and a wet cereal crimping technical equipment -IAICU, detailed in Fig.2, that can be easily adapted with several ensilage systems and an innovative mixing – transportation system on which are implemented the newest scientific solution from the fodder sector, to solve the most commune technical problems identified by the users and to improve the technological process.

As it can be seen in Fig. 1, the IAICU technical equipment is designed to be used in accordance with farmers necessity and its ensilage possibilities, in the upper branch is presented the technologic flow for those that have access to a large bunker, in this case the mixing system can evacuate the processed material in a inclined conveyor and from this point the material is transported to bunker upper supply opening, in the lower branch, the flow material is directly evacuated in tunnel silo gags, this method is more chipper the previous case because is now need for infrastructure expenses .

Fig.1. Innovative technology and technical equipment for crimping wet cereals and their capitalization as fodder.
(G.V. Ciobanu, 2016)

Usually the mobile conveyors have a length grater then 3.5 m and the revolution speed is between 900 and 1350 rot/min. Once this parameter is increased the can assure a high flow, but the mixing process cannot be assured, the material remains on the bottom conveyor because its weight, the crimped cereals avoid to enter in conveyor rotational movement and register a linear movement, and also the powering shaft end is positioned at the evacuation outlet in order to avoid axial solicitation and flambé.

In order to optimize the IAICU equipment and to adopt functional solutions needed in the case that is used in large exploitations, were implemented some innovative components as: a supply bunker with adjusting storage capacity powered by fluidic artificial muscles – solution that is subject of no. A/01014 patent request registered to OSIM in 15.12.2016 and a combined system that mix and transport for crimped grain no. A/01030, also patent request registered to OSIM in 21.12.2016, see Fig.2. Those components are design to increase the working capacity, to adapt to different working conditions, as: stationary – when the processed material is ensilage in large bunkers, in motion – when the crimped cereals are ensilaged in tunnel bags, for large quantities of cereals – cases when in the technologic flow the raw material is provided directly from harvester or big conveyors, or for small quantities – case in which the technologic flow is many made from small capacity equipment's.
frontal loaders/

Fig.2. Innovative technical equipment designed to crimp the wet cereals. (G.V. Ciobanu, 2016)

Part of this equipment is also an automatic technologic system to treat crimped grains for ensilage that is placed under the transport framework on combined system that mix and transport for crimped grain how's geometry and components are new in this application field. The advantage of this solution is that the mixing system has small gauge, due to the conveyor coverage geometry, and can assure a proper mixing process due to element 3 and 4, see Fig. 3.

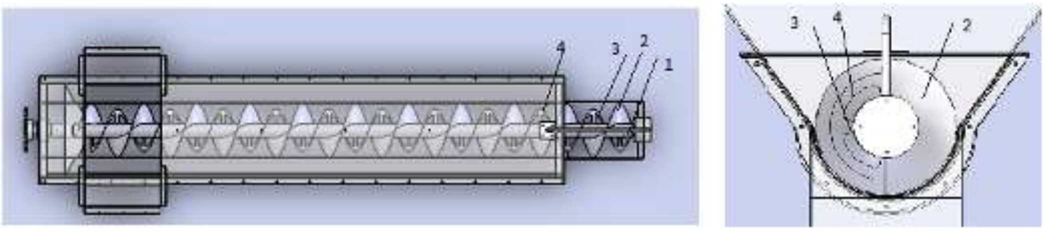


Fig. 3. Innovative mixing – transportation system

1 – Axial shaft; 2 - helical conveyor spire; 3 – mixing pallet; 4 - helicoidally mixing spire

The design requirements of the automatic technologic system to treat crimped grains were determined mainly form structural point of view (placement, available space, accessibility, maintenance, etc.) from working parameters (quantity, humidity, mixing length, shaft, revolution speed, helically conveyor spire) and also by the type of the solutions used (mixture of liquids or liquid with suspension).

MATERIAL AND METHOD

As was mentioned in the upper paragraph the automatic technologic system to treat crimped grains must take in to consideration many factors and for this reason the design process was made on several steps.

First of all was determined the type of the solution that must be administrated and its concentration in accordance with equipment maximum productivity which in our case is 25 t/h. In practical applications were found two kind of solutions, the liquid solutions (liquid concentrate and water) and suspension solutions (dray concentrate and water), the last case is usually used when the corn is harvested earlier because it has a greater humidity (≥ 25 %) and is ensilaging anaerobic conditions. For the first case can be used anticorrosive classical pomp, but for the second case the adequate pressure sources are membrane and peristaltic pumps. Because the best practice to preserved wet crimped corn, according to Kemira specialists, is to mixt three active compounds (Bacteria Control Concentrate – commercialised in liquid /powder form: Mould Control Concentrate - commercialised in liquid /powder form, and KemiSile/AIV concentrate – liquid conservator) in water, the most indicated pressure source are the membrane and peristaltic pumps, because can assure a wide range of type of concentrates and the motor element is protected from jamming and has a long life working cycle regardless of concentrate type.

The second step is to estimate the maximum solution quantity needed Q_s for the maximum processing capacity, when the equipment is working in the most harsh conditions (far away from any water source, on a full time schedule – 8 hour period, and for the most disadvantage type of wet corn – 35 ÷ 45 % humidity. In this case the mathematical relation is presented in equation 1, where: $Q_{p\,max}$ – is maximum raw material flow per hour; w_p –

working program; q_s – solution concentration. In this case the solution necessary is 1 mc and the reservoir must have the capacity to at least that value.

$$Q_{p\ max}\,[t/h] * w_p\,[h] * q_s\,[l/t] = Q_s\,[l] \quad (1)$$

The third step is to estimate the required solution flows for the working conditions that the IAICU equipment can work and in accordance with the corn processed humidity. If it is taken in to account the fact that the wet corn grain humidity can vary for three different category, Tabel.1, for 45 ÷ 35, for 35 ÷30 and for 30÷25, and for this cases were estimated three flow rates, respectively: 125 l/h – for the first interval, 100 l/h for the second interval and 75 l/h for the last interval. Taken in to consideration the fact that the IAICU equipment is provided with two crimping rolls, the supply pomp must work also at half of its capacity and for this reason the working flows must be 0,625; 0,8; 1,04; 1,25; 1,6; 2,08 l/min.

After that is important to establish the nozzle type and their placement, step for. Nozzle type is chosen in accordance with fluid pressure, drop diameter/pulverising opening diameter, and their number is estimated by maximum solution flow rate and the spreading range. In case in which is used solution with suspensions, the nozzles must be chosen by its granulation (opening diameter/drop >suspension granulation), in this cases the flow rate is greater and the working pressure must be smaller, in order to apply the right dosage. As a practical example was chosen a ceramic opening nozzle commercialised by ARAG company, model 422WRC11006, where Q_n=1.39÷2.4 l/min, and the p= 1÷3 bar. Dividing the pump maximum flow at the nozzle flow it can be noticed that can be used 3 nozzles.

Analysing the longitudinal placement of the nozzles, presented in Fig. 4, it can be noticed that the optimum distance between the nozzles is 350 mm, in case that the helically spire is loaded only half and the superposition area is only 51 mm. If it is decreased this distance to 300 mm is increased the superposition area but also can be increased the filling percentage and the mixing space is increased, fact that has a great influence on homogenization and coverage rate. Another advantage is that the treatment installation can be placed near the crimped corn supply opening fact that can influence the mixing and transport system length.

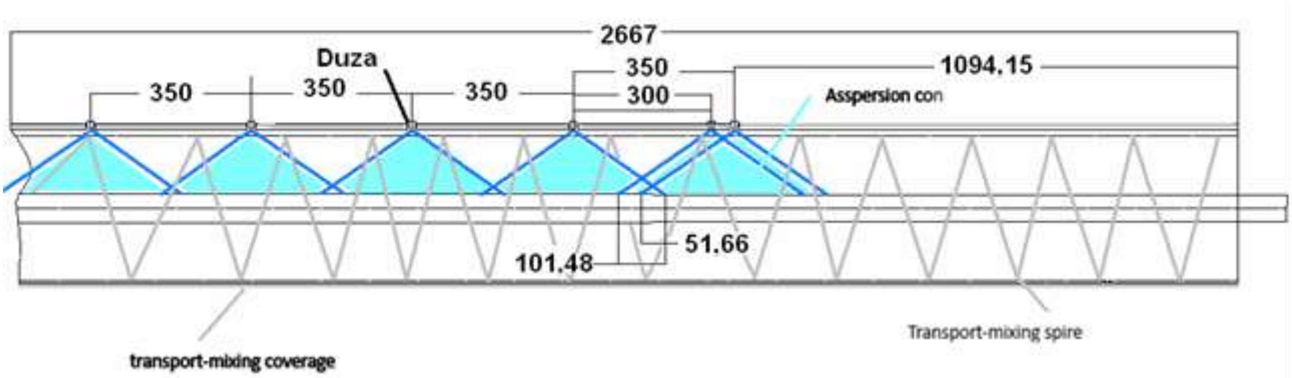


Fig. 4. Case study regarding the nozzles placement on mixing - transportation system – axial section

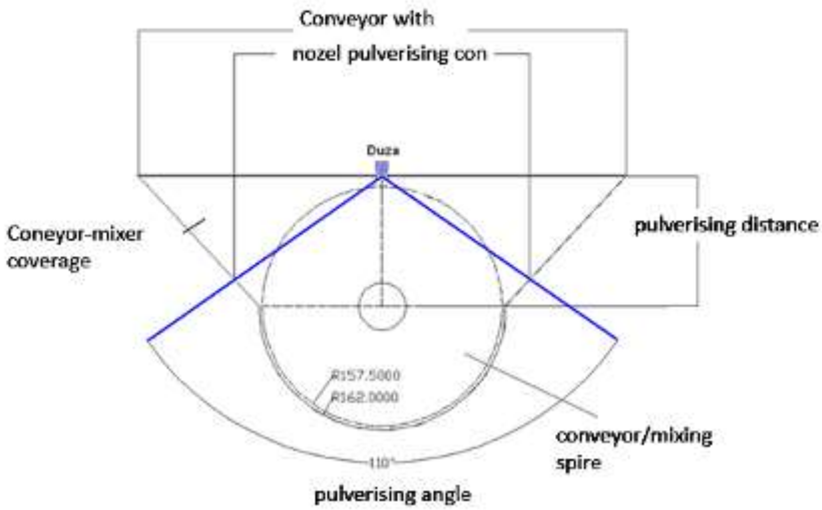


Fig.5. Case study regarding the nozzles placement on mixing - transportation system – transversal section

In practice the nozzle position on longitudinal mixing axe is conditioned by the filling rate when the equipment works at full capacity. In our case will be used 4 nozzles, placed at 350 mm one from another in order to have more mixing space. If it is analyse this solution on transversal plane, presented in Fig.5, concludes the fact that the nozzle can be placed above the conveyor axis at the coverage level if the spire is half filled, but it is over 50 % filled is recommended to be laced over the upper conveyor coverage and the openings to be larger so that the spring cone to pass through.

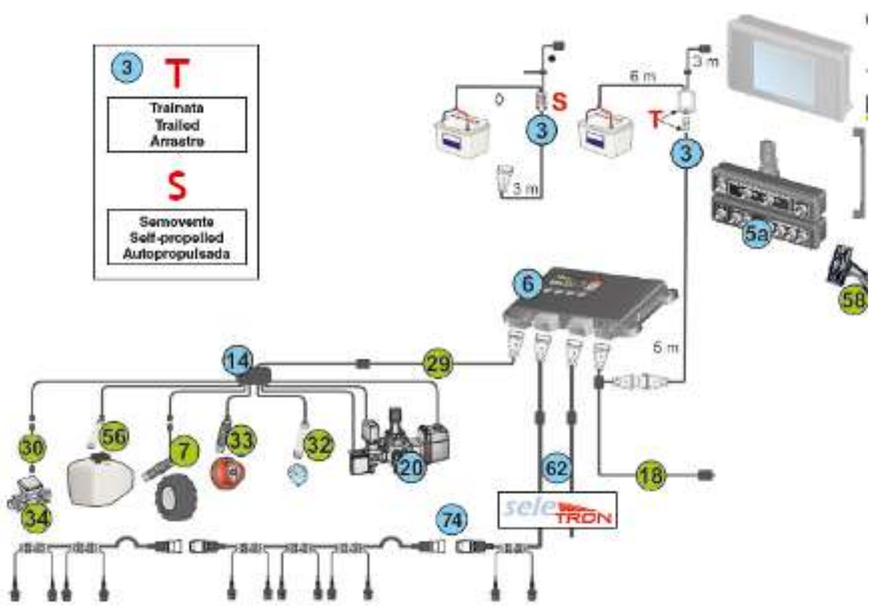
The forth step is to settle the nozzle command solution, this step is very important because it provide the system automation grade in accordance with space available. For this reason was chosen an electric valve provided with two aspersion nozzles, see Fig.6 and after that a membrane pump (cod F2133032E1) that can be commanded from a Command and Control Unit –UCC.

Fig.6. Nozzle assembly with upper coupling and flow regulator

The six step is to identify the proper coupling elements, tubes connections, reductions, sealing's and other hydraulic components that in our case are chosen from plastic material because have small acquisition cost, low weight and high resistance to corrosive substances. The seven step – the command and control unit configuration which is presented in the next paragraph.

RESULTS

In this chapter is presented a UCC configuration that could be easily adapted to our equipment.



1. Board computer,
2 coupling system,
3 connexion cable to computer and aspersion unit IBX100,
5a swithers unit,
6 aspersion unit IBX100,
7 speed sensor with cable, 5 m,
8 connexion cables with computer- switching unit, 3m,
14 cable 3m + main valve + adjusting valve,
18 connection cable for hydraulic command unit IBX100
20 command unit with flow regulator,
29 Black connection cable 3 m 30 flow regulator cable extension, 3m,
32 pressure sensor,
33 revolution sensor,
34 digital flow meter,
56 level sensor,
62 Seletron command cable,
58 single suction cup for switch

Fig.7. The mine command and control system of an automatic technical system to treat crimped cereals.

To design the UCC configuration it must be taken in to consideration two mine factors the placement of UCC and the working regime (stationary or in motion). This conditions are related one to another and depends the equipment working regime, if it works in stationary regime – the UCC can be placed near or on equipment structure, case in which it is proper to choose the Self-propelled mode, but if works in motion regime, respectively Trailed, the UCC it is necessary to be placed on tractor cabin. For this reason, the system architecture can be divided in a mobile part, made from switching unit and control interface, that could be placed either in the tractor cabin or outside and a steady part, made from the other components presented in Fig.6. In order to properly control the technologic system and its performances, it is required a feed-back connection and a memory function, in this way the data acquired from the transducers and sensors can be gendered in a Programmable Logical Controller that can automatically adjust the working parameters of the elements commanded electrically and to present this data on a touchscreen interface, in order to work at right performances. The memory module is necessary if we want to maintain the same working conditions over time, or if we want to analyse the process evolution and to optimise the working process.

CONCLUSIONS

Here in presented automatic technical system develop to treat the crimped grains for ensilage, presents several advantages over the existing machines:

- lowering the equipment gauge within technologic process, because were combined the transport and mixing operations of the crimped grains using a special design helical spire and detachment element specific to conveyor dimension;
- increasing the adaptability level on small gauge equipment's with small productivity;
- decreasing the processing period of crimped machines that works in continuous flow at maximum working capacity, because decreases the time line of transport and treatment operation by increasing the conveyor rotation speed;
- the system construction can be easily configured for two ensilage methods (bunker ensilage and tunnel bags), in this way the farmer can adapt to different cost to ensilage the processed products;
- decreasing the buckling risk of the crimping machine that it services, especially in the case in which the proceeded material presents a high humidity and also reducing the technological flow discontinuance;
- assuring the necessary dimensions of crimping installations trailed in order to fit on public transport normative;
- increasing the working field of cereal post processing machines and installations, because it is easily adapted to farmers requirements.

Our automatic technical system can be adapted to the newest management system developed by the biggest providers of chemical substance, which are developing new products to like user's inventory to their customer department in order to reduce gabs between product request and delivery, mixing the chemistry expertise with smart technologies in order reduce response time, cost-efficient chemical usage and increase process visibility.

ACKNOWLEDGEMENT

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UNIVERSAL SYSTEM TO MANUFACTURE BRIQUETTES FROM BIOMASS OBTAINED FROM MIXT VEGETAL WASTES - BIOBRIC
/
SISTEM UNIVERSAL DE REALIZARE A BRICHEŢILOR DIN BIOMASA OBŢINUTĂ PRIN COMBINAREA DIVERSELOR DEŞEURI VEGETALE - BIOBRIC

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Keywords: *biomass, equipment's, briquettes, biofuel, briquetting*

ABSTRACT
In this paperwork are presented information's regarding equipment's that manufacture briquettes and pellets form a wide range of agriculture or wood wastes. Here is presented a study that anises the most representative technical solutions using the Ideas Diagram Method from "Inventica".

REZUMAT
În lucrare sunt prezentate informații cu privire la echipamentele pentru producerea brichetelor și microbrichetelor din diverse deșeuri agricole sau deșeuri din lemn. Aici este prezentat un studiu în care se analizează soluțiile tehnice reprezentative utilizând metoda Diagramei de Idei din Inventica.

INTRODUCTION
Publishing this study is of almost importance in order to accomplish the objective to obtain sustainable bio-fuels and to align with European energy strategy and environmental protection normative, from this reason is strictly necessary to introduce to manufacturing and promote the briquettes universal systems from Biomass by combining different vegetal wastes, in this way the potential customers can achieve a better finite product quality and alternative solutions for conventional fuels used at large scale in this moment, the solutions that are in full development process at national level, but also in the world.

This study wants make an integrate system to manufacture biofuels that can be used by SME's that are willing to invest in this field and to be in line with quality and environmental UE norms.

Latest, at European and international level the Biofuels resources gain more and more interest from behalf of large agricultural companies, associations and farmers, in order to reduce the production cost and to capitalise their wastes. Also, in the energy market, especial on European level, was made a study regarding the cost-benefit analysis regarding the energetic resources and their environmental impact, see Table 1, [4]

Table 1.

- **Electric power generation from biomass compared to other energetic resources**

Power source	Technology	Cost 2005 ÷ 2030		Emissions	Efficiency	Reserves
		€ / MWh		tCO_2/MW h	%	
Natural Gas	Gas Turbine	45-70	55-85	0,44	40	64
	Combined cycle	35-45	40-55	0,40	50	
Petrol	Diesel Motor	70-80	80-90	0,55	30	42
ASPdg [1]		30-40	45-60	0,80	40-45	155
Cool	ASFC[2]	35-45	50-65	0,80	40-45	
	CCGI[3]	40-50	55-70	0,75	48	
Nuclear	Water Reactor	40-45	40-45	0,015	33	85
Biomass	**Electric power source**	**25-85**	**25-75**	**0,03**	**30-40**	Renewable
Wind energy	at shore **>**	35-175	28-170	0,03	90-98	
		35-110	28-80			
	On see	50-170	50-150	0,01	95-98	
		60-150	40-120			
Hydro	Big capacity	25-95	25-90	0,02	95-98	
	Small capacity (<10MW)	45-90	40-80	0,005	95-98	
Solar / photovoltaic		140-430	55-260	0,10	-	

- [1]ASPdg — pulverized firing with gas desulphurisation; [2]ASFC — circulating fluidized bed combustion; [3]CCGI — combined cycle with integrated gasification.

As can be seen in the table presented above the electric power generation from biomass resources presence lower costs, a good efficiency and a low environmental impact. On the other hand the biofuels resources, in analogy with other renewable energies (solar, wind, hydro and tides) can be stored, kept and used in difficult times. If we take in to consideration the fact that in agriculture and forestry are developed new crops with high energetic power and the energy generators now are more performant due to the fact that are incorporated performant energy recovery systems, this energy sector can gain a large coverage a European energy market.

As was mentioned above on energetic manufacturing companies are now headed to lighter manufacturing system that can be easily implemented on newest wood waste management system of sawmills, timber producers, or by firms that are willing to activate in bio-fuel branch.

The economic and scientific value of this study is represented by the fact that in many Romanian regions are present agriculture, fruit-grower and viticulture exploitations, rich in vegetal wastes (straw, wood, contaminated cereals, etc.) that represent an important energy source that is easily obtained and cheap, and in this way this wastes are neutralised form producing units and the wastes management can gain an important income. For this point of view, were identified three opportunities?

- Direct capitalisation of wood waste in thermic power sources, the energetic efficiency is lower, in this process are consumed large quantities for a caloric unit;
- Lightering the small wastes (sawdust, shavings, etc.) that are supplying the classical thermic power sources designed by solid fuels;
- Palletisation of small wastes (pellets of 6 ÷8 mm in diameter and 30 mm length) that are usually used in new thermic power source with an automatic supply system, systems that are more expensive and are usually used in Sudden, Germany, Austria, Italy, etc.

Every wood waste capitalisation system involves specific equipment's to manufacture them and sometimes specialised thermic power source.

At the last years, the most commune subjects debated on international level are the energy and clime changes, real and great ecologic threads, and also the necessity to make more efforts form the main energetic actors to use **clean and bio fuels.**

The entry on the XXI's century is marked by a great energetic challenge. In the wold the energetic consumption is continuously increased, and the classical fuels reserves are decreasing and are available only for several decades and are placed only on a few countries. The biomass is one of the most important renewable resources in this moment and also in the future, due to its great potential and their benefice offered in social and ecologic sectors.

In many scientific papers are underlined the fact that the human kind and life on this planet is threaten by the uncontrolled energy consumption, especially of fossil fuels, that causes:

- Global heating, which already has serious consequences: floods, violent storms, soil sliding, excessive temperatures, draught, etc.
- Exhaustion of natural gases and petrol reserves, great economic impact due to full price spectacular growth on international market;
- Great environmental pollution (air, water, soil) that deteriorates the human health and the planet biodiversity.

In 2008 the EU commission made a very important statement "An energetic policy for Europe", statement that is more than never followed, encouraged and respected, if we see all major political events. This tendency was encouraged after the oil crisis from 70's and the biomass resources were began to be used again in the West European countries to produce energy, especial thermal energy because has small costs. The use of wood biomass presents several advantages: the high density of energy source (straw from 80 to 150 kg/m^3; wood sawdust 200 kg/m^3; for final products from 10000 to 1200 kg/m^3); a high heat generation and a homogenous structure of compress resources that have a low humidity (lower than 10%). Usually the raw material used to manufacture briquettes and pelts, are usually manufactured by wood and agriculture wastes (chips, wood sawdust or tree bark, from sawmills or other woodworking enterprises), bought products have the same caloric values and must have a certain physical and chemical properties, important factors that act during the compression technological process as:

- Material flow and adhesion capacity (in special cases can be added adhesives lubricants or binders);
- The raw material granulation, a small granulation can lead to increase the adhesion process and small flow;

- The material hardness, if the material presents a high harness the compression process is stopped;
- The adhesion is another factor that can contribute to product structure.

Fuel briquettes from waste from wood processing and do not contain any dangerous substances (for example adhesives). The shape of this briquettes is cylindrical or polygonal, its length varies from 20 to 25 cm and its diameter is between 5 and 8 cm. The sawdust briquette are required for central heating, terracotta stoves and boilers. The specific information about this energy source are: caloric power 4443 cal/kg; relative humidity 6.1 %/kg; volatile substances 80.3/kg; sucks 0.02/ kg, ashes 0.43/ kg; specific weight 1.03 kg/dm$^{3.}$

The caloric power of 2 tone briquette is even of: 820 mc-methane; 900 l of diesel fuel and of 1170 l of GPL. The briquette production cost from straw and vegetal waste is very low (maximum 120 RON/t) and the commercialization market is large if it is taken in to consideration the fact that the in the country sides, many families can benefit of their use to generate thermic agent with central heating and terracotta stoves.

The information herein presented are resulted from a complex project required by an industrial partner and also form the experimental and industrial research activities conducted on universal system to manufacture biomass briquette by compression vegetal wastes.

MATERIAL AND METHOD

On international market are known many biomass briquetting methods, which were applied in practical applications. A brief classification is presented in ideas diagram used in INVENTICA and is presented in the figures presented lower.

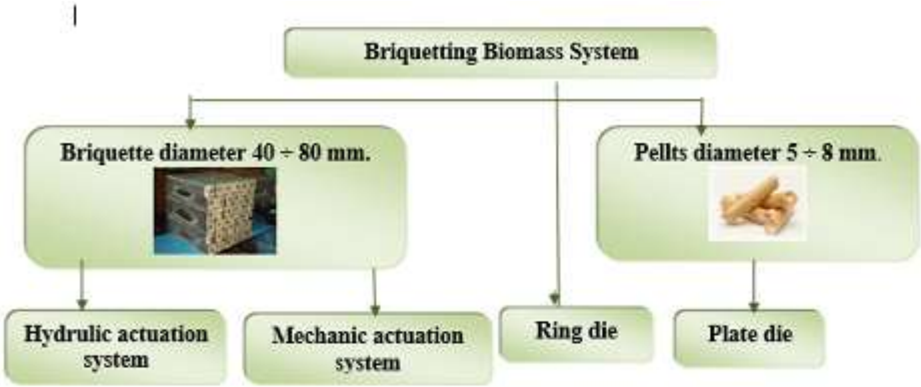

Fig. 1. Brief classification is presented in ideas diagram used in INVENTICA

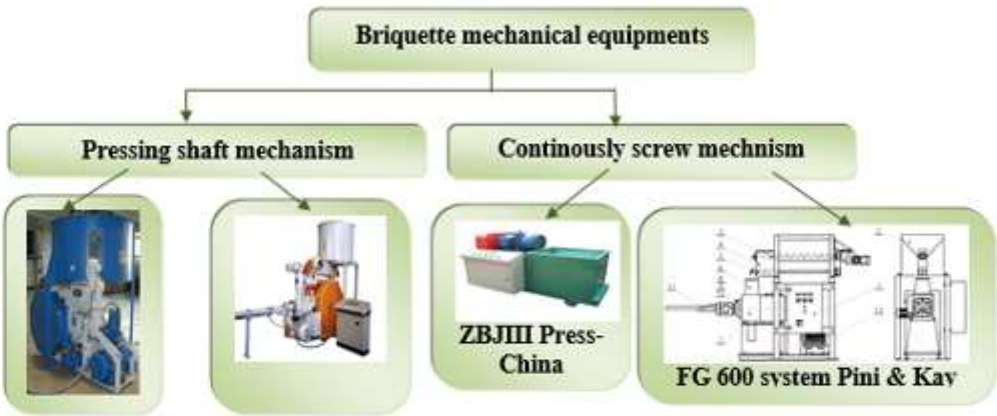

Fig. 2. Brief briquette mechanical equipment's

Fig. 3. Main ring die equipment's that manufacture the biomass pellets

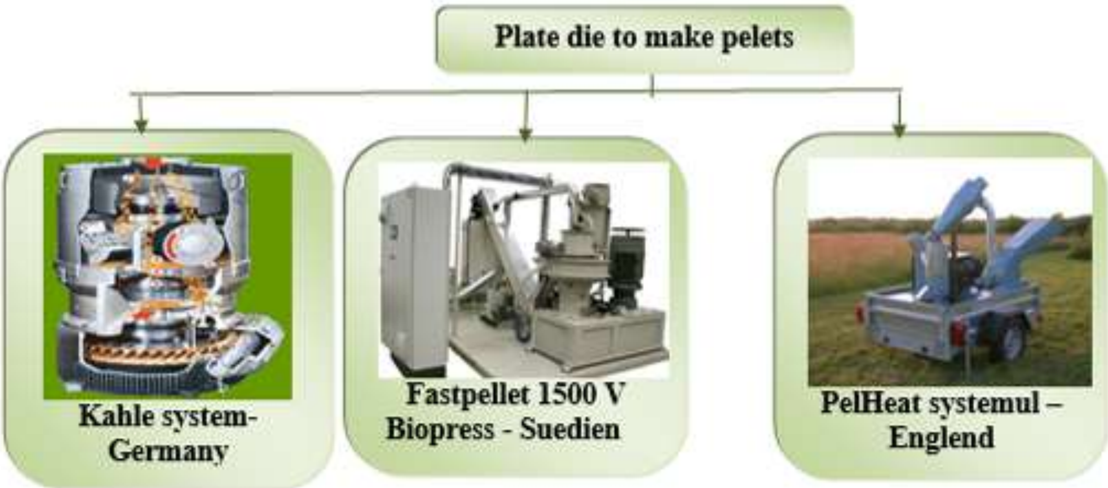

Fig. 4. Some of the most commune plate die equipment for palletisation

On national level, the concerns for the establishment of a biomass briquetting plant is materialized to date by MKT VIBROBLOC, plant that manufactured and implemented in production process on several biomass briquettes, from exploitation process was notice that are necessary several improvement in order to be competitive on market, as:

- to cover the active surfaces with hard materials (tungsten carbide) but also on the conveyor surfaces with CMS plates that are often used in mining industry, fact that will greatly reduce wear in the case of briquetting hardwood sawdust (oak, hornbeam, beech,.etc.);[5,6]
- to improve the active system design and also of compression shaft, in order to rise the compression axial force, see Figure 5;
- to optimise the bearing system of the main shaft that transport the raw material and compress it, this system it is necessary to be improved in order to provide a short maintenance and replacement of active parts;
- introducing a compression system with two active elements fact that will increase the productivity;
- including in to technological flow of an water vapour mixer in order to decrease significantly the compression forces and will rise the transport of row material during the briquetting process;
- designing an automatic command and control system to process a large variety of vegetable wastes and their mixtures;
- implementing an automotive cutting system.

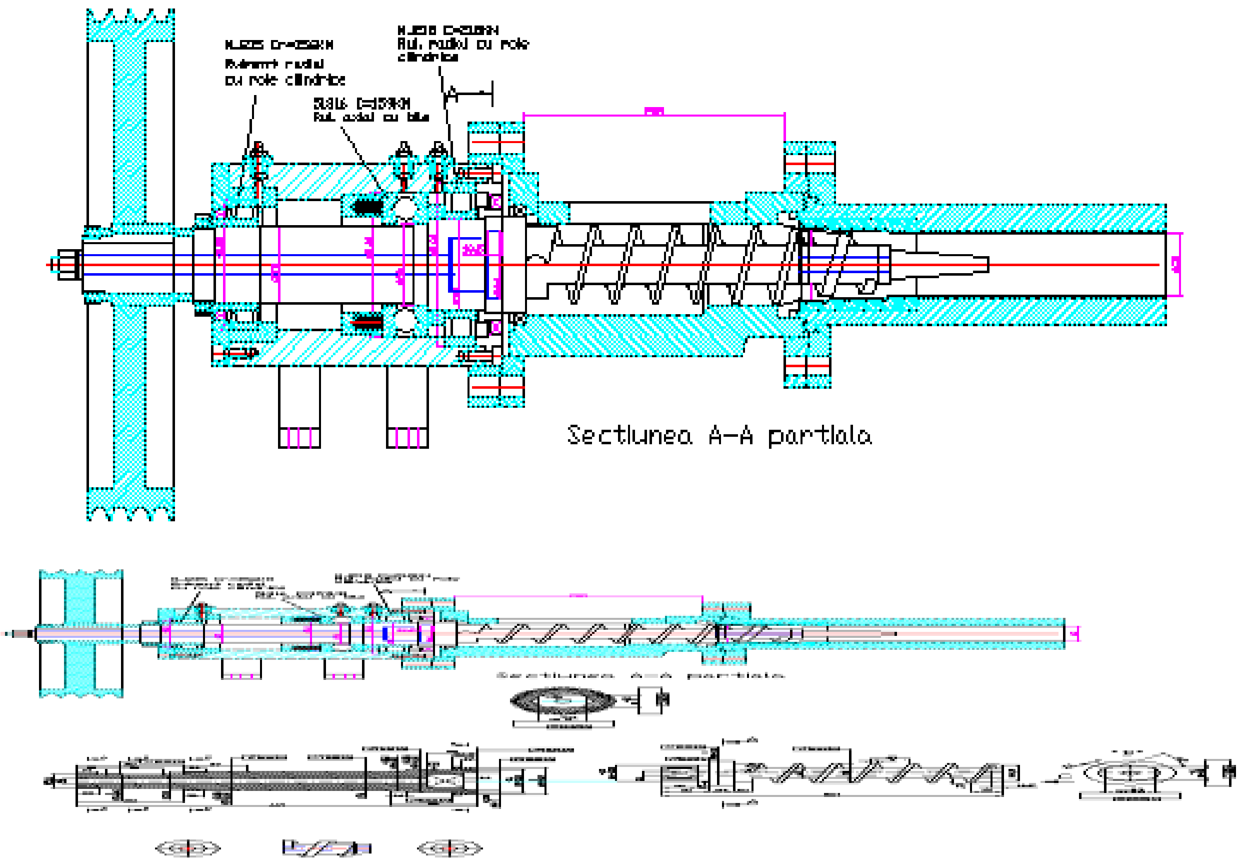

Fig. 5. Innovative solutions to design the briquette system

RESULTS

Based on experimental results this materials must be combined and mixed in order to obtain an appropriate recopies from caloric value potential and to obtain the proper binder necessary briquetting of the respective materials. From this process will result briquettes of 1200 kg/m3 and with a caloric value of minimum 4,000 cal/kg.

In this part is presented a diagram regarding the concept of a universal system to make the briquette from combined vegetal wastes, see Fig.6.

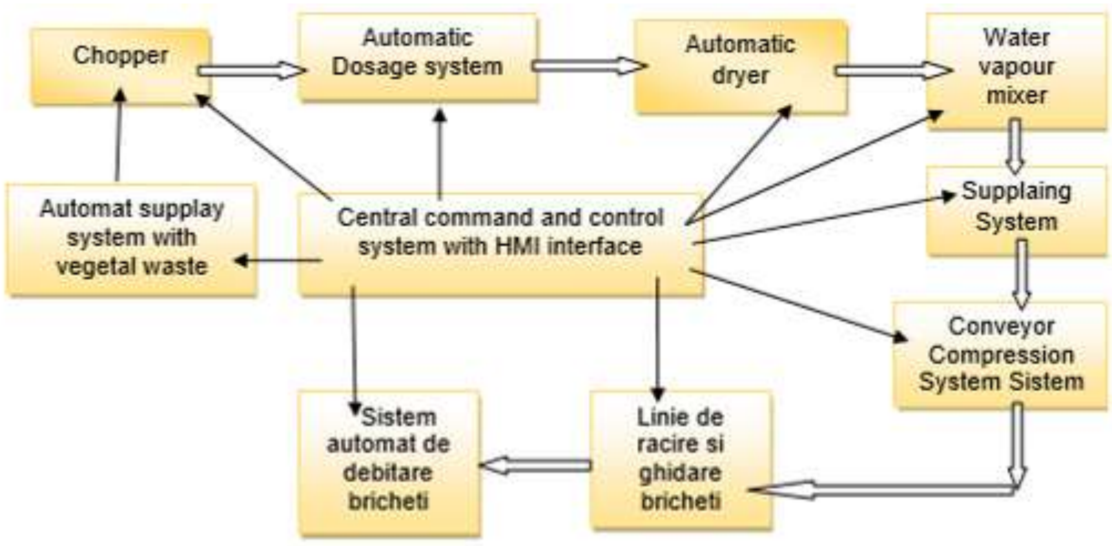

Fig. 6. Schematic diagram of a universal system to make the briquette from combined vegetal wastes

The novelty of this system is that can be used with a large category of raw materials because during the year there presence is not constant and can be easily adapt easily to different geographic regions and their crops, necessity that is needed at national level and add value to the newest technologies, if it is taken in to consideration, the fact that in present briquetting plants are design to use only certain raw materials.

As can be noticed in Fig.6, the technologic manufacturing process it is designed to be controlled by a computing system that uses an HMI interface designed to monitors all system's working parameters so to result an optimal final cost-price ratio of the finished product results.

The materials that will be capitalised using the briquetting process (wheat straw, wood chips joinery workshops, corn cobs, living string, etc.) are chopped in the first phase and stored in storage chambers of minimum 20 m^3, for every type of material. From the slices of chopped material, the raw materials can be transported by helical conveyors powered by a gear motor connected to the automatic dosage system. To make a quality briquetting it is necessary to have an optimal humidity of 8÷ 10 %, and for this reason the system is provided with a rotary dryer, and after that the material is chopped at 2 ÷ 3 mm granulation and are transported in to water vapour mixer that control the material humidity and heat it at 50 ÷ 60 ^{0}C and assures the material lubrication. In this way the prepared material is transported using a horizontal and vertical helical conveyor in order to enter in the pressing chamber.

The pressing system is powered by an electric engine of 18.5 kW and the shaft is driven by a transmission belt at the outlet end the metallic die is heated at 280 ^{0}C to liquefied the lignin materials and in this way it can be achieved a good quality briquette. The material extruded riches 80 ÷ 100 ^{0}C and it is guided and could on 3 m cooling system and then is portioned using a debiting system that cut pieces of 30 cm. The technologic flow of the system is presented in Fig.7.

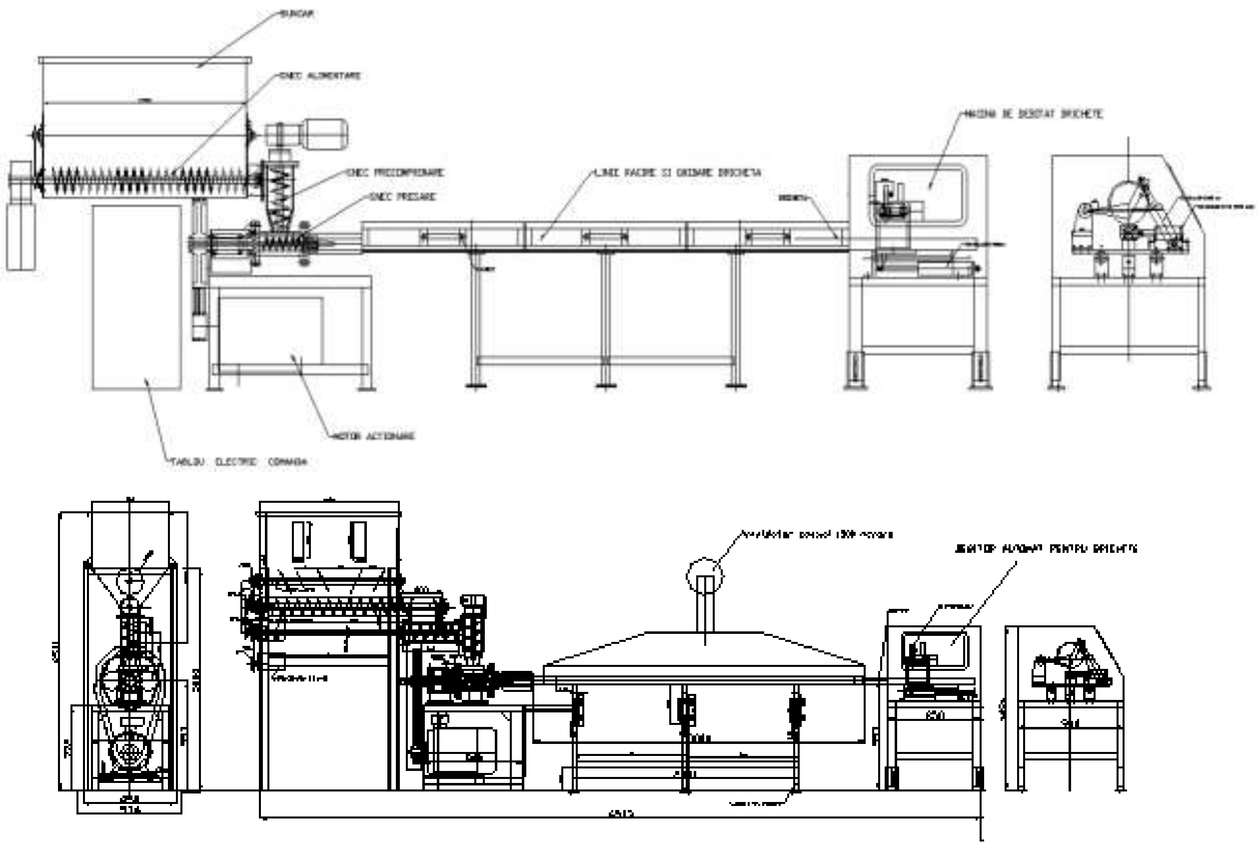

Fig. 7 The technologic flow of the briquetting process of combined vegetal wastes

Fig. 8. Imagines of briquetting system of combined vegetal wastes

Fig. 9. Imagines of briquetting system of combined vegetal wastes

In fig.8 and 9, it can be see the main components of this system and technology that can manufacture briquette with 60 mm and a centre hole of 20 mm. The pressing unit is powered by an electric engine of 22 kW, a squinting and conical helical sneak that has the compressing ends covered with tungsten carbide. The equipment is provided at user with 3 additional exchange sets. Also it has an 3 m briquette guiding system on which is positioned an flue gas and steam evacuation hood that uses an 1000 m^3/h fan and a 250 mm evacuation tubing with a length of 6 m. The automatic supply element has an inner bunker that has an conveyor powered by an 1.1 kW gear motor controlled by an electronic validator, an pallet conveyor to spraying the sawdust and an vertical conic conveyor powered by an second screw gear motor of 1.1 kW.[5.6]

- The technical properties of this plant are:
- -Productivity 200 kg/h;
- The power consumption of the electric engines is 22 kW and 2,2 kW for the

- The electric heating system is 3x1.5 kW advanced system.

Also this plant can be seen in the working process on link [5 and 6].

CONCLUSIONS

The universal briquetting system from biomass by combining a large variety of vegetal waste – BIOBRIC, also the equipment manufacturing company has the opportunity to make a public statement regarding its experience in this field of activity and wishes to purchase research-development services required to approve and homologate this product.

Based on this system, will be made in the near future, an industrial experimental research activities conducted by accredited research organization in the benefit of the construction company. The research activity will have the objective to make a biomass briquette quality in accordance with a large variety of vegetal waste identified in large scale on agro-farming complex, wood industry, fruit grower's agents, viticulture and other relevant sectors that generate vegetal wastes. Also in this rapport will be analysed the performance of the optimal technological processes, the will be acquired important data regarding the automatized briquetting system. Will be also improved the system friability if it is required and also the technologic impact on the market.

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APPLICATION OF ULTRASOUND ON GENUINE ROMANIAN VARIETY MUST FERMENTATION PROCESS
/
APLICAȚII ALE ULTRASUNETELOR ASUPRA PROCESULUI DE FERMENTARE A MUSTULUI PROVENIT DIN SOIURI AUTOHTONE

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Keywords: *ultrasound, winemaking, fermentation, maturation*

ABSTRACT

In order to meet consumer requirements for food safety products, the producers need to provide high quality wines. As an alternative to the traditional winemaking practices, new emerging technologies can be used among which is the ultrasound technique. Ultrasound has been used as a successful tool in the food industry to study complex food materials and to monitor the properties during processing. In the last years ultrasound has started to be implemented in processing, including in winemaking. In the food industry, low frequency ultrasonic waves (18-100 kHz) are capable of altering material properties (physical disruption, acceleration of chemical reactions). The process of fermentation in winemaking turns grape juice into an alcoholic beverage. During fermentation, yeasts transform sugars present in the juice into ethanol and carbon dioxide. Controlling the fermentation process is essential to improve the quality and organoleptic properties of the final product. Ultrasound can be used in the must fermentation process to both monitor and influence its progress. In this paper, the effects of ultrasound on the evolution of must fermentation during the winemaking process were investigated. The grapes were supplied by Pietroasa winery, located in Romania. The main objective was to examine the influence of ultrasonic treatment time on alcoholic fermentation.

REZUMAT

Pentru a satisface cerințele consumatorilor pentru produse sigure, producătorii trebuie să furnizeze vinuri de calitate. Ca alternativă la practicile tradiționale de vinificație, noi tehnologii emergente pot fi folosite printre care ultrasonarea. Ulltrasonarea a fost utilizată ca instrument de succes în industria alimentară pentru a studia produsele alimentare complexe și a monitoriza proprietățile în timpul procesării. În ultimii ani, ultrasonarea a început să fie utilizată în procesare, inclusiv în vinificație. În industria alimentară, ultrasunetele de frecvență joasă (18-100 kHz) sunt capabile să modifice proprietățile produsului: perturbări fizice, accelerarea reacțiilor chimice. Procesul de fermentare în vinificație transformă sucul de struguri într-o băutură alcoolică. În timpul fermentației, drojdiile transformă zahărul prezent în suc în etanol și dioxid de carbon. Controlul fermentației este esențial pentru a îmbunătăți calitatea și proprietățile organoleptice ale produsului final. Ultrasunetele pot fi folosite în procesul de fermentarea a mustului atât pentru a monitoriza procesul cât și pentru a-l influența. În aceasă lucrare au fost investigate efectele tratamentului cu ultrasunete asupra evoluției fermentației mustului în timpul vinificației. Strugurii au fost furnizați de Staţiunea de Cercetare Dezvoltare pentru Viticultură şi Vinificaţie Pietroasa, România. Obiectivul principal a constat în studiul efectului duratei de ultrasonare asupra fermentației alcoolice a mustului.

INTRODUCTION

The compounds contained in the grapes together with the winemaking process influence the final quality of the wine. In order to express and define the overall quality of the wine, the physicochemical parameters like pH, total and volatile acidity, alcohol content, sulphur dioxide and sugars are generally used. The sensory analysis, including the colour of the wine, total phenolic compounds, total concentration of antocyanins and the level of tannins complete the panel of measurable parameters related to wine quality and stability (*Garcia and Sun 2013*). For wineries, the fermentation process is a very important technological part of the winemaking process due to the influence in the obtained wine.

Face with consumer demand for high quality wines and increasing pressure to optimize production and costs, wineries are constantly looking for alternatives to apply during processing. One of such emerging technologies is ultrasound that can be used in fermentation to either monitor the progress or to influence it (*Ojha et al. 2016*).

Ultrasound is an efficient physical method, non-thermal, non-hazardous, environmental friendly, and inexpensive. Ultrasound is sound waves with frequencies higher than the upper audible limit of human hearing (16–20 kHz). In the food industry, the sound ranges employed can be divided into high frequency diagnostic ultrasound and low frequency ultrasound. High frequency diagnostic ultrasound (above 100 kHz) is a non-destructive technique used for quality assurance and, monitoring of food processes and causes no physical or chemical alterations. The low frequency ultrasonic waves (18 – 100 kHz) are capable of altering material properties: physical disruption, acceleration of chemical reactions. (*Dolatowski et al. 2007; Ojha et al. 2017*).

In oenology, ultrasound has been studied for its potential to accelerate reactions within the wine, to increase phenolic compounds extraction or antimicrobial effects (*Garcia and Sun, 2013*). In the literature, the latest research showed the potential uses of ultrasound in winemaking including reducing the fermentation time and increasing the extraction of phenolic compounds (*Sacchi et al., 2005; Vilku et al., 2008 Tiwari et al., 2010; Tudose-Sandu-Ville et al. 2012; Coletta et al., 2013; Bautista-Ortin et al., 2017*). Ultrasound is a simple and rapid extraction method, being an alternative for the analysis of wine flavour components through advantages that include higher reproducibility and possibility of simultaneous extraction of several samples (*Garcia and Sun, 2013*).

Some works indicate that application of ultrasound to wine might cause ingredients interactions, leading to chemical and structural changes in wine (*Garcia and Sun, 2013*). Other authors (*Cui et al., 2012*) studied the effect of combined ultrasound (40 kHz/20min)/SO_2 treatment on microbial-stability of Italian Riesling low alcohol sweet white wine and observed the improving of micro-stability of raw wines and a better taste, with typical and complex aromas and flavour. Also, no significant influence on titratable acidity, pH, free and total SO_2 was reported.

In this paper, we examined the influence of ultrasonic treatment time on the alcoholic fermentation of the white wine by applying a laboratory-scale power ultrasound system to white grape must obtained from indigenous Riesling grape variety. Riesling is a white aromatic grape variety which originated in the Rhine region of Germany. It has pronounced fruit flavours, and flowery, almost perfumed aromas as well as high acidity. Usually, it is used to make dry, semi-sweet, sweet, and sparkling white wines. In winemaking, the delicate nature of the Riesling grape requires special handling during harvesting to avoid crushing or bruising the skin. Without this care, the broken skins could leak tannin into the juice, giving a markedly coarse taste and throwing off balance the Riesling's range of flavours and aromas. The literature mentioned that during fermentation, the wine is cooled to between 10 and 18 °C in controlled stainless steel fermentation tanks. Most Riesling does not undergo malolactic fermentation in order to preserve the tartaric acid, an important parameter for Riesling wine quality. Riesling is often put through a process of cold stabilization, where the wine is stored just above its freezing point. After this, the wine is normally filtered again to remove any remaining yeast or impurities.

MATERIAL AND METHOD

Grapes were supplied by Pietroasa Development Research Center for Viticulture and Wine-making, located in Dealu Mare vineyard, Romania. The variety used for this research was Riesling. The grapes were transported on the same day to the laboratory for processing. The grapes were destemmed and crushed, and deposited in a stainless steel tank where the temperature was measured and controlled. The resulting must was treated with Bentonite (1 g. per litre) and enzyme (Enozyme Arome white skin maceration, 4g. per 100 litres) were added. After 24 hours, selected yeasts were added (Viniferm Saccharomyces cerevisiae Agrovin, Spain, 20g. per 100 litres). Four different samples were treated with a laboratory-scale power ultrasound system (Sonics & Materials Inc. U.S.A.) for 3 (US3), 5 (US5), 8 (US8) and respectively 10 (US10) minutes. The system operated at 750 W and 20 kHz frequency. A batch of must was not treated (control vinification). 5 litre vessels were filled with the same quantity and proportion to assure the same liquid ration in each vessel and fermented in a temperature-controlled climate chamber at 17-19 °C.

When alcoholic fermentation was finished, the wines were cold stabilised at 9°C and then the SO_2 was applied and filtration stage took place. Must and wines were analysed prior to the ultrasound treatment, after the ultrasound treatment, during the fermentation period and at the end of alcoholic fermentation. Figure 1 describes the flow diagram of white winemaking process.

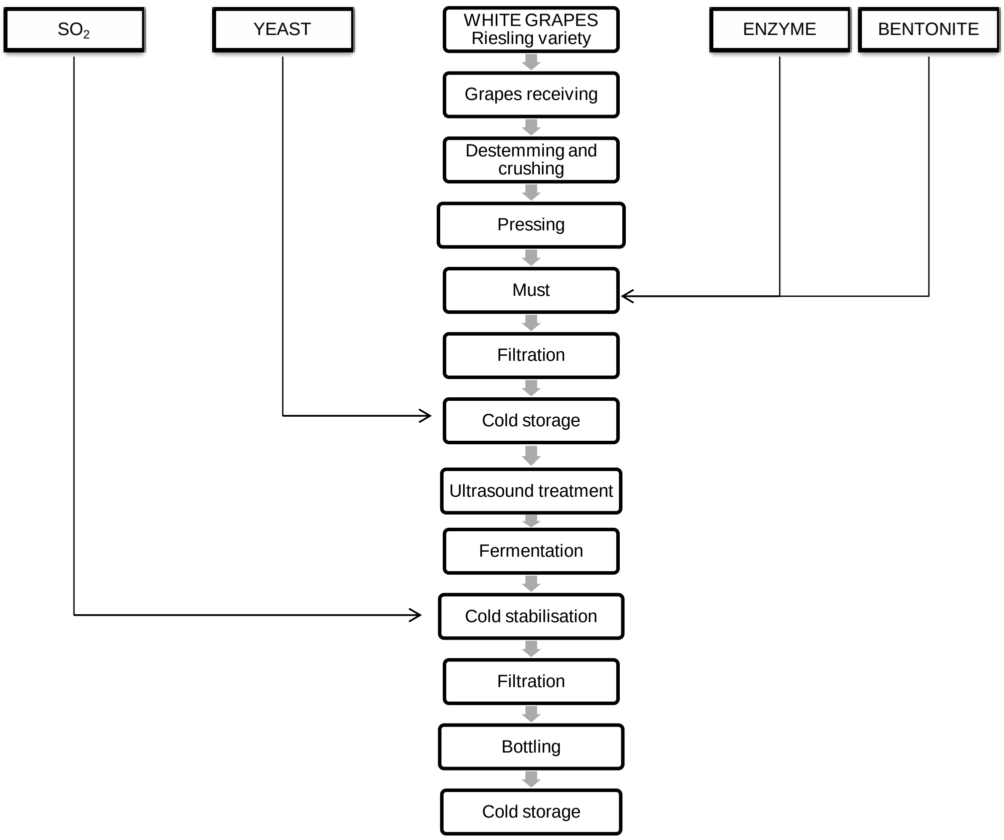

Fig.1. The flow diagram of white winemaking process

Analytical determinations

Spectrophotometric parameters

The colour density (CD) for the white wine was calculated as the absorbance at 420 nm using the optical system of Hanna HI 83742 series colorimeters. The measurement process was carried out in two phases: first the meter was zeroed and then the actual measurement was performed.

Total phenols (TP) were calculated based on the reaction of phenolic substances with Folin-Ciocalceu reagent. The reaction between phenols and the Folin-Ciocalteu reagent involves oxidation of the phenolic groups (R-OH) with a mixture of phosphotungstenic acid ($H_3PW_{12}O_{40}$) and phosphomolybdenic acid ($H_3PMo_{12}O_{40}$) to the quinoid form (R=O). The concomitant reduction of the Folin-Ciocalteu reagent causes a blue colour in the sample that is proportional to the total phenolic content that, in turn, is expressed as g/L of Gallic Acid Equivalents (GAE). TP were calculated by measuring wine absorbance at 610 nm.

Chemical analysis

The tartaric acid was determined using a HI83748 photometer that uses a method with two reagents to determine the concentration of tartaric acid less than 5.0 g/L (ppt). When both reagents are added to a sample containing tartaric acid, the sample turns an orange-red hue; the greater the concentration, the deeper the colour. The associated colour change is then colorimetrically analyzed according to the Beer-Lambert Law. This principle states that light is absorbed by a complementary colour, and the emitted radiation is dependent upon concentration. For determination of reducing sugars, a narrow band interference filter at 525 nm (green) allows only green light to be detected by the silicon photodetector and omits all other visible light emitted from the tungsten lamp. As the change in colour of the reacted sample increases, absorbance of the specific wavelength of light also increases, while transmittance decreases.

The reducing sugars in wine were determined using a HI83746 photometer that uses the Fehling method to determine the concentration of reducing sugars less than 50.00 g/L (ppt). When Fehling's A and Fehling's B Solutions react with a sample containing reducing sugars, the sample undergoes a colour change; the greater the concentration, the deeper the colour. The associated colour change is then colorimetrically analyzed according to the Beer-Lambert Law. This principle states that light is absorbed by a complementary colour, and the emitted radiation is dependent upon concentration. For determination of reducing sugars, a narrow band interference filter at 610 nm (orange) allows only orange light to be detected by the silicon photodetector and omits all other visible light emitted from the tungsten lamp. As the change in colour of the reacted sample increases, absorbance of the specific wavelength of light also increases, while transmittance decreases.

RESULTS

The results of the chromatic parameters and chemical analysis are shown in Table 1. The initial must already had large differences in total phenols and colour density. The total phenolic compounds showed the highest value in control must, while the sonicated samples had lower values. Comparing the chromatic characteristics of the different samples at the initial moment, 8 min. sonicated samples (US8) showed the highest value of the colour density while the lowest was observed in US3. The tartaric acid had the lowest value in the control must and the same value for all the sonicated samples. Also, the reducing sugars showed the same value for all the samples.

Comparing the total phenolic compounds, we observed that after fermentation, all the samples have higher values than initial must. At the end of alcoholic fermentation, we found a slight decrease in terms of colour density except in US5 and US10 that showed higher values than the initial ones. The highest colour density was found in 10 min. sonicated samples US10, and the lowest was observed in US3. The values for the tartaric acid were higher at the end of alcoholic fermentation. The highest value was found in US3 while for the control wine, US8 and US10 had the same value. Concerning reducing sugars, the highest value was observed for 5 min. sonicated samples US5 and the lowest for control wine and US3.

Table 1

Chromatic characteristics and chemical analysis of the contol and sonicated must and wines

Sample		TP [g/L GAE]	CD	Tartaric acid [g/L]	Reducing sugars [g/L]
Initial must	Control must	0.700		3.7	231
	US 3	0.609	0.251	4	231
	US 5	0.582	0.256	4	231
	US 8	0.599	0.263	4	231
	US 10	0.563	0.261	4	231
End of alcoholic fermentation	Control wine	0.951	0.237	4.5	1.25
	US 3	0.917	0.234	4.6	1.25
	US 5	0.917	0.287	4.1	2
	US 8	1.594	0.246	4.5	1.5
	US 10	1.361	0.291	4.5	1.5

TP – Total phenols; GAE - Gallic Acid Equivalents; CD - colour density;

CONCLUSIONS

The results obtained for total phenols showed that ultrasonic treatment had a large influence on these compounds, the values after fermentation being higher than the values from initial must. Also, an increasing of the colour density was observed for two samples at the end of alcoholic fermentation. The values obtained for tartaric acid showed an increasing for all the samples. All the samples, except US5 were in accordance with Romanian legislation that indicates the value 4.5 g/L as the minimum level of the tartaric acid. The values of reducing sugars obtained at the end of the alcoholic fermentation showed that sonication had influenced the fermentation time in terms of reducing it, but not for all the samples.

Most research, including this work was performed at a laboratory-scale level. The lack of standardisation relating to the sonication parameters indicates that further studies and assays are necessary due to the large variety of grape and winemaking techniques that might lead to different reactions to the ultrasound treatment.

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AGRICULTURE AND FORESTRY – COMPLETE INTEGRATED MODELS FOR ZERO WASTE AND CIRCULAR ECONOMY CONCEPTS / *AGRICULTURA ȘI SILVICULTURA, MODELE COMPLETE INTEGRATE PENTRU CONCEPTELE DE ZERO REZIDUURI ȘI DE ECONOMIE CIRCULARĂ*

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Keywords: *circular economy, agriculture, forestry, waste, conversion*

ABSTRACT

Circular economy and Zero Waste are two concepts which have been implemented in the latest years at European and Global levels. Agriculture and Forestry are two economic branches which fit perfect into these concepts allowing efficient technologies from the point of view of usage of human resources, technologic supplies and financial means in order to obtain two generations of products, within an integrated conceptual and complete model/system, by consuming all the available raw materials.

REZUMAT

Economia circulara și Zero Reziduuri sunt doua concepte, care au început a fi implementate, la nivel European și Mondial, în ultimii ani, iar agricultura și silvicultura sunt două ramuri economice, care se potrivesc perfect acestor concepte și care permit folosirea unor tehnologii, acceptabile din punct de vedere al consumului de resurse umane, tehnologice și financiare, pentru obtinerea a doua generatii de produse, în cadrul unui model/sistem conceptual integrat și complet, care utilizează toată materia primă avută la dispoziție.

INTRODUCTION

Circular Economy is a concept wihich apeard at the end of '70 (about 50 years ago), but which became a strategic objective, at worldwide level, after 2000, being developed both theoreticaly and practically, by the main European and Global economic public and private organisations.

One of the most influent non-governmental organization – Ellen MacArthur Foundation – defined the circular economy as "one that is restorative and regenerative by design, and which aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological cycles." [3]

More, in the "*Circular Economy*" of March 23rd, 2016, the Foundation stated that "A circular economy is a regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling. This is in contrast to a linear economy which is a 'take, make, dispose' model of production"[3]

Shortly, the concept states that "waste is a raw material, not a burden". The technological processes have to be designed in the manner that their parts can be dismantled and used for other purposes. The biological parts which are non-toxic shall be decompounded naturally and technical parts (as plastics, allies, glass) to be re-used with a minimum energy consumption.

It is a model of economic efficiency and it defines a new concept in world economy – Zero Waste.

European Commission and circular economy

On 17 December 2012, the European Commission published a document entitled *Manifesto for a Resource Efficient Europe*. [6]

From the beginning, it was clearly stated "*In a world with growing pressures on resources and the environment, the EU has no choice but to go for the transition to a resource-efficient and ultimately regenerative circular economy. Our future jobs and competitiveness, as a major importer of resources, are dependent on our ability to get more added value, and achieve overall decoupling, through a systemic change in the use and recovery of resources in the economy*".

In 2015, based on a Ellen MacArthur Foundation report, the Commission adopted an ambitious new Circular Economy Package in order to stimulate Europe's transition towards a circular economy which will boost global competitiveness, foster sustainable economic growth and generate new jobs.

According to the EC press release, "*EC adopted an ambitious new Circular Economy Package to help European businesses and consumers to make the transition to a stronger and more circular economy where resources are used in a more sustainable way. The proposed actions will contribute to "closing the loop" of product lifecycles through greater recycling and re-use and bring benefits for both the environment and the economy. The plans will extract the maximum value and use from all raw materials, products and waste, fostering energy savings and reducing Green House Gas emissions. The proposals cover the full lifecycle: from production and consumption to waste management and the market for secondary raw materials.* [5]

So, circular economy is now a priority in the financing program of EC and it will be supported by Horizon2020 and the further framework programs.

Romania and the Circular Economy

The national authorities react slowly to this new European issue and accordingly to Mrs. Elena Tudose, Program Manager at Public Policies Institute (IPP), "*unfortunately, in Romania, the wastes are considered a burden, not a business opportunity, despite of high level of recycling percentage of urban wastes (up to 65% till 2030) and up to 75% in the case of packaging wastes, as EC stated by documents. Also, the level of wastes storage will decrease up to 10% till 2030*". [7]

The legislation in Romania includes a National Strategy for Sustainable Development for 2013-2020-2030, adopted in November 2008. By that time, Romania had an economy based on intensive consume of resources and the situation has not changed since then. Moreover, Romania is on the lowest rank between EU28 concerning the level of waste recycling and on the top rank concerning waste storage.

The Law 211/2011 which refers to the implementation of EU Directive on Wastes never mentions the circular economy and the legal measures haven't practically been implemented.

The process of collecting selective wastes has been only recently stimulated by the central and local authorities, which put Romania in a very incipient position concerning the circular economy. One very necessary step is to have an efficient selective wastes procedure in order to make cost efficient the transformation of wastes from new raw materials into market products.

Agriculture and Forestry in a Circular Economy

Agriculture and Forestry are probably the most suitable economy branches to be subject for the circular economy. In almost all the cases, the agricultural and forestry wastes are non-toxic, being of vegetable and animal origin which make them appropriate for a transformation by biological methods.

There are several ways of transforming agriculture and forestry wastes into useful products (as it is shown in fig. 1) the most common applications are energy and fertilizers. By energy, we are referring to alternative (renewable) energy produced in classical manner from hydrocarbon. By fertilizers, we are referring not necessary to processed products, but to the raw wastes (the manure from pigs and cows) which are used as they are in the soil.

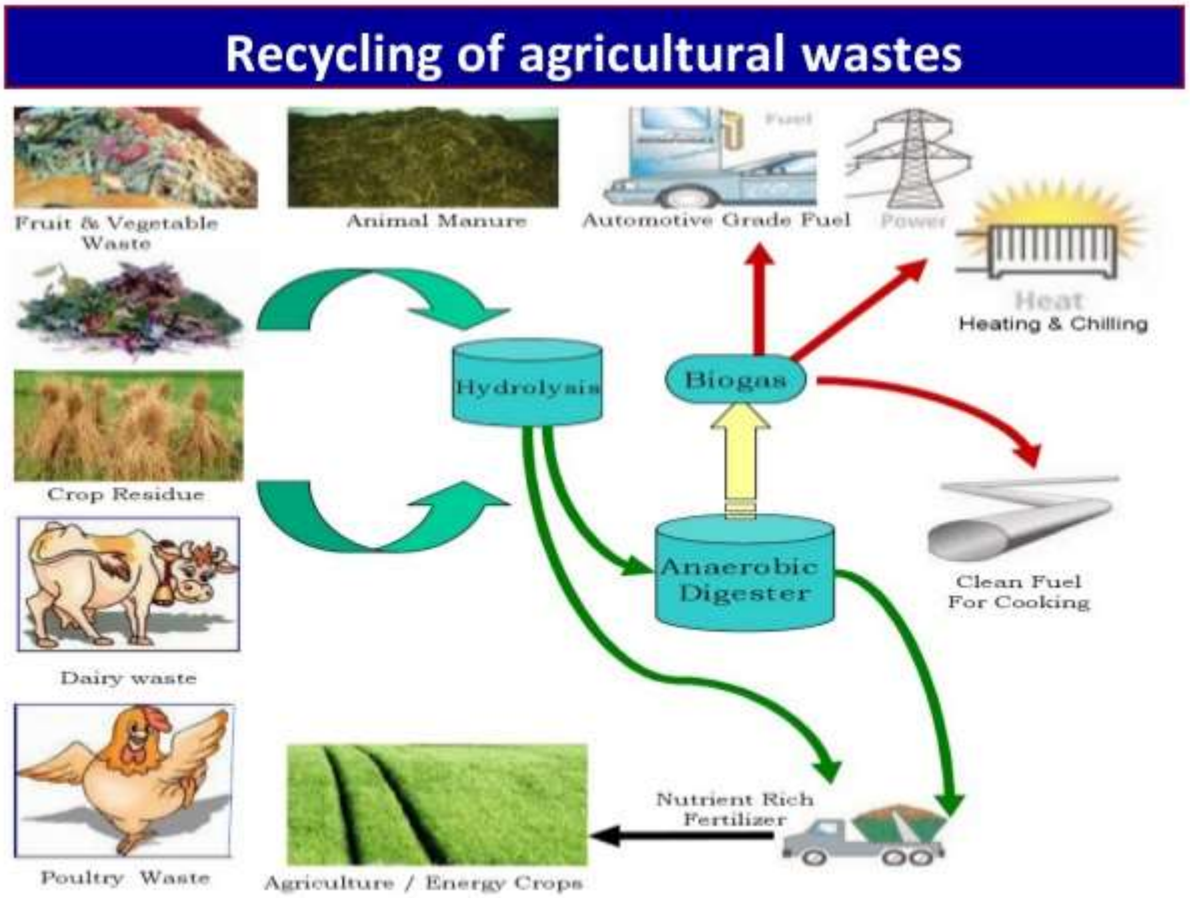


Fig.1. Recycling of agriculture wastes
(Souce: https://www.slideshare.net/pravash_85/nutrient-recycling-through-agricultural-and-industrial-wastes-potential-and-limitations)

Fertilizers from solid organic wastes from agriculture are also obtained by composting and/or fermentation. The technologies are no longer complicated, being widely accessible.

Biofuels and biogas from solid agriculture wastes are nowadays common technologies in developed and emerging countries. Several public-private projects and investments have been done in the last 20 years in almost all European countries to create alternative sources of energy and heat for housing systems, greenhouses and animal farms.

It is uneconomic and environmental unfriendly to supply with traditional (electric) energy and heat the animal farms and the greenhouses, as long as both of them can offer the raw materials.

In the Development Region of Romania named “CENTRU”, transforming the wastes into energy for heating human houses, greenhouse and animal farms has become a culture. Several companies but also individuals built or bought burners supplied with forestry wastes, even urban vegetable wastes (from gardens and trees) in a mixture (compost) or as pellets. In this last case, the burner’s yield is very high (90-93%) and offer a caloric power between 16-19 MJ/kg.

In other regions, projects and direct investments went to produce biofuels in an efficient and sustainable way. As an example, cellulosic ethanol is an advanced biofuel, almost neutral regarding carbon emission, produced from wheat and corn wastes, which are transformed in cellulosic sugars and then into ethanol by fermentation.

Fig.2. Pellets
(Source: www.ecofuels.eu)

Fig.3. Burner with pellets
(Source: http://www.atmos.eu/en/wood-burning-boilers)

The European Commission financed within framework programme 7 and now through Horizon2020 such projects in Romania. For instance the project of the company Clariant will be completed in 2018 with a specific unit with a maximum of processing capacity of 250,000 tone yearly of wheat and corn wastes (straw). [2]

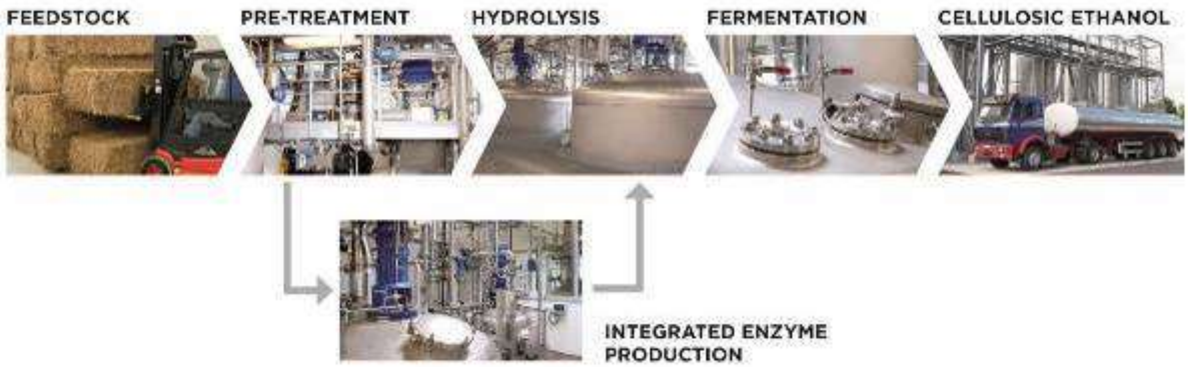
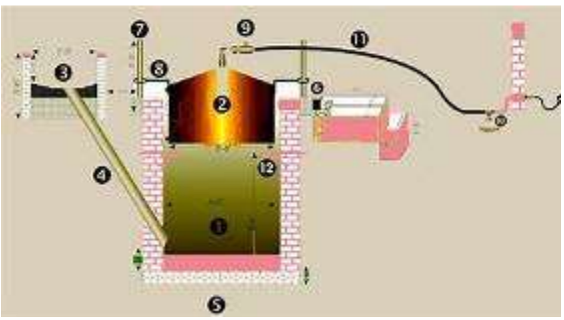


Fig. 4. Process of producing cellulosic ethanol [2]

The biogas production from fermentation of wastes is another type of biofuels. In several European countries (especially Germany, Austria and the Netherlands) the local authorities built up a national mechanism of collecting wastes from agriculture and forestry, using digesters of large capacity of waste fermentation.



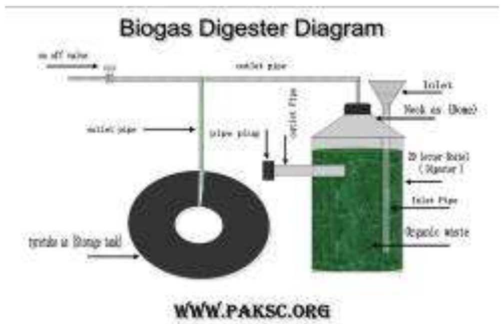


Fig.5. Biogas plant
(source: rtahir.blogspot.com)

Fig.6. Biogas Digester Diagram
(source: www.paksc.org)

The pyramid of valorisation the agriculture and forestry wastes is much larger than the above examples and including also products with high innovative value in chemical and pharma industries. As it is shown in Fig.7, the basic applications (energy and heat) are the most common, but the lowest innovative and low-cost products.

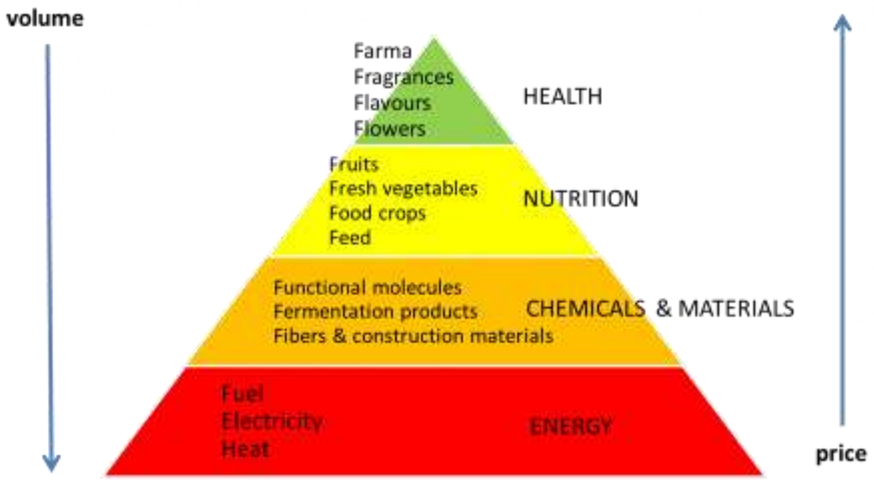


Fig.7. Applications of agro-forestry wastes
(source: https://maken.wikiwijs.nl)

Research, development and innovation teams are looking to valorise the biomass into high-price products and usually you can meet this request in pharma, chemistry and cosmetics industries. Incapsulating flavours, cosmetic fragrances and active principles (molecules) in new performed drugs is what the researchers are looking for.

Their intentions are fighting against the classical way of valorisation (energy and heat), because you have to extract first the useful compounds and then make pellets from biomass. Researchers need time and constant flow of raw materials (wastes from farms or sawmills or wood processing industry) which is not easy to get, because biofuels and biogas systems need large quantities of biomass from wastes.

We would like to show two examples of Romanian R&D completed projects, financed between 2012-2016 by the Financing Agency for High Education, Research, Development and Innovation, both of them using agriculture wastes (from corn and potato) and forestry wastes (from wood processing industry) in the region CENTRU.

There are two very useful acids in chemical industry: *levulinic acid* and *succinic acid*, both of them obtained in a classical way from hydrocarbon.

The first project to which we refer (*acronym BIOBUILD, coordinator Centre of Organic Chemistry of the Romanian Academy*) proposed a technology and an installation (small capacity, pilot plant phase) on a mobile platform, which it can obtain *the succinic acid* nearby the source of wastes, agriculture field or sawmills proximity). [1]

Referring only to **Succinic acid** which is considered by US Department of Energy one of the 12 most valuable chemical platforms. Succinic acid is a dicarboxylic acid with the chemical formula $(CH_2)_2(CO_2H)_2$. It is a white, odorless solid with a highly acidic taste.

It has several applications: [4]

- Succinate can be used to derive 1,4-butanediol, maleic anhydride, succinimide, 2-pyrrolidinone and tetrahydrofuran (additive for gasoline)
- Succinic acid is a precursor to some polyesters and a component of some alkyd resins. (additive for plastics)
- Succinic acid also serves as the bases of certain biodegradable polymers, which are of interest in tissue engineering applications.
- As a food additive and dietary supplement, succinic acid is generally recognized as safe by the U.S. Food and Drug Administration. Succinic acid is used primarily as an acidity regulator in the food and beverage industry.
- As an excipient in pharmaceutical products, it is also used to control acidity or as a counter ion.

The interconnected technologies developed by the BIOBUILD project include:

- conversion of alternative bio-masses (wood, potatoes, corn) to levulinic acid using combined ultrasound assisted heterogeneous catalytic process;
- synthesis of succinic acid from levulinic acid or furfural, main by-product of levulinic acid production, by novel heterogeneous catalytic processes;
- conversion of levulinic acid to methyltetrahydrofurane;
- conversion of glucose and/or glycerol to succinic acid by a fermentation process using novel genetically engineered E. coli strains.

Now, in several countries, this acid is obtained from corn, potato and wood wastes by a fermentation process. The value of this product is high, because of its numerous application in high innovative sectors. In some countries, like US, France, Italy, they started to build industrial facilities for large scale production of succinic acid from wastes.

The second project we would like to refer (*acronym LIGSALCHEM, coordinator University of Bucharest, Faculty of Chemistry*) aimed to extract lignin from *salix viminalis* (energetic willow).

This kind of willow is well spread in region CENTRU of Romania and it has several purposes, mainly as an alternative source of renewable energy. It is mainly used as a supply raw material for heating burners (as wood chips or as pellets).

At the same time, the LIGSALCHEM project showed that it can be used for the extraction of lignin and salicylic acid to produce bulk and fine chemicals (polymers or initial compound for medicine purposes), using organic synthesis, catalysts design and preparation, process development and bio-engineering.

CONCLUSIONS

Both agriculture and forestry can represent a complete model of circular economy and Zero Waste economy, because we have “first generation” of products by their main purposes and “second generation” of products, by complete valorisation of wastes.

The complete valorisation of wastes in structures on products with high value (for pharma, medicine and cosmetics), medium value (additives for chemistry and food industry), low value (pellets, fertilisers, wood chips for burning).

In an integrated system, from the same source of wastes, we may have all applications possible as mentioned above.

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THE RELIABILITY ESTIMATION OF TRANSPORT MEANS ELEMENTS UNDER THE ACTION OF CYCLIC LOADS AND CORROSIVE ENVIRONMENT
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ОЦІНКА НАДІЙНОСТІ ЗАСОБІВ ТРАНСПОРТУ ЗА ДІЇ ЦИКЛІЧНИХ НАВАНТАЖЕНЬ І КОРОЗІЙНИХ СЕРЕДОВИЩ

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***Keywords**: residual life of thin-walled elements of vehicles, corrosive environment, stress intensity factor, thin-walled elements, period of subcritical growth of corrosion-fatigue cracks, transport means.*

ABSTRACT
Based on the first law of thermodynamics and the fracture mechanics principles, the approach for determining the residual life of the vehicles' thin-walled metal elements with cracks under the action of cyclic loads and corrosive environment is developed. Based on the results of the mathematical description of electrochemical reactions and separate data of fracture mechanics, the equation describing the kinetics of the corrosion-fatigue cracks propagation is deduced. This equation and the initial and final conditions is a mathematical model for determining the residual life of structural elements. The correctness of the developed analytical models is confirmed by the experimental data known in the literature. The performance of this model is demonstrated on the example of determining the residual life of a plate made of 17G1S steel. The plate was diluted by a crack in a 3% NaCl solution and subjected to cyclic loading. An increase in the initial size of corrosion-fatigue cracks is proved to reduce significantly the period of their subcritical growth.

РЕЗЮМЕ
Розроблено підхід для визначення залишкового ресурсу тонкостінних металевих елементів транспортних засобів з тріщинами при дії циклічних навантажень і корозійних середовищ в основу якого покладено перший закон термодинаміки та положення механіки руйнування. На цій основі, а також відомих в літературі результатів математичного опису електрохімічних реакцій і окремих даних механіки руйнування, отримано рівняння опису кінетики розвитку корозійно-втомних тріщин, яке разом з встановленими початковими і кінцевими умовами є математичною моделлю визначення залишкового ресурсу елементів конструкцій. Коректність розроблених розрахункових моделей підтверджена відомими в літературі експериментальними даними, реалізацію продемонстровано на прикладі визначення залишкового ресурсу пластини з сталі 17Г1С послабленої тріщиною в 3%-му розчині NaCl, підданої дії циклічних навантажень. Доведено, що збільшення початкового розміру корозійно-втомних тріщин суттєво зменшує період їхнього докритичного росту.

INTRODUCTION
Nowadays, up to 65% of the mechanisms are known to get out of order under the influence of aggressive (corrosive) environment and mechanical stresses; up to 25% of these mechanisms are broken down due to the overloads caused by strength losses because of corrosion damages *(Popovych P. Rybak T., 2010; Shchurin K.V., 1994; Romaniv O.N., and others. 1990; Supervisors Y. A. Bondarenko, K. E Shchyrin 1989; Cherepanov G.P. 1974; Severniev M.M. and others 2011; Rybak T.I. , and others 2009; Pohmurskyi V.I., Khoma M.S. 2008; Severnyi A.Ye. 1993; Potskaliov A.F. and others 1984*).

According to the data on agrarian production development in Ukraine, the growth of the transportation volumes of chemical and mineral fertilizers (*Vernera Ye. 2017*) is about 2% of all cargoes. To maintain the tendency, it is rational to take into account the influence of these overaggressive environments on the vehicles' metal materials (*Popovich P.V., Barna R. A., 2014; Popovych. P. V., Lyashuk O.L., Shevchuk O.S., Tson O.P., Bortnyk I. M., Poberezhna L.Ya. 2017; Popovych. P. V., Lyashuk; O.L., Murovanyi I. S., Dzyura V. O., Shevchuk O. S., Myndyuk V. D., 2016).* The performance of 47 semitrailers ММЗ -771, 15 semitrailers ММЗ -771Б, 13 trailers ММЗ-768, 7 trailers ММЗ -768Б were studies during the period of one calendar year. The mentioned vehicles were engaged in the transportation of mineral and organic fertilizers. The mean time between failures of the main elements of the specified trailers is found to be from 0 to 4000 hours. The insufficient service life of thin-walled metal structures of the undercarriages and suspensions is ascertained. The percentage of failures ranges from 50% to 80% *(Shchurin K.V. 1994; Popovych P. Rybak T., 2010; Supervisors Y. A. Bondarenko, K. E Shchyrin 1989).* The most characteristic failures of the undercarriages are the cracks in frames, spar and cross bars *(Shchurin K.V. 1994; Popovych P. Rybak T., 2010; Supervisors Y. A. Bondarenko, K. E Shchyrin 1989)*. The analysis of the reasons due to which steel structures enter the failure state became it possible to draw a conclusion on the causal complex of events that lead to failure. In general, the steel structure failures are caused by the defects of manufacturing (stage of production), as well as the errors in the designs (stage of designing). The total percentage of failures caused by the inadequate level of design and production quality can reach 60% *(Cherepanov G.P., 1974; Arnoux P., 2010; Dmytrah I.M., Panasiuk V.V., 1999; Sieradzki K. Newman R.C., 1987; Andreikiv O. Y., Tym'yak N. I., 1994*). The cause analysis of fragile fracture of welded metal structures explains the influence of individual factors in terms of the frequency of their occurrence in emergency states. In total, the amount of factors associated with the stresses concentration and cracks propagation reaches up to 50% (*Cherepanov G.P., 1974; Arnoux P., 2010; Dmytrah I.M., Panasiuk V.V., 1999; Sieradzki K. Newman R.C., 1987*). The impact of aggressive environment greatly reduces the lifetime of structural elements *(Severniev M.M. and others 2011; Severnyi A.Ye. 1993; Severnyi A.Ye. and others 1984).* The pitting and / or ulcers occur in the locations of damage to the surfaces of metal structures. The corrosive fatigue cracks arise up to critical dimensions, limiting the vehicle's reliability *(Shchurin K.V. 1994; Pohmurskyi V.I. Khoma M.S., 2008; Severnyi A.Ye. 1993; Severnyi A.Ye. and others 1984)*. When accelerating the development of cracks *(Shchurin K.V. 1994; Pohmurskyi V.I. Khoma M.S., 2008*), the aggressive environments cause a significant reduction in the durability of machine elements.

To calculate the durability of thin-walled vehicle elements, it is necessary to take into account the influence of aggressive working environment on the corrosion-fatigue destruction (Shchurin K.V. 1994; Popovych P. Rybak T., 2010; Severnyi A.Ye. 1993; Severnyi A.Ye. and others 1984). Delayed spontaneous fracture of structural elements under the action of variable in time (cyclic) loads and corrosive-aggressive environments is relatively continuous but dangerous process because of the low degree of its predictability and diagnosis. Corrosive environments increase the failure probability of metal materials during cyclic loading and cause the propagation of corrosion-fatigue cracks. To determine the service life of vehicles constructions elements under the influence of cyclic loads and corrosive environments, the appropriate analytical models should be applied. Most of the known (*Andreikiv O.Y., 2003; Andreikiv O.Y. Gembara O.V., 2008; Andreikiv O. Y., Tym'yak N. I., 1994; Andreikiv O. Ye. Sas N. B. 2006; Andreikiv O. E. Sas N. B. 2007; Dmytrah I.M., Panasiuk V.V., 1999; Andreikiv O.Y., Kit M.B., 2006; Andreikiv A.Y. Darchuk A.I., 1992; Andreikiv O.Y. Kit M.B., 2006)* mathematical models are based on the analysis of exclusively specific experimental data. Therefore, based on such theories, the service life of only certain elements of structures made of the same materials can be defined.

Let us consider an element of metal construction of a vehicle - a plate located in a corrosive environment, weakened by an initial rectilinear crack of length $2l_0$. The crack is stretched by evenly distributed forces p, directed perpendicularly to the line of the crack location. The forces are changed cyclically in time (loading the plate with a crack in the Griffiths problem, Fig. 1). The number of load cycles $N = N_*$ should be determined. After reaching this number, the corrosion-fatigue crack acquires a critical value and the thin-walled element breaks down.

MATERIAL AND METHOD

To solve this problem it is necessary to design an analytical model for determining the kinetics of corrosion-fatigue crack propagation and to deduce a differential equation describing the process. The assumption: the stress-strain state in the plate is symmetrical to the location line of the crack that extends along the line of location. Similarly (*Andreikiv O. Y., Tym'yak N. I., 1994; Andreikiv O.Y. Gembara O.V., 2008;Hembara O. V., Terlets'ka Z. O., Chepil' O. Ya., 2007;, ; Andreikiv O.Y., Kit M.B., 2006; Andreikiv A.Y. Darchuk A.I., 1992; Andreikiv O.Y. Gembara O.V., 2008; Andreikiv O. E. Sas N. B. 2007)*, to develop the kinetic equation for the corrosion-fatigue crack propagation, an energy approach based on the first law of thermodynamics is applied for the case of elemental propagation of the crack by the value Δl_c in time Δt :

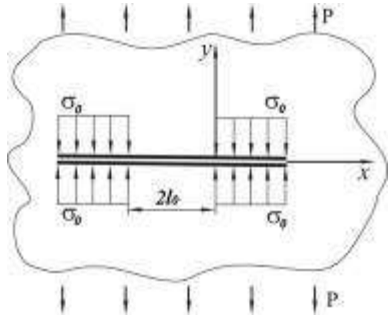

Fig. 1. Classical load diagram of the plate with a crack

$$A = W + \Gamma + Q + K. \tag{1}$$

where: A –work of external forces; W –energy of body deformation after the crack is increased by the value Δl_c

$$W = W_s + W_p^{(1)}(l) + W_p^{(2)}(t) - W_p^{(3)}(t), \tag{2}$$

where W_s – elastic component *W*;

$W_p^{(1)}(l)$ – part of the work of plastic deformations in the pre-fracture area, which depends exclusively on the length of the crack l;

$W_p^{(2)}(t)$ –part of the work of plastic deformations caused by external forces, which is performed at a constant crack area during the incubation period of its leap preparation Δl_c, and depends only on the time t (the number of load cycles $N = tT^{-1}$, T - the cycle period);

$W_p^{(3)}(t)$ - work of plastic deformations during body unloading and compression of the pre-fracture zone, which depends exclusively on t and is generated by the body itself;

Γ – body destruction energy depending on l, the characteristics of the environment, and t;

Q – thermal energy released during the fracture of the body, the energy is considered relatively small and is neglected in calculations;

K – kinetic energy, which in this case is also a small value.

According to (*Sieradzki K. 1987; Tym'yak N. I., Andreikiv O. E., 1995; Sakara A. Banahevych Yu., Lohman I., 2010)*, the length of the elemental jump of the crack Δl_c is the sum of the mechanical jump l_m caused by mechanical loading and flooding during electrochemical corrosion and elemental crack propagation l_a due to the anode dissolution

$$\Delta l_c = l_m + l_a. \tag{3}$$

Applying *(Andreikiv O. E. Sas N. B. 2007; Andreikiv A.Y. Darchuk A.I., 1992; Andreikiv O.Y., Kit M.B., 2006; Andreikiv O.Y. Kit M.B., 2006)*

$$l_m = \beta(\delta_t - \xi),\ l_a = Fm^{-1}n^{-1}\int_0^{\Delta t} i(t)dt. \tag{4}$$

where *F* - Faraday number; *m* - gram-equivalent weight of metal; *n* - valence of metal; ξ, β, A - experimentally determined constants (*Dmytrah I.M., Panasiuk V.V., 1999, Tym'yak N. I., Andreikiv O. E., 1995*).

Since the condition of the energy balance (1) is satisfied, the condition of the velocities balance of the energies components changes is satisfied as well; in time analogy of the load cycles number N, this condition can be written as

$$\partial A/\partial N = \partial W/\partial N + \partial\Gamma/\partial N. \tag{5}$$

Substituting (2) in (5), the specified condition is written

$$\frac{\partial}{\partial l}\left[\Gamma - \left(A - W_s - W_p^{(1)} - W_p^{(2)}\right)\right]\frac{dl}{dN} + \frac{\partial\Gamma}{\partial N} - \frac{\partial W_p^{(3)}}{\partial N} = 0. \tag{6}$$

Based on (6), the rate value of crack propagation $V = \partial l/\partial N$

$$\frac{dl}{dN} = [\frac{\partial W_p^{(3)}}{\partial N} - \frac{\partial \Gamma}{\partial N}] \Big/ \frac{\partial}{\partial l}\left[\Gamma - \left(A - W_s - W_p^{(1)}\right)\right]. \quad (7)$$

Based on the results (*Andreikiv O. E. Sas N. B. 2007; Andreikiv A.Y. Darchuk A.I., 1992; Andreikiv O.Y., Kit M.B., 2006; Andreikiv O.Y. Kit M.B., 2006; Dmytrah I.M., Panasiuk V.V., 1999*), the expression in square brackets on the right side (7) will be written

$$\partial\left[\Gamma - \left(A - W_s - W_p^{(1)} - W_p^{(2)}\right)\right] / \partial l = \gamma_C - \gamma_t . \quad (8)$$

where $\Gamma = \Delta l_C \sigma_0 \delta_{CC}$; $\Gamma = \Delta l_C \sigma_0 \delta_{CC}$ - specific work of plastic deformations in the pre-fracture zone near the top of the crack;

$\gamma_C = \delta_{CC}\sigma_0 -$ critical value of specific work;

$\delta_{CC} = \delta_C - AC_H(\Delta t)$. Substituting (8) in (7), the following formula is deduced

$$dl/dN = [\partial W_p^{(3)} / \partial N - \partial \Gamma / \partial N] / \sigma_0(\delta_{CC} - \delta_t). \quad (9)$$

Based on [12-17] and relations (3), (4), the values $\partial W_p^{(3)} / \partial N$, $\partial \Gamma / \partial N$ are determined

$$\partial W_p^{(3)} / \partial N = \beta\sigma_0[(\delta_{t\max} - \delta_{t\min})^2 - (\delta_{scc}^{(\max)} - \delta_{scc}^{(\min)})^2], \eta_2 = 0{,}25\beta AB\sqrt[4]{Ti_{\max}}, \quad (10)$$

$$\partial \Gamma / \partial N = -\eta_2\sigma_0 T(\delta_{t\max} - \delta_{scc}^{(\max)}) + \sigma_0 FTn^{-1}m^{-1}i(T)[\delta_C - AC_H(T)]$$

where $\delta_{t\max}, \delta_{t\min}, \delta_{scc}^{(\max)}, \delta_{scc}^{(\min)}$ - respectively, the maximum and minimum values of the opening at the top of the crack during the load change per cycle (*Andreikiv O.Y. Kit M.B., 2006; Dmytrah I.M., Panasiuk V.V., 1999*). Basis on (10), the equation (9) is written down

$$dl/dN = \{\beta[(\delta_{t\max} - \delta_{t\min})^2 - (\delta_{scc}^{(\max)} - \delta_{scc}^{(\min)})^2] + \eta_2(\delta_{t\max} - \delta_{scc}^{(\max)})\}(\delta_{CC} - \delta_{t\max})^{-1} \quad (11)$$

The case of a macroscopic crack is considered: when the following relations are valid [7, 12, 13, 14]

$$\delta_t(l)\delta_{CC}^{-1} = K_I^2(l)K_{IC}^{-2}, \ \delta_{scc} = K_{scc}^2\sigma_0^{-1}E^{-1}, \ \delta_t(l) = K_I^2(l)\sigma_0^{-1}E^{-1} \quad (12)$$

For this case, (11) is written

$$dl/dN = \{\beta_1(1-R)^4(K_{I\max}^4 - K_{scc\max}^4) + \eta_2(K_{I\max}^2 - K_{scc\max}^2)\}(K_{fC}^2 - K_{I\max}^2)^{-1}, \beta_1 = 0{,}25\beta E^{-1}\sigma_0^{-1}. \quad (13)$$

where $K_{I\max}$ - the maximum value of the stress intensity factor (CIF) per cycle;

$K_{fC}, K_{scc\max}$ - respectively, the upper and lower thresholds of CIF on the kinetic diagrams of the fatigue and corrosion-mechanical cracks propagation;

$R = K_{I\min} / K_{I\max}$ - asymmetry coefficient of a load cycle (*Andreikiv O. Y., Tym'yak N. I., 1994; Andreikiv O.Y. Gembara O.V., 2008;Hembara O. V., Terlets'ka Z. O., Chepil' O. Ya., 2007;, ; Andreikiv O.Y., Kit M.B., 2006; Andreikiv A.Y. Darchuk A.I., 1992; Andreikiv O.Y. Gembara O.V., 2008; Andreikiv O. E. Sas N. B. 2007*). To complete the mathematical model, the following initial and final conditions are added to equation (13)

$$N = 0, \quad l(0) = l_0; \ N = N_*, \quad l(N_*) = l_*; \qquad K_I(l_*) = K_{IC}. \quad (14)$$

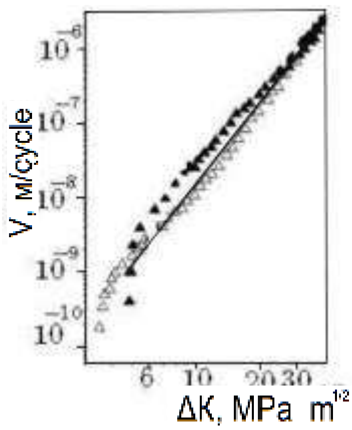

Fig.2. Kinetic diagram of 17G1S steel fatigue failure in air (Δ) and in 3% solution $NaCl$ E_{cor} at a frequency of 1 Hz (▲) and R = 0.1.

The research results of 17G1S steel (Fig. 2) (Andreikiv O. E. Sas N. B. 2007; Andreikiv *A.Y.* Darchuk A.I., 1992), studied in air and in 3% solution $NaCl$, were compared with (13). As a result, in order to describe the kinetic diagram of the fatigue crack growth in 17G1S steel in air, the following formula is deduced:

$$dl/dN \approx 12 \cdot 10^{-9}\,(K_{I\max}^4 - 81)\big/(12996 - K_{I\max}^2)^{-1} \tag{15}$$

$$dl/dN \approx 5 \cdot 10^{-6}\,(K_{I\max}^2 - 25)\big/(12996 - K_{I\max}^2)^{-1} \tag{16}$$

Similarly, for the 3% solution $NaCl\ E_{cor}$, to depict the kinetic diagram of the corrosion-fatigue crack propagation in 17G1S steel, the following equation is obtained $dl/dN \approx 5 \cdot 10^{-6}\,(K_{I\max}^2 - 25)\big/(12996 - K_{I\max}^2)^{-1}$ (16)

Pre threshold propagation of a corrosion-fatigue crack. In the threshold site of the kinetic diagram of the corrosion-fatigue crack propagation ($K_{fC} >> K_I \to K_{scc}$), the anode processes are more active as compared with mechanical destruction, that is $l_a \geq l_m$, Then, for this site, the corrosion-fatigue crack will propagate at the same velocity mainly. The kinetic diagram of the velocity of corrosion-fatigue crack growth (VCFCG) will have a plateau (see Fig. 3.) This is explained by the fact (*Andreikiv O. Y., Tym'yak N. I., 1994; Andreikiv O.Y. Gembara O.V., 2008;Hembara O. V., Terlets'ka Z. O., Chepil' O. Ya., 2007;, ; Andreikiv O.Y., Kit M.B., 2006; Andreikiv A.Y. Darchuk A.I., 1992; Andreikiv O.Y. Gembara O.V., 2008; Andreikiv O. E. Sas N. B. 2007)* that, due to the large time intervals Δt of the incubation period of preparing an elemental jump of a crack, its peak grows blunt with the growth of CIF K_I, the concentration of stress decreases and, accordingly, V stabilizes. In these sections of VCFCG diagrams (with an error to increase the durability reserve), we can assume that (the model part of the diagram in Fig. 3 is represented by a dashed line) the corrosion-mechanical crack increases with the same speed V_c to the intersection with the diagram of fatigue crack propagation at the coefficient value intensity of stress $K_{I\max} = K_{Ii}$.

Thus, the VCFCG kinetic diagram is described by the relations:
on the site $K_{scc} < K_{I\max} \leq K_{Ii},\ V = V_c$;
on the site

$$K_{Ii} < K_{I\max} < K_{fC},\ dl/dN = \beta_1(1-R)^4(K_{I\max}^4 - K_{scc\max}^4)(K_{fC}^2 - K_{I\max}^2)^{-1} \tag{17}$$

These ratios are applied to determine the residual life of thin-walled elements of vehicle structures (the period of sub-critical growth of corrosion-fatigue crack) under cyclic loads and corrosive influences.

Determination of the period of subcritical growth of a corrosion-fatigue crack. The infinite plate is weakened by a rectilinear crack of the initial length $2l_0$. It is cyclically loaded with tensile forces in distant points by continuous amplitude p efforts, which are perpendicular to the line of the crack location. When corrosive aggressive environment enters a crack cavity, the growth of the corrosion-fatigue crack is described by the equations (17) and the data in Fig. 3. The challenge is to determine the number of load cycles of an element - a plate of thin-walled metal construction of a vehicle $N = N_*$. Achieving this number, a crack gains its critical size $l(N_*) = l_*$ and the knot breaks down. To solve this problem, the following mathematical model is written:

$$V = V_c,\ K_{scc} < K_{I\max} \leq K_{Ii};$$
$$dl/dN = \beta_1(1-R)^4(K_{I\max}^4 - K_{scc\max}^4)(K_{fC}^2 - K_{I\max}^2)^{-1},\ K_{Ii} < K_{I\max} < K_{fC};$$
$$N = 0,\ l(0) = l_0;\ N = N_*,\ l(N_*) = l_*,\ K_I(l_*) = K_{fC} \tag{18}$$

For the given power scheme, the intensity of the stresses is determined by [5]

$$K_I = p\sqrt{\pi l} \tag{19}$$

RESULTS

For example, if a thin-walled element (plate) is made of 17G1S steel, the loading value $p = 200MPa$ in the of 3% NaCl solution with a flood potential *E=-2B* and *R = 0.5* (Fig. 3), the ratios (18) are recorded

$$dl/dN = 10^{-6},\ 12 < K_I < 64; \tag{20}$$

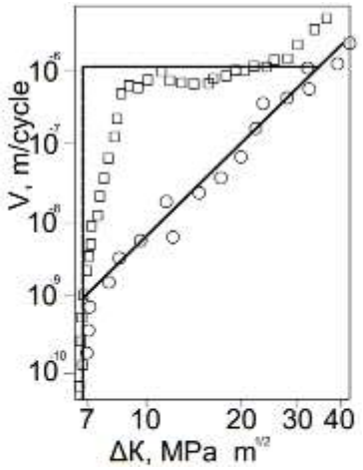

Fig. 3. Kinetic diagram of 17G1S steel fatigue failure in air (○) and in 3% solution *NaCl E=-2B* (□) at *R=0.5*; dotted line - a model representation of the corrosive part of the diagram.

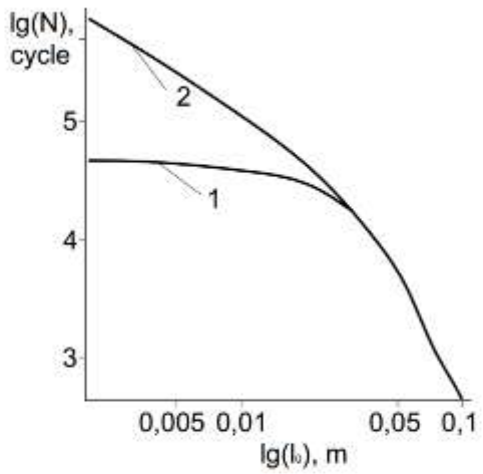

Fig. 4. Dependence of residual life N_* on the initial crack length l_0 :

curve 1 – considering the environment, curve 2 - without considering the corrosion environment.

$$\frac{dl}{dN} = \frac{45 \cdot 10^{-11}(K_{I\max}^4 - 20736)}{12996 - K_{I\max}^2},\ 64 < K_I < 114.$$

$N = 0,\ l(0) = l_0;\ N = N_*, l(N_*) = l_*, K_I(l_*) = 114\ MPa\ m^{0,5}$. To determine the residual life $N = N_*$ of a vehicle (plate) element, the ratio (20) is integrated with the given initial and final conditions. The resulting formula is

$$N_* = N_1 + N_2,\ N_1 = 10^6(l_1 - l_0),$$
$$N_2 = 2 \cdot 10^9 \int_{l_1}^{l_*} (158 \cdot 10^8 l^2 - 20736)^{-1}(12996 - 13 \cdot 10^4 l)dl \,. \tag{21}$$

The values l_1, l_* in (21) are deduced from equations

$$K_I(l_*) = K_{fC},\ K_I(l_1) = K_{Ii}\,.$$

The resulting formulas are $l_* = 0.103м,\ l_1 = 0.033м$.

Substituting in (21), we obtain:

$$N_* = (33\cdot 10^3 - 10^6 l_0 + 15510)\quad (0{,}001 < l_0 \le 0{,}033) \qquad (22)$$
$$N_* = 1650\,(l_0^{-1} + 10\ln l_0 + 13{,}3)\qquad (0{,}033 \le l_0 < 0{,}103)\,.$$

Based on (22), the graphical dependence of the residual life $N = N_*$ of a thin-walled element (a plate) on the initial size of a crack (curve 1) is developed in Fig.4. Based on (22), for the case of corrosive environment absence under the equivalent force load of a thin-walled element (curve 2), the dependence $N_* \sim l_0$ is developed as well. Thus, (Fig. 4), a decrease in a service life under the effect of corrosive environment is observed during a crack growth from 0.001 m to 0.033 m ($l_{th} < l < l_1$). Then, the propagation of exclusively fatigue cracks occurs. This process is explained by the fact that at $l > l_1$, a velocity of crack propagation is large and the delayed corrosion processes do not have time to be realized.

CONCLUSIONS.

The analytical model of the description of delayed fracture for determining the residual life of thin-walled elements of vehicles metal structures under the action of cyclic loads and corrosive aggressive environments is substantiated. Based on the obtained solutions, the residual life of a steel plate (doped 17G1S steel) with a crack under the action of long-term cyclic tension loads in a 3% NaCl solution is defined. The increase of the initial size of the rectilinear crack is proved to reduce significantly the residual durability of the structural element. The correctness of the developed mathematical model for determining the residual life of structural elements is confirmed by the experimental data known in the literature.

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APPLING GENERAL OBJECTIVE METHOD OF TECHNICAL CREATION ON BIOFUEL MANUFACTUING EQUIPMENT ANALISE USED AT THERMAL POWER PLANTS
/
APLICAREA METODEI OBIECTULUI GENERALIZAT AL CREAŢIEI TEHNICE ÎN ANALIZA ECHIPAMENTELOR PENTRU PRODUCŢIA BIOCOMBUSTIBILOR UTILIZAŢI LA CENTRALE TERMICE

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ABSTRACT

In this paper, the generalised object method is applied to find optimal solutions to manufacture briquettes and pellets, using the imposed decision technics used on known solutions but also on new solutions that can be developed on further projects. Also, will be presented the main processes and equipment's representative of the briquettes and micro-briquettes production, but to pick the optimum solution using the technical creation methods, as general object method research presented in Inventica by Prof. Vitalie Belousov and Boris Plahteanu. Using this method was developed a technical solution that will based the design of several equipment's with superior technical features then those present on European market.

REZUMAT

În cadrul prezentului articol, aplicarea metodei obiectului generalizat se face în scopul găsirii unor soluţii optime pentru producerea brichetelor şi a microbrichetelor prin folosirea tehnicii deciziei impuse aplicate pe soluţiile cunoscute dar şi analiza unor soluţii noi viabile ce urmeaza a fi dezvoltate în viitoare proiecte. De asemenea, sunt prezentate principalele procedee şi echipamente reprezentative pentru producerea brichetelor şi microbrichetelor dar şi alegerea variantei optime folosind tehnicile de creaţie tehnică şi anume cercetarea prin metoda obiectului generalizat ce au fost dezvoltate în Inventica de către prof.univ. Vitalie Belousov şi Boris Plahteanu. A fost stabilită astfel soluţia tehnică ce va sta la baza proiectării constructivă a unor echipamente cu caracteristici tehnice superioare celor cunoscute pe plan european.

INTRODUCTION

In this section will be made a short presentation of the Biofuels and their use in third millennium. The biomass resources were used in energetic purposes form the moment in which the human discovered the fire. This days the biomass, as the fuels, can be used to heating of dwellings or industrial buildings.

Developed countries in Europe had passes from several years to Intensive exploitation programs for this uninterrupted, clean, bioregenerable energy reservoir. This energy source is considerate to be the key to the renewable energy resources because it can be easily implemented on small and also on large scale, cause it has the potential to replace 14% of the world's primary energy consumption.. (*Andrzej Krauss et all, 2006*) The use of biomass energy has many qualities that provide benefits to the environment and it can help mitigate climate change. [4]

At national level, it has been identified a huge volume of second-generation fresh biomass that is unused, Fig.1. In this moment, the briquetting or pelleting plants are imported from specialized companies from Europe or China, and in Romania there identified a few plant producers in this field.

In order to add value of vegetable wastes from wood industry, from agriculture exploitations, from farmers associations, pomiculture sector, viticulture and vegetable growers, must be used briquetting and pelleting plants in accordance with raw material provenience and usage (as thermal agent for domestic heating equipment, farms, greenhouses, drying installations, pyrolysis and gasification equipment, hot water generation, but also to obtain biogas and biochar).

The pelletization and briquetting plants are also valuable for biomass crop growers that can provide and place on energetic market the necessary biomass products (pellets or briquettes) at reasonable price in large quantities and also can be easily placed at the big supermarket chains as: Bricostore, Dedeman, Praktical, etc.

Fig.1. Romanian biomass potential on different regions.

The pelletization process demand to press the raw material that is previous heated and humidified using at least two pressing roles that assures a compression rate of 4:1 that passes throw a fix die, see Fig. 2. (*Olan M., 2009*) The pellets have a diameter starting of 6 to 8 mm and a length between 20 - 30 mm, due to their dimensions are adequate to be used at small thermal power plants when the burning process is controlled and tailored to the owner needs and due to this characteristic, the heat generators can be easily adapted to many applications fields, see Fig. 3.

Fig. 2 Pellet press - industrial model [5]

Fig. 3 Krontherm Pellet thermal plants - model 355I

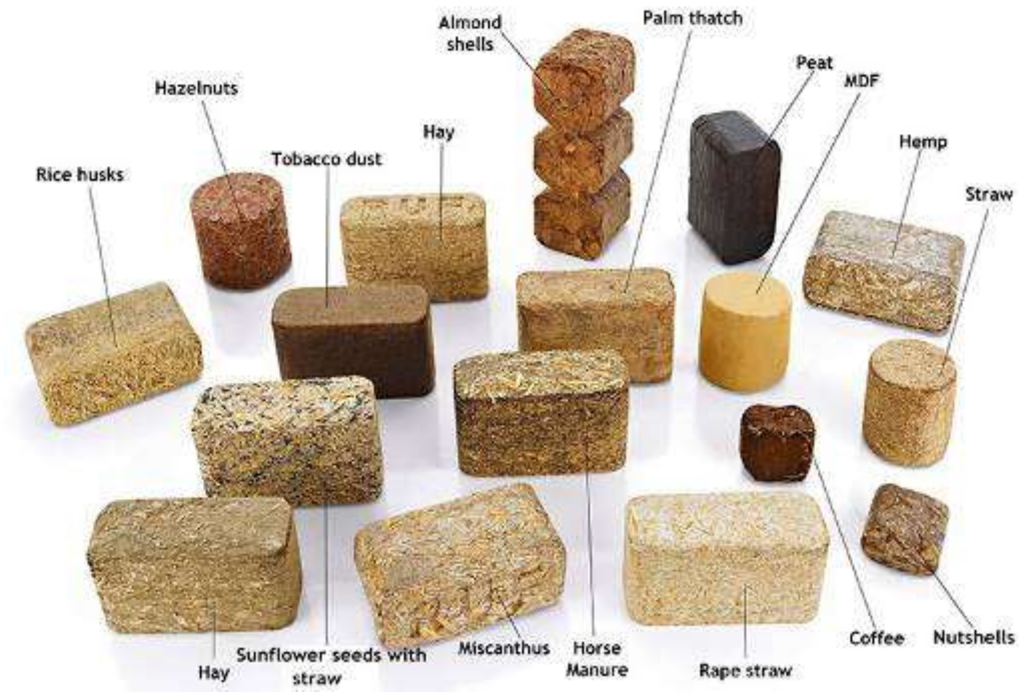

Fig. 4 Shape of biomass pellets and raw materials.[23]

The briquettes are products with very large compression rate due their mechanic or hydraulic compression system, usually their diameter is from 5 to 8 cm and a length starting from 10 to 30 cm.

Fig. 5 Briquette press - industrial model [7]

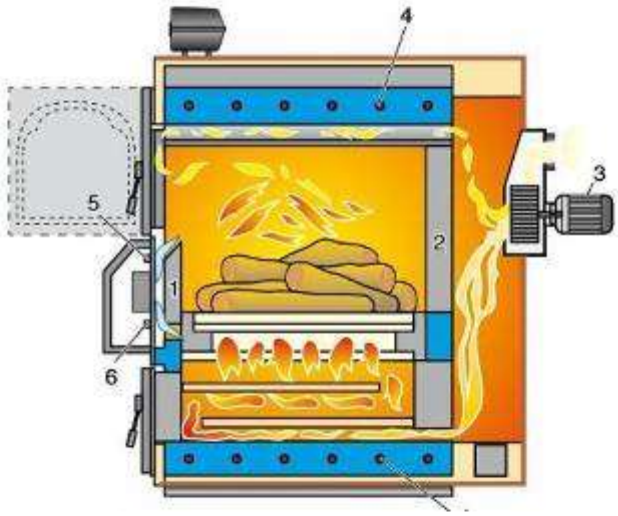

Fig. 6 ARCA ASPIRO briquette plants - model 45 R [8]

Fig. 7 Shape of biomass briquettes [24,25]

METHOD AND RESULTS

The morphologic research of biofuel production processes was carried on using the general objective method in order to identify the optimal manufacturing process of briquettes. This method is based on imposed decisional process on known technical solutions and based on this study can be developed new viable solutions to be developed in future projects. This method has 5 steps and will be applied in the next paragraphs.

Step 1 - Setting and printing the pressing-shaping assemblies. On the market are present a large number of equipments and at some of them are used the same compressing assemblies, for this reason was necessary to lay down several classification criteria of biomass briquetting/pelleting systems - symbolised with B. Those systems are actuated using different systems noted as followed: B_1 - mechanical compression systems with continuous screw; B_2 - mechanical compression systems with poanson; B_3 - hydraulic compression system; B_4 - rolls compressing system.

Also it was taken in to consideration the constructive-functional solution used to pressing process, criteria that was noted with C and divided in: C_1- forming the briquette using a cylindrical die; C_2- forming the briquette using a polygonal die; C_3- - forming the pellets using an ring die; C_4- forming the pellets using an flat die.

Another criteria it was according to the geometric shape of the obtained product, criteria that was noted with D and was divided in: D_1 - cylindrical shape ; D_2 - cylindrical bore shape; D_3- polygonal shape (square and hexagonal section); D_4 - bore polygonal shape.

Step 2 - Elaboration of the generalized object of technical creation. Generalized creation objective is presented in shape of a cylindrical morphologic matrix, on which each sector represents a technical solution (a combination of criteria B_i C_j D_k) and the total constructive solutions is presented in equation (1).

$$N = i \times j \times k \tag{1}$$

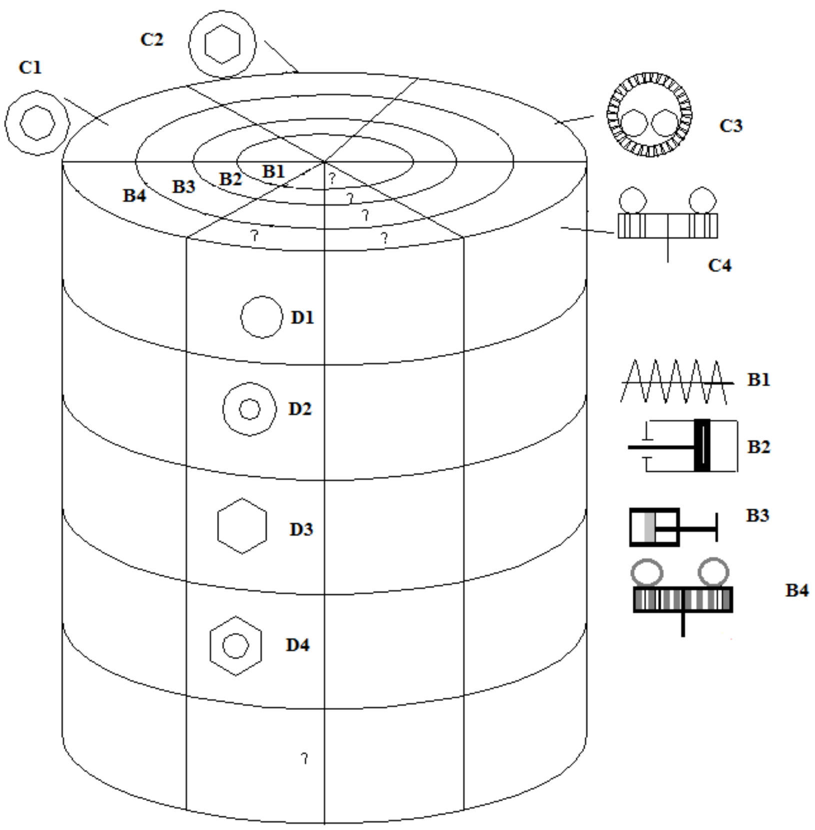

Fig.6 The matrix of generalized creation objective of technical solutions of the briquetting plant.

In our case presented is created the matrix as it can been seen in Fig. 6 and the Total number of solutions *is N = 4x4x4 =64*, one of this combination are not present in reality or are not identified yet and are represented with question mark "?". From this matrix will be eliminated the incompatible solutions and the others must be analysed so after their complete solving, they can lead to particularly efficient construction. In order to eliminate the incompatible solutions, the first type of solutions mentioned, it can be can be done by sub-morphology analysis, making a sequential-selective morphological research. [2]

Step 3 - Analyzing and evaluating the technical solutions identified on equipments. Identifying the technical solutions transposed into practice was completed the left column of Table 1, on which the technical solutions where symbolised in the next way: [ ] known solutions; ( ) unknown solutions; { } incompatible solutions. In this tabel are listed also 5 known solutions in this moment that can lead to make new investment in briquetting equipment developing. (*Belous V., Boris P., 2005*)

In order to evaluate this technical solutions, was used the impose decision technique in order to classify them taking in to consideration the next appreciation criteria and their symbols: productivity - *P*; the investment cost - *C*; the technical - constructive construction simplicity - *S*; the agronomy in exploitation - *Ex*; the maintenance - *I* and the operator specialization - *F*.

Table 1.

Technical solution analyse

Possible solutions	Level
[B1C1D1]	3
[B1C1D2] - {B1C2D1}	4
{B1C1D3 } -{B1C2D2} - {B1C3D1}	5
{B1C1D4} - {B1C2D3} - {B1C3D2} - (B1C4D1)	6
{B1C3D3} -{B1C4D2} - [B1C2D4] - [B2C2D3] - {B2C1D4} - {B2C3D2} - (B2C4D1)	7
{B1C3D4} - (B1C4D3) - {B2C3D3} - {B2C4D2} - (B2C2D4) - {B3C1D4} - {B3C2D3} - {B3C3D2} - (4C1D3) - (B4C2D2) - (B4C3D1)	8
{B1C4D4} -{B2C3D4} - (B2C4D3) - (B3C3D3) - {B3C2D4} - {B3C4D2} - {B4C1D4} - {B4C2D3} - {B4C3D2} - [B4C4D1]	9
{B2C4D4} - {B3C3D4} - (B3C4D3) - (B4C3D3) - {B4C2D4} - {B4C4D2}	10
{B3C4D4} - (B4C4D3) - { B4C3D4}	11
{B4C4D4}	12

The solutions analysed the most representative are:

- B1C1D2, mechanical actuation systems with continuous screw, the briquette is formed in the cylindrical die and the product shape is cylindrical with bore, this system is found mainly on briquetting plants, Fig.7 ; [1]
- B1C2D4, mechanical actuation systems with continuous screw, the briquette is formed in the polygonal die and the product shape is polygonal with bore, solution found also at briquetting plants, Fig. 8;
- B2C1D1, mechanical actuation systems with poason, briquette is formed in the inlet cylindrical die and has a cylindrical form, solution present on DI-PIU briquette plants, Fig.9;
- B3C3D1, mechanical actuation systems with pressing roles, this system is used mainly at pelleting products by passing throw a ring die provided with opening on its external diameter, the geometric product form is cylindrical, this technical solution is present in plants manufactured by SALMATEC - Fig.10 , LA MECCANICA, etc.;
- B4C4D1, mechanical actuation systems with pressing roles, this system is used mainly at pelleting products by passing throw a plan die on which is made openings with certain configuration, the product shape is cylindrical, technical solution found on KAHLE plants, Fig. 11.

Fig.7 GCBA-II bbriquette plant [9]

Fig. 8 EB-350 BRONTO extruder [10]

Fig.9 DI-PIU briquette plants [11]

Fig.10 SALMATEC pellet pres [12]

Fig.11 KAHLE pellet pres[13]

The criteria's *P, C, S, Ex, I* and *F* are compered between and in this way is made the diecizional proces based on the numerical way: 1 - 0; 0.5 - 0 or 0-1, and the value obtained is estimated using the equation (2).

$$D = C^2_e = 6\ (6\text{-}1)/2 = 15 \text{ decisions} \qquad (2)$$

Reporting the positive decisions number *N* to the value of *D* is obtained the importance coefficient N_{12} of each criteria, fact that leads to a new order, see Table 2.

Table.2

Criteria analyses using the imposed decision method

Nr. crt.	Criteria	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Sum of positive decisions number N	Importance coefficient N_{12}
1	P	1	0	1	0.5	1											3.5	0.233
2	C	0					1	1	1	1							4	0.266
3	S		1				0				0.5	1	0.5				3	0.2
4	Ex			0				0			0.5			1	1		2.5	0.166
5	I				0.5				0			0		0		0.5	1	0.066
6	F					0				0			0.5		0	0.5	1	0.066

Then the above representative solutions are compared taking in to consideration every criteria and are established the decisions D1, D2, D8 and then are estimated the values for them using the equation (3) in which are placed the values from Table 2.

$$N_v = (0.233 \times D_P + 0.266 \times D_C + 0.2 \times D_S + 0.116 \times D_{Ex} + 0.166 \times D_I + 0.066 \times D_F)\ /10 \qquad (3)$$

In Table 3, are presented above equation main parameters in order to have a large view of their variation.

Table.3

Solutions analyse

Nr. crt	Technical solution	Decisional process											
		P		C		S		Ex		I		F	
		D_P	0,233 D_P/ 10	D_c	0,266 D_C/10	D_S	0,2 D_P/10	D_{Ex}	0,166 D_{Ex}/10	D_I	0,066 D_I/10	D_F	0,066D_F/10
1	B1C1D2	0.5	0.01165	2.5	0.0665	3	0.06	0.5	0.0083	1.5	0.0099	1.5	0.0099
2	B1C2D4	1	0.0233	2.5	0.0665	3	0.06	1	0.0166	1.5	0.0099	1.5	0.0099
3	B2C1D1	3.5	0.0815	3.5	0.0931	3	0.06	4	0.0664	3.5	0.0231	4	0.0264
4	B3C3D1	3	0.0699	1.2	0.0319	0.3	0.006	3	0.0498	3	0.0198	2.5	0.0165
5	B4C4D1	2	0.0466	0.3	0.0080	0.7	0.014	1.5	0.0249	0.5	0.0033	0.5	0.0033

Appling the equation (1) and the values from Table 3, in equations (4) - (8) where obtained the N_v values for every technical solution:

$$N_{v1} = (0.233 \times 0.5 + 0.266 \times 2.5 + 0.2 \times 3 + 0.116 \times 0.5 + 0.166 \times 1.5 + 0.066 \times 1.5) / 10 = 0.17875 \quad (4)$$

$$N_{v2} = (0.233 \times 1 + 0.266 \times 2.5 + 0.2 \times 3 + 0.116 \times 1 + 0.166 \times 1.5 + 0.066 \times 1.5) / 10 = 0.2012 \quad (5)$$

$$N_{v3} = (0.233 \times 3.5 + 0.266 \times 3.5 + 0.2 \times 3 + 0.116 \times 4 + 0.166 \times 3.5 + 0.066 \times 4) / 10 = 0.36555 \quad (6)$$

$$N_{v4} = (0.233 \times 3 + 0.266 \times 1.2 + 0.2 \times 0.3 + 0.116 \times 3 + 0.166 \times 3 + 0.066 \times 2{,}5) / 10 = 0.26292 \quad (7)$$

$$N_{v5} = (0.233 \times 2 + 0.266 \times 0.3 + 0.2 \times 0.7 + 0.116 \times 1.5 + 0.166 \times 0.5 + 0.066 \times 0.5) / 10 = 0.09758 \quad (8)$$

The most representative solutions are N_{v3} and N_{v4}

Step 4 - Narrowing the scope of technical creation. In this part are made the conclusions regarding the adequate developing of future equipments technical solutions to product pellets in the next directions. [14, 15]

a) Designing new equipments based on the labour productivity and manufacturing price;

b) Designing of new systems for mechanical pre-compression using the continuous screw in order to prepare the raw material adequate to pelletization.

Step 5 - Engineering analyses of possible functional-constructive possibilities. Starting form possible combinations viewed in generalized objective method on technical creations, the incompatible variants being already eliminated, the following possible solutions can be:

- manufacturing a plant to produce pellets with low electric power consumption;
- implementing a pre-compressing mechanical system with continuous screw to prepare the raw material that is supplied on pellet plant.

CONCLUSIONS

In this paperwork are detailed and put in practice the newest methods decisional that can be made in the research activities to determine the optimum technologic solutions. Base on the above research theme, was manufactured the pellet plant that was delivered to Fundul Moldovei - Suceava country from Romania, see Fig. 12.[17-20]

Fig.11. Pellet plant

This pellet plant is made from a supply bunker with helical conveyor powered and controlled by an electric motor, a mixing system that humidify the raw material with 2 to 5 % on which is placed a spraying system, pellet equipment and a rotary sieve that separates and cools down the pellets. [21-22]

In order to increase the product competitively on the market, it is required to make some research activities because pellets may be a more efficient alternative to using methane gas for heating. (*Olan M., 2009*)

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HEALING CHAMBER – KEY FOR SURVIVAL OF GRAFTED VEGETABLES / *CAMERA DE CALUSARE – CHEIA SUPRAVIEȚUIRII LEGUMELOR ALTOITE*

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Keywords: *grafted vegetables, healing chamber*

ABSTARCT

The use of grafted plants on resistant genotypes is now widely widespread in the world. Grafting not only can increase the disease-resistant ability but also can promote the production quality for vegetable crops. Since both stock and scion are cut for grafting, they need to reconstruct their vascular bundles in the course of acclimatization. Therefore, vegetable grafting must be carried out in monitored and controlled environment. The most commonly used are the greenhouses in which the main microclimatic factors that affect the healing process (temperature, relative humidity and solar radiation) can be adjusted. Both grafting and post-grafting curing operations significantly affect the survival rate of grafted seedlings. An improper curing environment will cause the seedlings languishing, over-growth, or even death. For healthy production of grafted vegetables, the environmental parameters values must be monitored and adjusted very precisely, especially in the healing period. This can be done either manually or automatically, depending on production type of the farm.

REZUMAT

Utilizarea de plante altoite pe genotipuri rezistente este acum foarte răspândită în lume. Prin altoire se poate spori nu numai rezistența la boli ci și calitatea producției. Odată ce altoiul și port-altoiul au fost tăiați, ambii au nevoie în perioada post-altoire de un timp de aclimatizare pentru reconstrucția vascularizării tulpinelor. Prin urmare, altoirea legumelor trebuie să fie efectuată într-un spațiu cu un microclimat foarte precis monitorizat si controlat. Principalii factori de microclimat care influențează procesul de vindecare sunt temperatura, umiditatea relativă și radiația solară. Aceștia pot fi monitorizați și modificați. Atât operațiile de pre-altoire cât și cele post-altoire afectează în mod semnificativ rata de supraviețuire a materialului săditor altoit. Un microclimat necorespunzător poate determina subdezvolatrea , supra dezvoltarea sau ofilirea răsadurilor altoite. Pentru o producție sănătoasă de răsaduri altoite, parametrii și valorile factorilor de microclimat trebuie să poată fi ajustați foarte precis, în special în perioada post-altoire. Acest lucru se poate face fie manual, fie automat, în funcție de tipul producției agricole.

INTRODUCTION

Grafting of vegetables is widely practiced worldwide and began to develop also in Romania. Starting with 2007, Protected Crops Laboratory of the Institute of research and development for processing and marketing of horticultural products - HORTING, began to conduct researches in the field of grafted vegetables.

Practically, vegetable grafting can be considered an organ transplantation. A successful grafting of vegetables requires high relative humidity (RH) and optimal temperature for 1 week following grafting to reduce transpiration of the scion until rootstock and scion vascular tissue are healed together and water transport is restored [7]. Generally in the healing room, according to the seedlings cultivar, the adjustable temperature range is 15 to 30°C, the control precision is ±0.5°C; relative humidity can be controlled within the range of 60 to 90% RH, the control precision is ±3% RH; and the light adjustable range is 0 to 5000 lx.[8] Acording to L. Rivard and J. Louws [3] , the whole process from seeding to grafting, to healing and to transplanting in the field is five weeks (see Fig. 1). The complete vascular connection establishment takes approximately five to eight days, during which the scion is unable to uptake water through the rootstock. Terefore, reducing scion transpiration is crucial for the grafing survival (Johnson and Miles 2011). In order to reduce scion water loss to the surrounding environment, the air relative humidity (RH) should be high, ranging from 85% to 100%. However, specific timing of rootstock and scion seeding as well as the total time of propagation will vary based on the greenhouse environment and light intensity within a given propagation area.

Generally, healing and acclimatization of the grafted plants are done in particular chambers in a greenhouse. They involve healing of the cut surface and hardening for field or greenhouse survival [12].The healing room can provide a suitable artificial environment for newly grafted vegetable seedlings. The environment can be controlled based on the healing requirements of grafted seedlings through automatic control of artificial climate, including relative humidity, temperature, light, wind speed, and other environmental factors. This can be a challenging task, requiring frequent monitoring and continuous adjustment of the environment conditions in the grafting chamber [7]. Out of the grafting season, the grafting chamber can be used as acclimatization chambers for non-grafted seedlings of other crops.

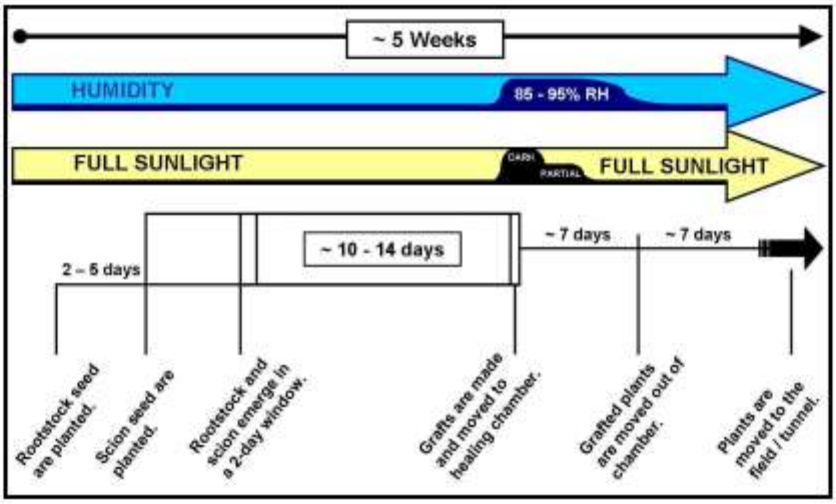

Fig. 1. Timeline for Grafting.

Generally, healing and acclimatization of the grafted plants are done in particular chambers in a greenhouse. They involve healing of the cut surface and hardening for field or greenhouse survival [12].The healing room can provide a suitable artificial environment for newly grafted vegetable seedlings. The environment can be controlled based on the healing requirements of grafted seedlings through automatic control of artificial climate, including relative humidity, temperature, light, wind speed, and other environmental factors. This can be a challenging task, requiring frequent monitoring and continuous adjustment of the environment conditions in the grafting chamber [7]. Out of the grafting season, the grafting chamber can be used as acclimatization chambers for non-grafted seedlings of other crops.

MATERIAL AND METHOD

Several types of acclimatization chambers have been developed and widely used by commercial plug seedling growers. The healing chambers could be very simple construction, with manual control of environmental factors like in fig.2 where the healing chamber consists of a frame covered by polyethylene sheeting, which can be used to keep the humidity levels high enough in order to ensure seedlings, depending on the cultivars used as scion and rootstock. The floor must be able to hold water, and during the first days after grafting, an opaque covering is used to keep all light out of the chamber [8]. The size and design of the healing chamber depends on the scale of production of grafted plants. A home gardener can create a small healing chamber like those shown in fig. 3[8] and in fig. 4[12].

Fig. 2. Relatively simple and cheap healing chamber [8]

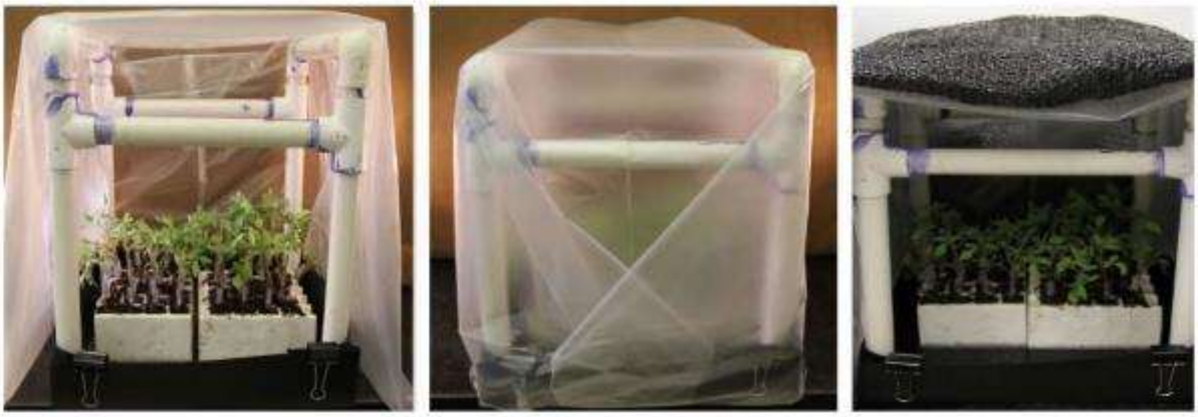

Fig. 3. Healing chamber built with PVC pipes and plastic [8]

Fig. 4. Healing chamber constructed on a bench in greenhouse [12]

The commercial growers need a larger healing chamber to accommodate larger numbers of plants. The factory farming production of grafted vegetables need healing room which can provide a suitable artificial environment for newly grafted vegetable seedling. In this way, the survival rate and quality of grafted plants will be at high level and the cost of production management will be reduced.

Joe L. [10] have developed the control strategies for the healing / acclimatization chamber and evaluated their operation performance. The control strategy is explained as follows:

1. The air conditioner starts if the inside temperature is higher than the upper setting point. The air conditioner stops if the inside temperature drops to bottom setting point.

2. The humidifier comes into operation if the inside humidity is decreasing to the bottom setting point. It stops if the inside humidity rises to upper setting point.

3. If the outside weather conditions reach the setting range, both the ventilation windows and circulation fans are activated and the ambient air is directed to regulate the chamber environment. Meanwhile, the air conditioner and humidifier are forced to stop if they are in operation.

4. The lights and ventilation windows are turned on periodically by timer settings.

All equipment can be turned on or off manually. [3]

The logic control unit is able to control the temperature, humidity and CO2 regulation processes. The system is designed for both flexible adjustments of environmental conditions and easy operations for users.

In recent years, various advanced control techniques and related strategies, such as predictive control [7–8], adaptive control [1], nonlinear feedback control [6], fuzzy control [11–12], robust control [2], optimal control [14-15] and compatible control [9] are widely proposed for different types of greenhouse environment control. These studies are important to real-world engineering application in greenhouse production. But it is difficult for such controllers to achieve a satisfactory control effect, and the tuning of such controllers is still a challenge to process engineers and operators in the greenhouse production. Haigen et all. (2011) consider that most of these approaches are either theoretically complex or difficult to implement in the actual greenhouse production, and the controller designs in the greenhouse engineering application mostly adopt the conventional proportional, integral, and derivative (PID) controllers owing to the simple architecture, easy implementation and excellent performance [8]. Even so, they do not generally give an overall consideration of various properties, such as strong interactions among variables, nonlinearities, multiple constrains and conflicting objectives, that may exist in greenhouse climate control systems. The greenhouse environment is a complex dynamical system. Over the past decades, people have gained a considerable understanding of greenhouse climate dynamics, and many methods describing the dynamic process of greenhouse climate have been proposed. Most of the analytic models on analysis and control of the environment inside greenhouses have been based on the following state space form:

$$x' = f(t;x;u;v) \tag{1}$$

where x are state parameters like indoor temperature, relative humidity and carbon dioxide concentration, u are control inputs like energy input by the heating system, fogging systems, ventilation system and CO_2 supply flux, v are external disturbances like solar radiation, outdoor temperature, humidity and wind speed, t denotes time, and $f(\cdot)$ is a nonlinear function [8]. We could summarize all the processes taking place in a protected space of culture (greenhouse or healing chamber), using the functional block diagram given in Fig. 5 [8].

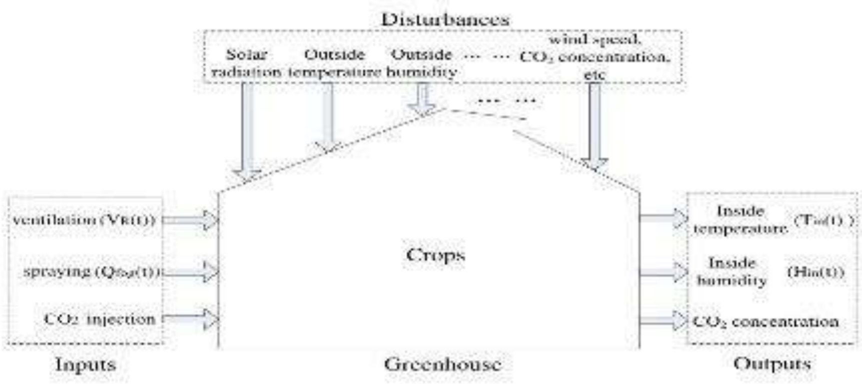

Fig. 5 : Greenhouse climate dynamic model

The heat balance equation of the processes taking place in a greenhouse can be expressed by following relationship :

$$Q_{total} = Q_{gain} - Q_{loss} \tag{2}$$

where :

Q_{total} = Amount of energy accumulated inside the greenhouse (net energy change) [W];

Q_{gain} = Amount of energy entering the greenhouse [W];

Q_{loss} = Amount of energy leaving the greenhouse [W].

Starting from equation (2), it can be determined the climatic conditions inside the greenhouse or the healing chamber, according to the outside environmental conditions.

Another healing room for factory farming production of grafted vegetables was developed by Dong and all. (2015) in China (Fig. 5).This healing room consists of an intelligent environment control system, cycle ventilation equipment, spray humidification system, CO2 fertilization equipment, lighting system, temperature control system, seedling, and perimeter protection. The intelligent environment control system involves gradually changing environmental factors (temperature, humidity, and light intensity) to achieve the best healing environment conditions for grafted seedlings to increase crop yield, adjust crop growth cycle, and improve related economic benefits [6]. The logic diagram of the environment control system operation is shown in Fig. 6 .

Fig. 5 : Heling chamber for vegetable factory seedling [6]

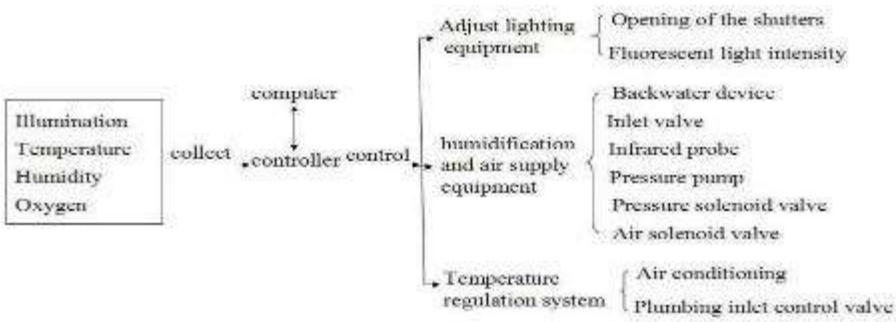

Fig. 6: Schematic diagram of environmental control system of healing chamber [6]

CONCLUSIONS

Healing and acclimatization are critical for grafted plants to survive. They involve healing of the cut surface and plant hardening for survival in outdoor field or greenhouse environment The size and design of the healing chamber depends on the scale of production of grafted plants. Healing chambers can be small, such as plastic bags that wrap a few potted seedlings for a home gardener, or they can be larger structures within a commercial/industrial greenhouse. Regardless ~~of~~ the chamber~~s~~ size, they must provide suitable environmental conditions in order to ensure a fast and successful graft union. In the same time, light intensity, relative humidity, and temperature are the most principal key environmental factors influencing the healing and acclimatization of grafted seedlings. This can be a challenging task, requiring frequent monitoring and continuous adjustment of the environment conditions in the grafting chamber

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CONSIDERATIONS ON SEA BUCKTHORN HARVESTING EQUIPMENT / *CONSIDERAȚII ASUPRA ECHIPAMENTELOR DE RECOLTAT CĂTINĂ*

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Keywords: *sea buckthorn, harvesting equipment, aspiration systems*

ABSTRACT

Hippophae rhamnoides L., also known as common sea buckthorn is a spiny shrub with many branches having yellow or orange berries that has been used for centuries in Europe and Asia to protect the environment, in nutrition and for medical remedies. In this paper, various methods of harvesting sea buckthorn berries are presented.

REZUMAT

Cătina albă, cunoscută în unele părți și sub numele de cătină de râu sau simplu cătină (având numele științific Hippophaë rhamnoides L.), este un arbust foarte ramificat și spinos cu fructe de pădure galbene sau portocalii care s-a utilizat timp de secole în Europa și în Asia pentru protecția mediului, nutrițional și în remedii medicale. În această lucrare sunt prezentate diverse metode de recoltare a fructelor de cătină.

INTRODUCTION

Sea buckthorn is a spiny shrub which also grows in Romania and it is an extremely versatile plant. Sea buckthorn is successfully used, in industry (as wood, branches and vegetal remains in the form of fuel briquettes), in the pharmaceutical or food field, or for decorative purposes. Due to the high sprouting capacity, sea buckthorn is used to consolidate sloping land.

The plant is native in about 30 countries and was also successfully introduced on the American continent. In general, it can be found in temperate areas including China, Mongolia, Russia, Lithuania, Romania, Germany, Finland, Italy, Latvia, Sweden, Denmark, Holland, France, Poland, Estonia, Belarus, Great Britain and Norway (*Li and Schroeder, 1996; Zeb, 2004*). Sea buckthorn can be used for many purposes and therefore has considerable economic potential (Li, 2002). Recently, it has attracted particular attention from researchers around the world, especially North America and Japan, mainly for its nutrition (*Kanayama et al., 2012*).

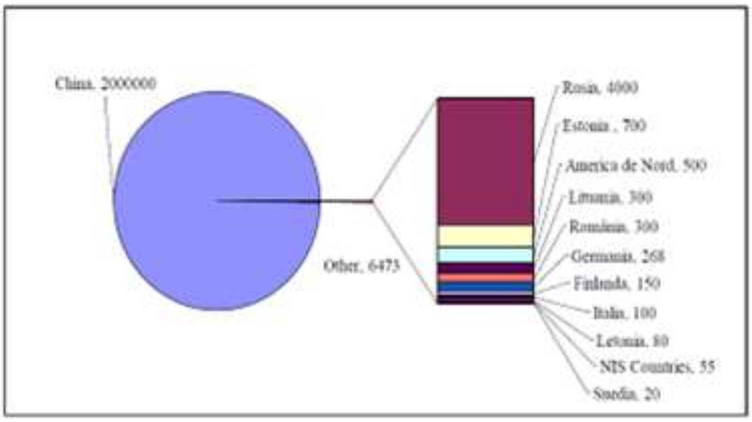

Fig. 1. Distribution of sea buckthorn cultivated areas at world level (according to Wähling, 2008)

In terms of pedoclimatic conditions, sea buckthorn is characterized by a very high adaptability, both regarding climatic factors and soil. In respect to the climate, sea buckthorn can withstand extreme temperatures and low rainfall, one of the only limiting factors being light. Regarding soil, the sea buckthorn proves to be a pioneer plant for poor and highly degraded soils, succeeding in a short time to improve both soil structure and its chemical composition by fixing atmospheric nitrogen (*Rati and Rati, 2003*).

Currently in Romania there are over 300 ha of sea buckthorn plantations spread all over the country, but most of them are small. Sea buckthorn grows spontaneously in the Subcarpathian area of Moldavia and Muntenia, starting from the upper basin of the Siret to the Olt River. In Moldavian Subcarpathians, it can be found in the valleys of the Bistrita, Trotus, Putna and Milcov rivers. In Buzau County Subcarpathians, sea buckthorn is more frequent than in other areas of Romania. The highest density of sea buckthorn is found in the Danube Delta and Buzau Basin. Sporadically, the sea buckthorn is also found in Transylvania, currently being mentioned in the hilly areas of Cluj and Mures County.

Vitamin C content (129-272 mg %) exceeds 2 times that of rosehips and about 10 times that of citrus fruit. The amount of vitamin C is higher in well-ripened fruits, even up to 400-800 mg per 100 grams of juice. Sea buckthorn berries are also rich in other vitamins (A, B1, B2, B6, E, F, K, P) being considered a true natural polyvitamin. Sea buckthorn oil contains 10 times more carotene than carrot, has antibacterial action, slightly narcotic, sedative, accelerating tissue repair.

Sea buckthorn berries, leaves and wood have a very rich and varied content (over 150 substances identified so far): almost all natural vitamins, carotene-rich oil with certain curative effects, organic acids, mineral salts (calcium, magnesium, potassium, etc.) and many other biologically active substances, for which sea buckthorn is considered a miraculous plant and a true “living plant”.

Research performed in the country and abroad has shown that sea buckthorn berries contain a number of valuable active biological substances, with a very important role in the regulation of human metabolism, with therapeutic and curative action in the prevention and treatment of diseases of the eyes, skin, juvenile acne, gastroenteritis, chronic hepatitis, kidney disease, hypertension, avitaminoses, nervous system diseases, burns, etc.

By processing the fruits, highly appreciated products are obtained: juice, syrup, nectar, jelly, marmalade, fruit jelly, jam, gelatine, liqueurs, alcoholic beverages, etc.

Used in agriculture, it increases bees overwintering resistance. Sea buckthorn biofertilizes the soil with natural nitrogen (300 kg/ha) formed in the root nodosities following the symbiotic activity of Actinomyces eleagni fungus (N. Balan, 1957, 1987). The first sea buckthorn plantations in our country were made in forestry for the fixing and capitalization of degraded land, especially in the hilly area of the country, for the fixing of the moving sands in the delta, thus appearing the sea buckthorn plantations from Letea, Cordon, Sistovka and Sfantu Gheorghe. The first experimental plantations were set up at ICPP Piteşti Maracineni, SCPP Bacău (S.C. Fructex S.A.) and Iaşi Agronomic Institute, Faculty of Horticulture. Sea buckthorn has been introduced into culture since 1980. In order to fix and consolidate degraded lands, 300 ha of sea buckthorn were made in the area of Bârnova, Dagâţa, Dolheşti, Rediu and Adamache. In Russia, since the end of the nineteenth century, the problem of sea buckthorn cultivation has been raised. Both the extensive spread and the variety of sea buckthorn forms led to the stimulation of plant culture research. The area around Novosibirsk has so far remained the Russian research centre for sea buckthorn. At the beginning, these plantations were handled by the individuals, and then they were supported by the state. In 1920, by a decree given by Lenin, the growing had to be made in a planned manner. From 1960 we can speak in Russia about the culture sea buckthorn. In 1969, the first sea buckthorn congress in Russia was held in Altai. Baltic States put a special emphasis on the development of commercial sea buckthorn plantations. In the nursery, annual production is 250,000 rooted cuttings. In China and India large farms were built, some of which were organized in cooperatives. Sea buckthorn plantations have extended very much in Finland, Sweden, eastern Germany and Poland, England, Canada, and lately Colombia, Chile - South America.

Important domains

- *Food importance* - sea buckthorn berries and leaves have a high content of minerals, vitamins, oils, carotenoids, unsaturated fatty acids, etc.
- *Therapeutic importance* - Vitamins C, E, carotenoids, etc. of sea buckthorn berries have strong oxidative action, contributing to the slowing of aging. Sea buckthorn oil is administered alongside chemotherapeutic treatments, counteracting the toxic effect of classical medication. The administration of sea buckthorn oil on skin wounds, either mechanical injuries or burns, hastened the healing process. Other benefits of sea buckthorn oil include treating dermatitis, ulcer, reducing arterial sclerosis, etc. From the bark are obtained extracts that are assumed to have an anticancer effect, together with which the oil extracted from the seeds proved antimutagenic effects and inhibiting the multiplication of tumour cells. Many studies indicate that sea buckthorn oil is fighting against cardiovascular diseases, but at present there is not enough

argumentation and more studies are necessary. Studies have shown no toxic effect of regular oil consumption (*Yang and Kallio, 2005b*).

- *Economic importance* - Currently, the interest in the development of new sea buckthorn-based products has grown considerably, both in food / nutrition fields and in the cosmetics and pharmaceuticals industry, both through "bio" and traditional industrial products.

Sea buckthorn-based products have appeared in various countries (Germany, Russia, etc.), in food (juices, jams, jellies etc.), pharmaceutical (oils, etc.) and cosmetics (various creams) industries (e.g. Albrecht, 2003).

- *Ecological importance* - Due to its rusticity, strong radicular system with high sprouting capacity (Qinxiao and Hongyan, 2003; Rati and Rati, 2003) and atmospheric nitrogen fixation capacity, sea buckthorn is used as a pioneer plant in areas with very eroded land or in restoration of anthropic soils in industrial and mining areas.
- *Ornamental importance* - Through the colour contrast between the leaves (white-silver) and the fruits (yellow-orange that remain on the plant also during the winter), it is used in landscape architecture as an ornamental plant; it is a plant that participates in the realization of spiritual and cultural connections between people.

Fruit harvesting is one of the hardest works because the fruits are very small with short and rigid stalks, besides the fact that they are strongly attached to the branches, they are grouped very close together around the branches, covering the thickest ones as a sleeve. Fruits, detaching harder from the branches, crack in the hand during late picking. These, unlike other fruit species, remain on the branches both after full ripening and after the frosts, and sometimes, if they are not eaten by birds, even until spring. Fruits strong attachment to the branches and their resisting over a very long period of time, besides the disadvantage of a very difficult harvest, has the advantage of prolonging the harvesting time, the sea buckthorn being a unique species under this aspect.

As a moment of harvesting, this can be done depending on how it is capitalised, the sea buckthorn berries can be harvested from the beginning of the ripening process until after full ripening, provided the fruit retains its integrity, does not crack during harvesting and contains as many vitamins and other biochemical components.

The beginning of ripening is marked by colour intensification, when the fruits get the characteristic colour of the variety; this occurs in the second half of August and early September. At this point, fruits contain less vitamin C and oil, are strong and crack resistant.

After that, the fruits continue to grow in volume, intensify their colour and increase their biochemical content by over 50-60% in vitamin C, 60-70% in dry matter and about 3 times in fat substances, being hard and having durable peel. The time when all components reach the maximum value is called full maturation and corresponds to the end of September - the first half of October. Then, towards the end of October, there is already a decrease in biochemical content the most significant being that of vitamin C, the peel resistance that easily cracks during harvesting. Due to the difficulty of harvesting, the largest share of crop-related expenditure is represented by fruit harvesting, depending on how this work is done.

MATERIAL AND METHOD

Techniques for the mechanical harvesting of sea buckthorn have been studied in a number of countries, including Russia, Germany, Sweden and Canada.

There are three important ways of harvesting the sea buckthorn: manually, cutting branches from the tree and mechanically or semi-mechanically harvesting by shaking.

Mechanical fruit harvesters can be classified as either direct harvesters or indirect harvesters (Olander, 1995).

A direct harvester relies on direct contact with the fruit, while an indirect harvester causes the fruit to be removed without physically touching it.

RESULTS

1. Direct harvesting

Direct mechanical harvesting can be very effective in removing sea buckthorn berries by means of a vacuum-suction machine.

A representative model of this type of equipment is the MII 70-6 vacuum suction SBT harvester which was developed by Moscow Scientific Research Institute of Agriculture (*Yang et al., 2002*). The harvesting equipment is coupled to a tractor and has a power of more than 36.6 kW. Components of direct mechanical harvester include universal shaft (1), driving pulley (2), fruit boxes (3), vacuum pump (4), equipment transporting wheels (5) container for filling with fruits (6) fruit tank (7), vacuum suction flexible tubes (8), picking heads (9), and chassis (10), as shown in Figure 2.

During harvesting, the negative pressure generated by the vacuum pump, which is powered by the tractor through the universal shaft, will form a suction flow of fruits into the special picking heads and then they will be stored in the tanks. Once the container is filled, the fruit can be transferred to the fruit boxes. Generally, this type of harvester has six picking heads for six people to work at the same time. The machine has the capacity to harvest up to 1000 kg of fruit in one day. It is recommended to be used for harvesting sea buckthorn variety with big fruit.

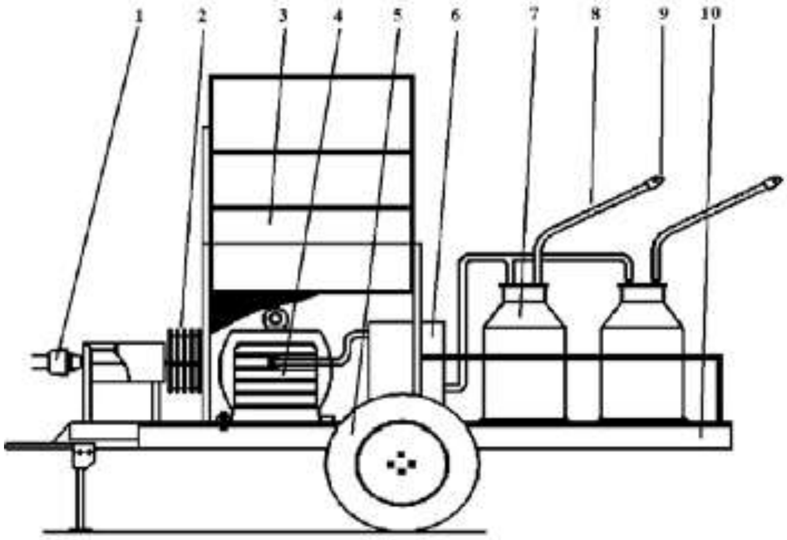

Fig. 2. Structure of suction harvester for sea buckthorn fruit - MII 70-6 model

Another model of direct harvester that has been tested on the following forest fruits including sea buckthorn is also the model in the figure below:

Fig. 3. Suction harvester

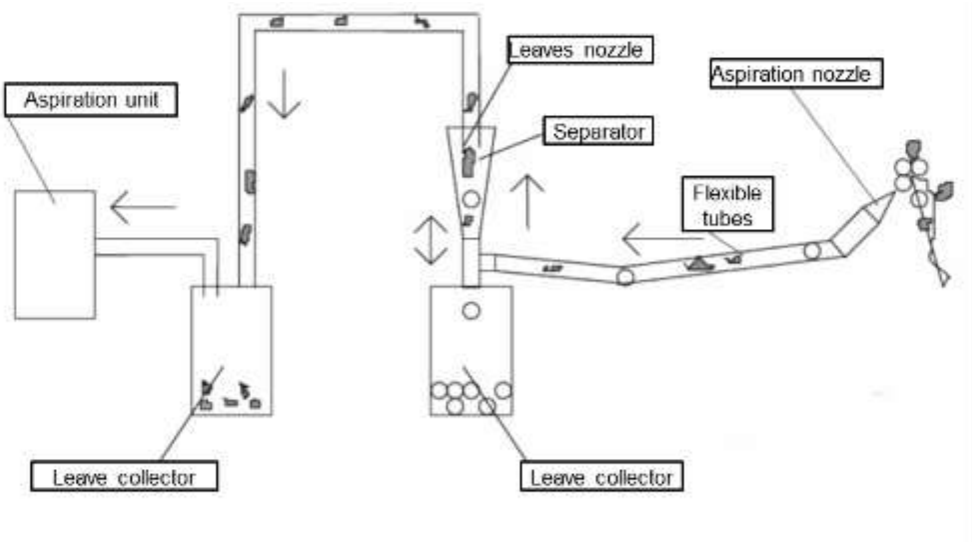

Fig. 4. Scheme of equipment operation - aspiration

The harvesting principle is achieved by suction and gravitational separation. Following experiments with this type of equipment, it has been tested in harvesting different varieties of forest fruits resulting in the following values:

- sea buckthorn harvesting – 2.5-12 kg/h;
- redcurrant harvesting – 6-11 kg/h;
- blackcurrant harvesting – 8-14 kg/h;
- gooseberry harvesting 6-9 kg/h.

<u>Main operations of equipment functioning</u>

Using equipment such as the one in the picture, the berries are picked almost without leaves. The berries go into a berry collector, from which they are easily transported in any means of transport. The separation unit is operated by suction. The berries are sucked from the twigs (from the bush) with a nozzle attached to a flexible tube. Berries and leaves pass through the flexible tube into the separation equipment. Berries are separated into a berry collector and the leaves go into a container, which is located near the suction unit.

For this sea buckthorn harvester, there are also three equipment variants ranging from 2 to 8 collecting positions.

Fig. 5. Three variants of aspiration harvesting systems

In version 1 we have the suction equipment - electric and driven by a small genset (about 10kVA)

In version 2 we have suction equipment with turbine powered by a diesel engine or a genset.

In version 3 we have the aspiration device with towed turbine and powered independently by a small tractor or electric generator.

2. Indirect harvesting

Indirect harvesting is usually accomplished by shaking a portion of the plant. Forces applied to either the trunk or branch of the plant cause the fruit to be detached from the stem. This type of indirect harvesting is divided into two harvesting techniques namely vibration harvesting and cutting harvesting.

2.1. Vibration harvester

Such a vibration harvester was developed by the Department of Agricultural Machinery in the Russian Institute of Medicinal Plant (figure 6).

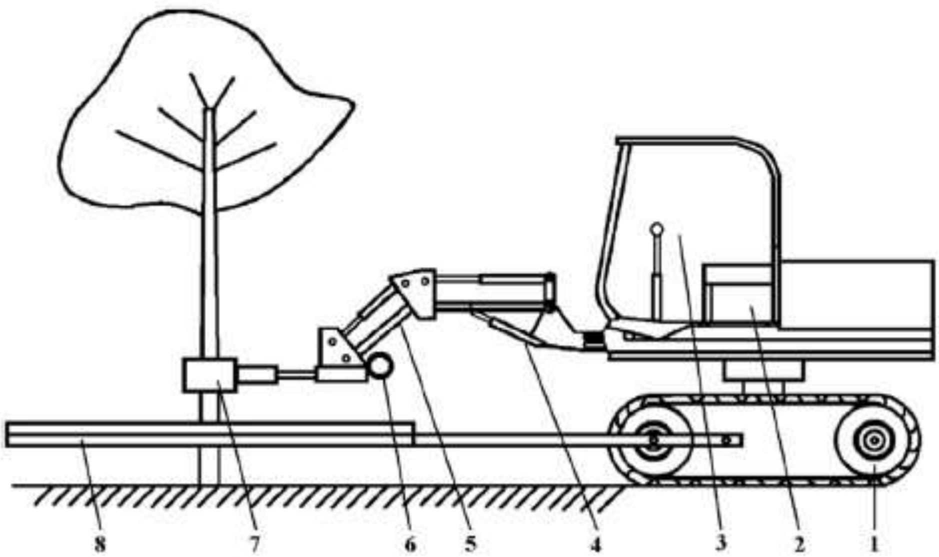

Fig. 6. Vibration harvester for sea buckthorn

1- Running system
2- Engine
3- Cab
4- Height control cylinder
5- Front control cylinder
6- Hydraulic motor
7- Clamp
8- Collecting device

The equipment harvesting system consists of a fruit collecting device, clamp vibrating device, hydraulic motor and control cylinder, as shown in Fig. 6 (Qiu, 1989). For harvesting, the clamp position on the trunk is first selected and clamped by the vibrating device. Its height and angle are adjusted via the hydraulic control valve. After that, the trunk is vibrated by the vibration from the eccentric mechanism in the vibrating device, which is driven by the hydraulic motor. The vibrating frequency is regulated through the flow valve to adjust the hydraulic motor speed, so that it is close to the natural frequency of the plant. The ripe fruit is shaken free from the plant and drops down into the collecting device. The trunk vibration harvester needs the tree height to be more than 1 m, line spacing of 4-5 m and tree spaced of more than 3 m. This equipment is only suitable for use with sea buckthorn plantations where the varieties have big fruit.

2.2. Cutting harvester

In Germany, a cutting harvester for berries was developed by the Kranemann Co. Ltd (Kranemann, 2009), the harvesting being made by cutting the fruit-bearing branches. This equipment includes wheels (1), hydraulic cylinder (2), container (3), engine (4), cab (5), elevator (6), reel (7), circular saw (8), adjustable baffle (9), as shown in Fig. 7.

During harvesting, the harvester is driven along the sea buckthorn tree line and directed towards the trees by adapting the circular saw cutting height to the fruit bearing-branches level. Then, the fruit bearing-branch is cut and conveyed to the container. After that, the fruit-bearing branches are transported on a special truck to a flash freezer tunnel where the fruit-bearing branches are flash-frozen while passing through within 10-15 min. Finally, they are transferred to a machine that separates the fruit from the branches by vibrating. This method has great adaptability to various sea buckthorn varieties and high efficiency. However, it results in a large yield reduction the following year.

Fig. 7. Sea buckthorn cutting harvester

CONCLUSIONS

Although sea buckthorn is a unique and valuable plant species that is widely grown in various parts of the world, its main constraint to large-scale fruit production is still the harvesting. It was found that most research on mechanical harvesting of sea buckthorn fruit in developed countries was done in the 1990s, except for Khazaei and Mann (2004a, 2004b, 2004c, 2004d) from Canada, who have performed some fundamental studies that would be helpful for designing mechanical harvester, from 2001 to 2005. In developing countries, especially China, sea buckthorn fruit are still being harvested manually, even though much research has been done and some devices were developed in these countries.

The performance of each harvester is compared in the table below.

Type		Country	Operators needed	Harvesting efficiency (kg/h/person)	Removal rate	Damage rate
Vacuum suction harvester		Russia	6	21	70%	–
Trunk vibration harvester		Russia	3	50	50%	–
Cutting harvester		German	6	30	80%	5%
Small fruit harvester	Vibration head	China	3	25	85%	15%
	Dial spring head	China	3	15	85%	10%
Portable vibration picker		China	2	24	80%	12%

The trunk vibration harvester from Russia reached the highest harvesting efficiency of 50 kg/h, but its removal rate of 50% is too low to be acceptable. The best harvester is the cutting harvester from Germany: it could remove 80% of the fruit at a harvest rate of 30 kg/h, while only damage 5% of the fruit. Therefore, this method, supplied by the Kranemann Co. Ltd., is the only commercially viable way for mechanical harvesting of sea buckthorn fruit. Therefore, it could be possible to breed sea buckthorn cultivars suited for harvesting by shaking. For large scale harvesting, the only realistic method is to shake the berries off the plant. However, shaking the trees causes severe bark damage, so even if all the berries are successfully harvested by shaking, the bush will still need to be cut down anyway.

Therefore, the most realistic harvesting method is to cut off the branches during the harvest season, but to do that in one operation is quite complex. This is due to the bush usually growing with thick branches that makes the machine passage through difficult. Therefore, it is necessary to develop a culture system that makes the bush grow upwards, without branches. Some researchers are already working on this

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TECHNICAL EQUIPMENT FOR PLANT RESIDUES COMPOSTING AND CAPITALISATION
/
ECHIPAMENTE TEHNICE DE COMPOSTARE ŞI VALORIFICAREA REZIDUURILOR VEGETALE

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ABSTRACT

The best method of capitalizing organic waste of any kind is composting. The paper presents plant waste processing equipment aimed at developing a sustainable agriculture and greening of agricultural and forest areas. We also present mobile equipment for fragmentation-shredding of wood, resulting from the activities of pruning trees and shrubs in the agricultural, fruit and forest areas, as well as equipment for mechanized preparation / processing of vegetable waste for obtaining the organic plant compost used for the development of a sustainable agriculture, with favourable environmental effects, and for obtaining healthy agricultural products for the population.

REZUMAT

Metoda cea mai bună de valorificare a reziduurilor organice de tot felul o reprezintă compostarea. În lucrare sunt prezentate echipamente de procesare a deşeurilor vegetale, în scopul dezvoltării unei agriculturii durabile şi al ecologizării arealelor agricole şi silvice. De asemenea sunt prezentate echipamente mobile de fragmentare-mărunţire a materialului lemnos, rezultat în urma activităţilor de toaletarea arborilor şi arbuştilor din arealele agricole, pomicole şi silvice, precum şi echipamente pentru prepararea / procesarea mecanizată a deşeurile vegetale, pentru obţinerea compostului ecologic vegetal, utilizate pentru dezvoltarea unei agriculturi durabile, cu efecte favorabile asupra mediului şi obţinerea unor produse agricole sănătoase pentru hrana populaţiei.

INTRODUCTION

Over the last few years, in the world, organic farming has been developed by eliminating the use of synthetic fertilizers and pesticides. In order to increase soil fertility, more and more natural, biodegradable fertilizers are used. By using the compost obtained from waste from the agricultural and forestry areas, as well as from the wood processing industry, soil fertilization is made; this represents its natural capacity to balance the processes that are at the basis of the organo-mineral complex formation, with those for balancing the nutrients for the vegetal cover. The use of organic plant compost also ensures the preservation, protection and improvement/rehabilitation of degraded or poorly productive land by introducing natural organic matter into the soil, resulting in the increase or maintenance of humus quantity and quality, in accordance with the principles of developing a sustainable agriculture [1, 2, 3].

It is true that in order to accomplish these operations, which make up the technological flow of obtaining the organic plant compost, it is necessary to develop an appropriate infrastructure, namely to create a range of machines and equipment suitable for obtaining the organic plant compost.

MATERIAL AND METHOD

Technological aspects in obtaining organic plant compost

Composting is operation of recovering organic waste components for processing and the final product of the organic waste composting operation is the compost. Compost means a shredded and fertile mixture obtained by an aerobic, thermophilic, total or partial decomposition of organic matter and which is used to improve soil quality in order to increase its fertility [1].

Composting is a naturally controlled process in which beneficial microorganisms, bacteria and fungi convert waste into a finished product, fertilizer and soil conditioner, which can be considered the enemy of pathogens in the soil. By decomposing and stabilizing organic substances during aerobic fermentation under the action of microorganisms, by biological degradation, the organic material is transformed into a humus-like material.

Composting can therefore be defined as a method of managing the biological oxidation process that converts heterogeneous organic matter into more homogeneous ones, with humus-like fine particles.

Parameters necessary for the composting process

The process of plant mass decomposition is a biological process. In order to achieve good compost, optimal life conditions must be ensured for the microorganisms involved in the decomposition process. Factors that influence the formation of good compost are: water, air, heat, nutrients and waste shredding. Each of these factors influences composting differently. Thus, the lack of water blocks the activity of the microorganisms and therefore of the decomposition process. Too much water makes microorganisms that need only a little water and much air to be unable to live. Insufficient aeration (compost deposits closed or built into concrete pits, in too thick layers, with too much moisture) causes the multiplication of microorganisms that prefer wet places, and with them there are also shortcomings such as bad smell.

To ensure good aeration, venting or water drainage must be allowed. For a rapid decomposition of the compost material, it is important that all the organic components of harder substance, for example the wood, be shredded. The advantage lies in the fact that the shredded wood material loosens, while the plant material remains stuck. The mixture of the two types of material results in a loose and airy compost.

The composting process is used to speed natural degradation of materials. The process of composting is a natural biological process, carried out under aerobic conditions (in the presence of oxygen). In this process, various microorganisms, including bacteria and fungi, decompose organic matter into simple substances.

The effectiveness of the process depends on the conditions in which it occurs, such as: the presence of oxygen, temperature, humidity, material clutter, organic matter and the size and activity of microbial populations.

Methods of composting

A. passive composting in open pile;
B. composting on platforms, in rows or piles by using a loader for turning, mixing and handling;
C. composting on the platform using special pile reshaping equipment;
D. aerated static pile systems using perforated pipes;
E. container composting system.

The first three methods are usually carried out outdoors and the last two in closed spaces to have better control of humidity, treatment and odour capturing.

A) ***Passive composting in open pile*** (fig. 1) is suitable for small or moderate farms with less management. The method involves forming the pile of organic materials and leaving it untouched until the materials are decomposed into stabilized products. These small piles have the advantage of natural air movement. Due to the active fermentation the pile is heated in the interior, the warm air rises and is lost to the upper surface of the pile, being replaced by the cold air penetrating at the base of the pile and on the sides, thus refreshing the air in the pile. Depending on pile size, the airflow can refresh the air in the pile faster or slower by activating the fermentation process. For an efficient air exchange, especially during the summer period and if more heat-generating materials are composted, such as horse manure, the pile height will be only 0.9-1.2 m.

Fig. 1. Passive composting in open pile [8]

B) ***composting on platforms, in rows or piles*** is the most common form of composting. Because in an active management of the process, rows and piles are reshaped by a special machine, which avoids compacting the pile, improves the exchange of air, brings to the pile surface the inside material and inserts into the pile the material at its surface. In this way, weed seeds, pathogens and fly larvae can be destroyed by composting, as they reach the middle of the pile where the temperature is very high. By turning and mixing again when reshaping the materials undergoing composting, they fragment into smaller particles and their active biological contact surface increases. Excessive reshaping can reduce the porosity of the pile if the particle size becomes too small. The size of the pile (of the row) is given by the characteristics of the equipment that performs pile reshaping. It is preferable for the composting platform to be surrounded by a drainage ditch. The collected liquid can be used to wet the pile when reshaping if necessary or can be applied to the agricultural land as a liquid fertilizer.

C) ***Composting on the platform*** using specialised pile reshaping equipment is practiced in large composting plants. It is identical in terms of organisation method with the B method - composting on platforms, in rows or piles, but the specialised reshaping equipment is required.

D) ***Aerated static pile systems using perforated pipes*** (fig. 2) – can be developed in open or closed spaces. In the pile, perforated pipes for aeration are incorporated into the pile to its bottom. The hot gases inside the pile rise and cold air penetrates through the pipes inside the pile. Forced aeration can also be practiced by using an air blower in the pipes at the bottom of the pile, which makes the air circulation faster. The forced aeration system allows the pile to grow and better control of the composting process.

Negative pressure arrangements (inside the perforated pipes) allow air extraction directly through biological filters if odours become a problem. Aerated static piles are based on wood chips, chopped straw or other porous materials. The porous material at the bottom also incorporates perforated aeration pipes. Selection and initial mixing of the raw materials subjected to composting are essential as it must have a good structure to maintain its porosity throughout the composting period. This general requirement is ensured by the use of a density-maintenance agent such as straw or wood chips. The initial height of the aerated static pile is 1.5-2.5 m. In winter the larger piles help keeping the heat. A finished compost layer covers the compost pile. The length of the aerated static pile is limited by air distribution through the aeration pipes. For aerated static piles, the mixing of pile materials is essential because the pile is formed once. The pile is shuffled by means of a Fadroma front loader by mixing the materials several times in another pile and then depositing in the final pile. It is recommended to mix and form the pile on a concrete surface.

Fig. 2. Aerated static pile system with perforated pipes [8]

E) **Container (vessel) composting system** involves the confining of active composting materials in a container, building, etc. The container (vessel) system has the most aggressive management and it is generally the one with most capital-intensive investment, but provides the best control of the composting process. Most container methods involve a variety of forced aeration systems and mechanical turning techniques leading to enhanced composting. Some container composting systems (an enormous bag) include no-turn composting materials. Composting in small containers that are installed for use for about a year are available for composting in a variety of farms that generate organic materials including dead poultry and manure. Many of these systems combine the attributes of the platform with turn equipment and of the aerated static pile.

RESULTS

Worldwide, there is a wide variety of fragmentation-shredding equipment, which varies according to the technological process of shredding, the size of the material used and resulted, as well as the necessary productivity.

Wood fragmentation-shredding equipment (Figure 3) is a constructive solution consisting of trailed equipment mounted on the chassis of a single-axle trailer that uses as a source of mechanical energy a self-contained heat engine, which offers autonomy of use irrespective of the existence or not of a tractor for movement.

Fig. 3. Fragmentation-shredding equipment ECHIFRAG [5]

The Bioshredder BC 60 (Fig. 4) is a hobbistic machine suitable to triturate, grind and cut wood, linden tree, grass, leaves. Unwieldy branches and twigs are cut up in such a way that the shredded material becomes an optimal organic basis for composting. The machine has a rotor with hammers and a chipper which permits to work wood up to 4 cm diameter. Thanks to the particular conformation of the rotor, the BC 60 can be endowed, by request, with a leaf sucker kit with collecting bag, which turns it in a vacuum unit suitable for the cleaning of boulevards, gardens, green spaces, etc.

Fig. 4. Bioshredder BC 60 / BC 450 [6]

The Italian company OSMA TLPF-UX produces the forestry mulcher (Fig. 5) for medium and heavy residues, with fixed teeth and a HARDOX steel structure, with rotor drum with fixed tools to cut branches, shrubs and trees up to 20 cm in diameter, with lateral transmission and hydraulic hood. Required power of the tractor: between 80 - 160 hp.

Fig. 5. Equipment produced by OSMA, TLPF-UX model [7]

At international level, composting technologies are very diverse and widespread. After analyzing the constructive variants achieved worldwide, it was concluded that the construction type of plant composting equipment is the type of tractor-trailed equipment that is usually held by customers who have composting platforms. The composting equipment, designed and made in Romania, is a preparation equipment for small and medium-sized producers of organic plant compost intended to fertilize arable and forest land and to green agricultural and forestry production, to a healthy diet of the population, as well as to ensure the protection and rehabilitation of degraded land, in line with the principles of sustainable agriculture. Composting equipment (Fig. 6) is designed to mix / turn/overturn the compost windrows/heaps in order to biologically aerate and treat the compostable organic matter.

Fig. 6. Composting equipment [1]

The composting equipment performs the following functions: moving, by tractor traction, along the compost heap by placing it under the drum arm; hydraulic rotation of the mixing drum with rotating hammer/knives; hydraulic lifting and lowering of the drum while working, on a limited distance; water spraying of compost windrow and inoculation of microbial substances.

Another composting equipment is designed by the Italian company RIVOLTATRICI RV-T 1500/2000/2500/3000 (Fig.7) as equipment for small composting plants. The rotor is driven by the 540 rpm tractor's PTO, and is capable to work heaps of 1500 to 3000 mm in width and up to 1600 mm in height. The machines can be hydraulically tilted and towed for transportation. It can be equipped with hydraulically height-adjustable axle shaft, stabilizer side wheel, double counterweight and rear lights bar.

Fig. 7. Machine RIVOLTATRICI RV-T 1500/2000/2500/3000 – Bioshredder [6]

Italian company Bioshredder designed and built for a highly professional use a wide range of equipment such as the machine BS 1000 (Fig. 8) which is widely used in industrial plants, composting centres, farms, forestry and public bodies.

Fig. 8. Industrial composting equipment BS 1000 – Bioshredder [6]

For concrete situations in each case, Backhus GmbH, the German manufacturer of these machines, can offer from very small machines with capacities of 500, 700 ml/hour (Fig. 9), to very large machines, whose capacity can exceed 6000 ml/hour (Fig. 10), accessories for compost windrows irrigation and the assistance needed to choose the best processing solution.

Fig. 9. 500-700 ml/hour composting equipment [11]

A special option of Backhus machines is to cover the windrows with a foil as composting progresses. This avoids the cost of building a compost protection plant against rain.

Fig. 10. High capacity composting machine - 6000ml/hour [11]

WEIMAR Malaysia produces composting machines (Fig. 11) applying the “Container System” principle with 25 to 100 kg compost capacities.

Fig. 11. Waste composting machine 25kg (left photo) respectively 1000kg (right photo) [9]

Compost Systems GmbH produces various composting equipment, among them the mixer (Fig. 12) is the ideal solution for mixing two or more types of compostable waste together to prepare optimal composting conditions. With an installed 25 kW rotor power and a production capacity of up to 100 m^3/h, the mixer is a high-performance, low-power unit. The speed of electric motors can be varied (optionally with remote control) and individually adapted to the different types of waste. This generates the best mixing results required for the composting process. The mixing funnel can be produced with volumes from 10 to 24 m^3. The vertical side panels, without conical inlet, prevent the possible connection of the waste.

Fig. 12. Waste mixer for compost [10]

Another equipment from the Austrian company is the KA 4018 screening station (Figure 13) which can be mounted at the desired height with a concrete foundation and is loaded by means of a conveyor belt. The feed hopper is a compost mobile distributor or a controlled unloading fixed hopper. The screen excess can optionally be separated by a transporter with an integrated air separator, before returning to the rotting process, the equipment having a working capacity of max. 120 m^3/hour.

Fig. 13. KA 4018 Screening Station [10]

Another compost turner CMC SF 300 (Fig. 15) produced by the same company is the most advanced model, with a working width up to 3.4 m, showing very good properties for the production of high quality compost and high quality compost substrates. The equipment promises aerobic conditions for the composting process, with a turning performance of more than 1000 m^3/h and a windrow cross-section of up to 3.5 m^2/m. This machine corresponds to the strict criteria of controlled microbial composting.

Fig. 15. Compost turner CMC SF 300 [10]

CONCLUSIONS

Those presented above show that the use of composts in soil fertilization has beneficial consequences for the greening of agricultural land and products, so also for human health, and it is therefore necessary to implement these ecological technologies on a large scale in agriculture.

The main beneficial effects of compost are:

• Improves plant growth and roots - it has been found that where compost takes part in the formation of the growing environment, the plants grow stronger and have a higher production; compost not only brings organic matter and nutrients but also the essential microelements necessary for plant growth;

• Reduces the rate of nutrient release - compost links nutrients, ensuring their release and use over a longer period of time; fixing nutrients reduces their washing by groundwater and surface water during rains;

• Improves soil porosity - microbiological activity is essential for fertile soils; microorganisms decompose organic matter and provide the necessary nutrients to plants, but this happens better in aerated porous soils; the high intake of organic matter leads to increased soil porosity;

• Improves water storage capacity - both by increasing the soil porosity and by the ability of the compost to absorb water;

• Improves soil resistance to erosion caused by water and wind - by improving soil physical characteristics and faster plant growth due to water and nutrient accessibility; faster land coverage reduces soil erosion caused by water and wind;

• Reduces plant diseases - it has been demonstrated that the application of compost inhibits the incidence of plant diseases.

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[10] http://www.compost-systems.com/en/green/maschinentechnik/siebstation#station%C3%A4re-siebanlagen;
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EXPERIMENTAL RESEARCHES ON THE FLOW RATE DISTRIBUTION OF FIELD SPRAYING MACHINE NOZZLES
/
CERCETĂRI EXPERIMENTALE PRIVIND DISTRIBUŢIA DE DEBIT A DUZELOR MAŞINILOR DE STROPIT ÎN CÂMP

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Keywords: *flow rate distribution, nozzles, spraying machines, degree of coverage, pressure, jet angle*

ABSTRACT

The use of spraying equipment for the application of phytosanitary treatments in field crops is of great importance both economically and ecologically. In this respect, this paper aims to highlight the importance of using spraying equipment in field crops.

The paper presents the results of a series of experimental researches on the flow rate distribution of spray nozzles in the field. The HERBST TEST 2000 stand was used for the experimentations. In order to assess the distribution uniformity, six types of nozzles (01, 02, 03, 04, 05, 06) were used at five working pressures (1-5 bar) at the spraying height of 500 mm, using water as spray solution. The data obtained were processed using Microsoft Excel, the results highlighting the uniformity of normalized linear distribution.

REZUMAT

Folosirea echipamentelor de stropit pentru aplicarea tratamentelor fitosanitare în culturile de câmp este de o mare importanță atât din punct de vedere economic, cât și din punct de vedere ecologic .În acest sens, această lucrare își propune să sublinieze importanța utilizării echipamentelor de stropit în culturile de câmp.

În lucrare sunt prezentate rezultatele unor cercetări experimentale privind distribuţia de debit a duzelor maşinilor de stropit în câmp. Pentru realizarea experimentărilor s-a utilizat standul HERBST TEST 2000. În vederea evaluării uniformităţii de distribuţie s-au folosit şase tipuri de duze (01, 02, 03, 04, 05, 06), la cinci presiuni de lucru (1-5 bar), la înălţimea de pulverizare de 500 mm, utilizând ca soluţie de stropit apa. Datele obţinute au fost prelucrate cu ajutorul programului Microsoft Excel, rezultatele evidenţiind uniformitatea distribuţiei liniare normalizate.

INTRODUCTION

Agriculture has been a vital human activity since ancient times, being the main source of food for a country's population, the advances achieved in agriculture having a beneficial effect throughout the country's economy. [10]

Developing and modernizing agriculture is a natural and necessary process. We cannot imagine raising the quality of life if agriculture is not stimulated to produce as much as possible and of high quality. The development of agriculture is influenced by natural, technical and social factors. Technical factors play an important role in the increase of production through mechanization, chemistry, irrigation, etc., phytosanitary protection occupying a very important place (*Bran M, 2009*).

An important factor in the continuous improvement of the quality of products obtained by the economic agents is the maintenance of the compliance of the plant protection equipment (*Drocas I. et al., 2009*). Thus, the purpose of a spraying work is to uniformly deposit a maximum amount of phytosanitary product at the control site, respectively on the sprinkled surface (*Boja F. C., 2010*).

In order to have qualitative crops, it is important to correctly apply the phytosanitary treatments specific to the moment and to their needs in order to maximize the beneficial effects (*Marian O., 2016*).

Disease and pest control treatments are performed by spraying plants with solutions prepared in various concentrations and combinations of fungicides, insecticides, acaricides, herbicides, growth stimulants, used depending on the nature of the diseases and pests to be combated. [11]

The uniformity of distribution of machines for spraying in the field is an important indicator of the quality of treatments applied, its quality having environmental effects. Factors that influence distribution uniformity across the working width include the flow of liquid through each nozzle, working pressure, and nozzle type (*Zhang T. et al., 2017*). In paper (*Drocas I. et al., 2009*), the influence of height and working pressure on distribution uniformity for two types of nozzles (IDK 120-04, AD 120-02) is presented.

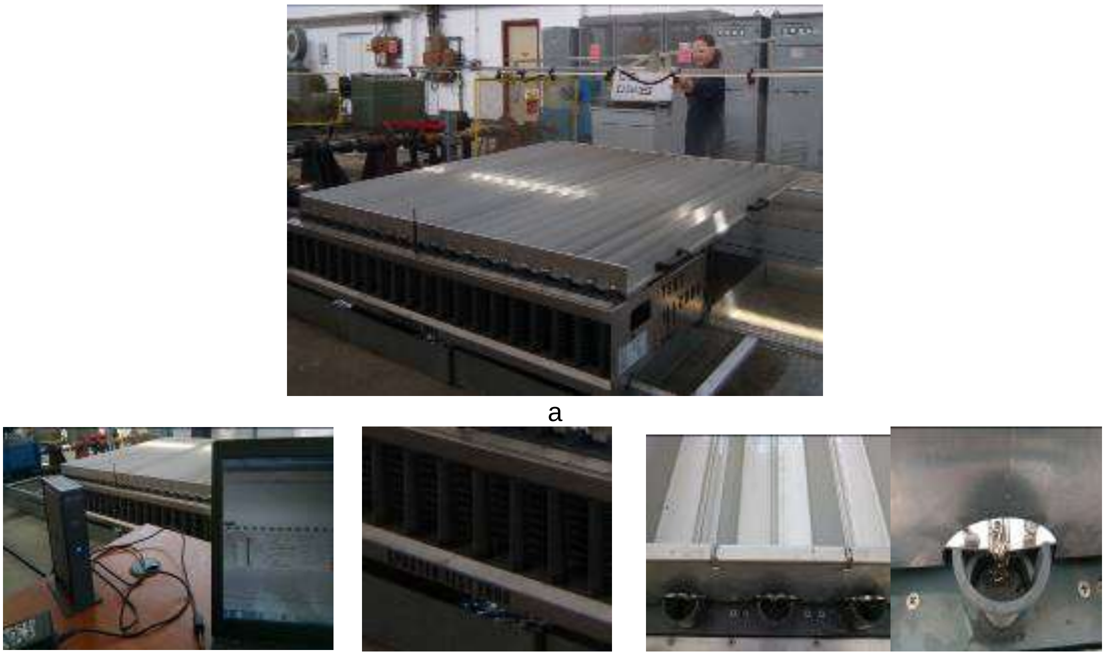
In recent papers (*Liu X et al., 2017; Jiang H. et al., 2016*), spraying machines were studied to determine the homogeneity of spray droplets and their sizes under different test conditions in order to accurately assess the uniformity of distribution by spraying.

In the field of nanomaterials (*Woo JS et al., 2017*), optimization of spraying and evaporation behaviour of spray coating solutions was studied using nozzles that are 1.2 mm in diameter, to improve the uniform film of single wall carbon nanotubes (SWCNTs) and silver nanowires (AgNWs) on plastic substrates.

The paper presents the uniformity of the distribution of nozzle flow rates in spraying machines depending on the working pressure, which will allow to estimate the quality of the phytosanitary treatments in the field crops. The experimental results obtained in the measurements were carried out with six types of nozzles (01, 02, 03, 04, 05, 06) used on machines for spraying in the field at five working pressures using water as spray solution.

MATERIAL AND METHOD

Experiments on the influence of working pressure on the distribution uniformity were made using the HERBST TEST 2000 stand for the determination of the uniformity of the cross-sectional distribution of the machines for spraying field crops (fig. 1). It consists of a scanner with 20 rines with a width of 100 mm and a depth of 100 mm. The scanner width is 2000 mm and the 20 cylinders are all of the same type and size. The scanner moves on the rails under the spray ramp collecting and weighing the liquid (water) from each nozzle, thus covering the entire width of the sprayer. Measurement values are sent wirelessly to the computer which processes and displays them in graphical form.



a

b c d

Fig.1 – HERBST TEST 2000 stand used for determining the uniformity of transversal distribution
a – overview of the stand; b – data transmission detail; c – collaction cylinder detail; d –rina detail

Experimental studies were conducted with 6 types of nozzles (type 01, 02, 03, 04, 05, 06) at 5 different working pressures (1-5 bar), and water was used as the test solution. Also, the working height was 500 mm.

Experiments on the process of testing the distribution uniformity were conducted by moving the scanner from a reference point. The scanner moved on the track on the test surface. For a measurement, the scanner has been waiting at a point and the collected solution has reached the collection cylinders. Each cylinder is equipped with an ultrasonic sensor to determine the level of liquid collected, and with the help of the software, this height was converted into a volume of solution.

After measuring one point and sending the data, the cylinders were automatically emptied using electromagnetic faucets placed at the inferior part of the cylinders.

The data obtained for each cylinder were transmitted to the computer by the wireless system and were stored in a database. After finishing the complete measurement on the working width, the scanned moved back to the reference point.

The same procedure was repeated for each type of nozzle (type 01, 02, 03, 04, 05, 06 nozzle) for the five working pressures.

From the database obtained, the data was processed in the form of absolute values and processed using Microsoft Excel.

A very important characteristic of a spray nozzle is the parameter called distribution uniformity, which provides accurate information about the uniform distribution of spray droplets on the solution coated surface. Normally, it is preferable to obtain the most uniform distribution possible, this being done in the past by visual inspection of a diagram, by reporting the amount of water contained, for example, in glass pipes aligned on the spray coating area.

Figure 2 presents the spraying geometry of a nozzle.

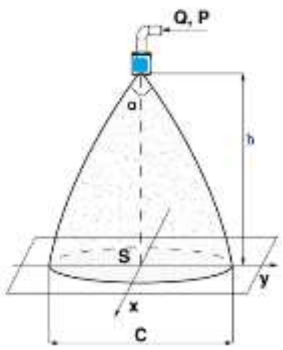


Fig.2 – Pulverization geometry for nozzle with the capacity *Q* and pressure *P* [12]

where, Q = flow rate

P = pressure

h = spraying height

α = spraying angle

C = actual spraying coverage

S = surface covered by spraying

Liquid flow through a nozzle represents the volume of substance that passes during the unit of time through its section (*Carafoli E. et al., 1983*).

The area covered by spraying (surface *S*) depends on the type, angle, and spray height. In this sense, the value of the specific flow q of a nozzle is given by the relation [12]:

$$q = \lim_{\Delta S \to 0} \frac{\Delta Q}{\Delta S} \tag{1}$$

where ΔQ = quantity of liquid that flows through the surface S

ΔS = fraction from the surface S

The determination of the q function is, however, very expensive, therefore, in practice, linear distribution is used, which in most cases provides sufficient information. Linear distribution is of the form [12]:

$$q_\alpha = \frac{\partial Q}{\partial \alpha} \tag{2}$$

where ∂Q = flow rate variation

$\partial \alpha$ = variation of a generic angular coordinate

The curves obtained depending on the level of the fluid in the stand cylinders are, however, not precise, as they depend on the test time, the more so as the amount of liquid to be sprayed is higher. To eliminate the influence of test time, curves obtained with gross values were converted into normalized curves that do not depend on time.

Normalized linear distribution represents the ratio between the linear distribution of a cylinder (q_x) and the maximum measured distribution (q_{xM}) [12]:

$$q_x = \frac{q_x}{q_{xM}} \tag{3}$$

RESULTS

The results of experimental researches on the distribution uniformity for the six types of nozzles tested, at the five working pressures are presented in fig. 3.

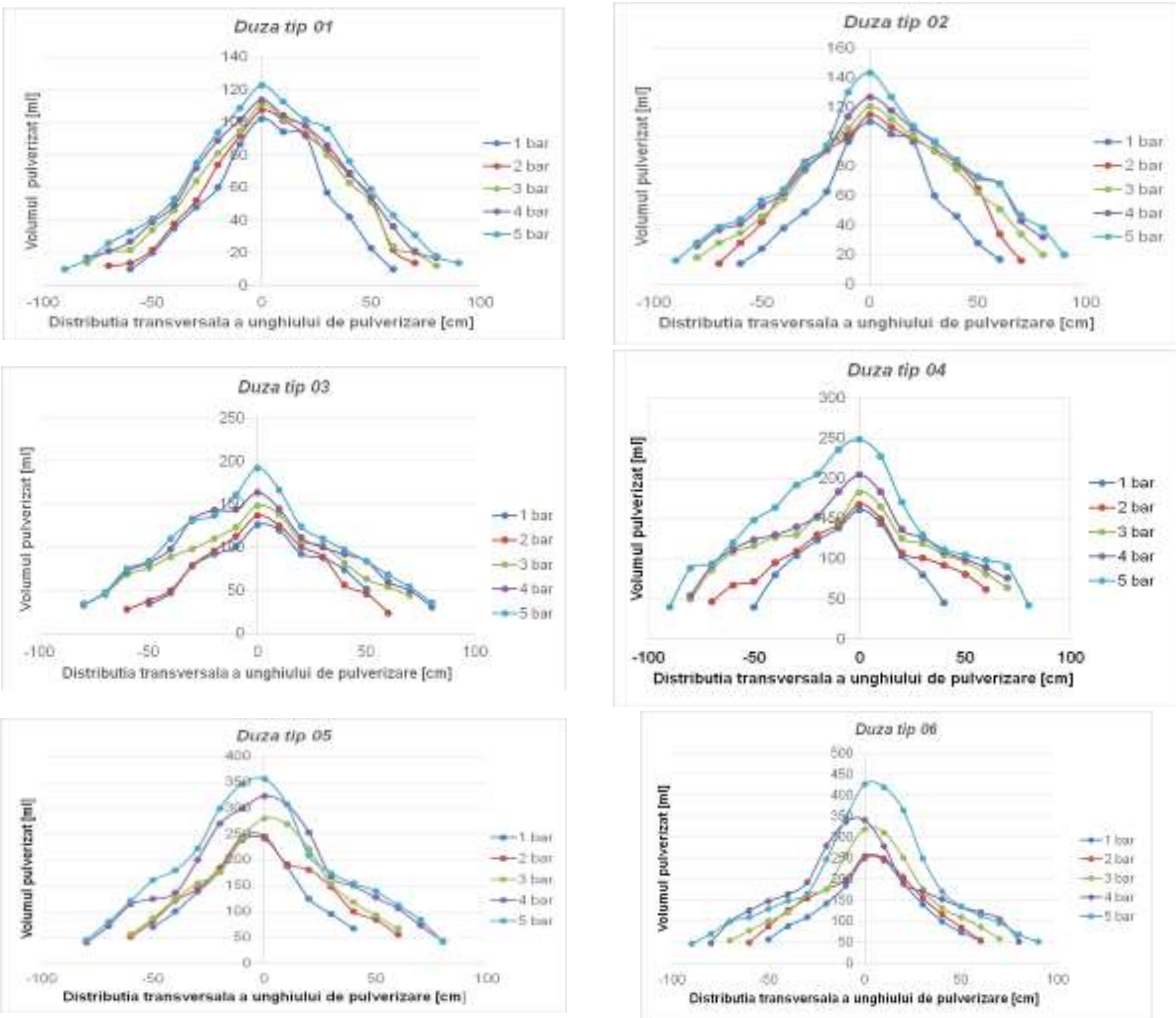


Fig.3 – Uniformity of linear distribution for the raw experimental data, dependent by time

Analysing the graphs of fig. 3 it can be seen that the volume of the pulverized material increases as the working pressure as well as the size of the nozzles increases. For the selected maximum pressure (5 bar), the spray volume increases from 120 ml for type 01 nozzle, 140 ml for type 02 nozzle, 200 ml for type 03 nozzle, 250 ml for type 04 nozzle, 350 ml for type 05 nozzle and 430 ml for type 06 nozzle.

Also, as the working pressure increases, the transversal distribution of the spraying angle also increases.

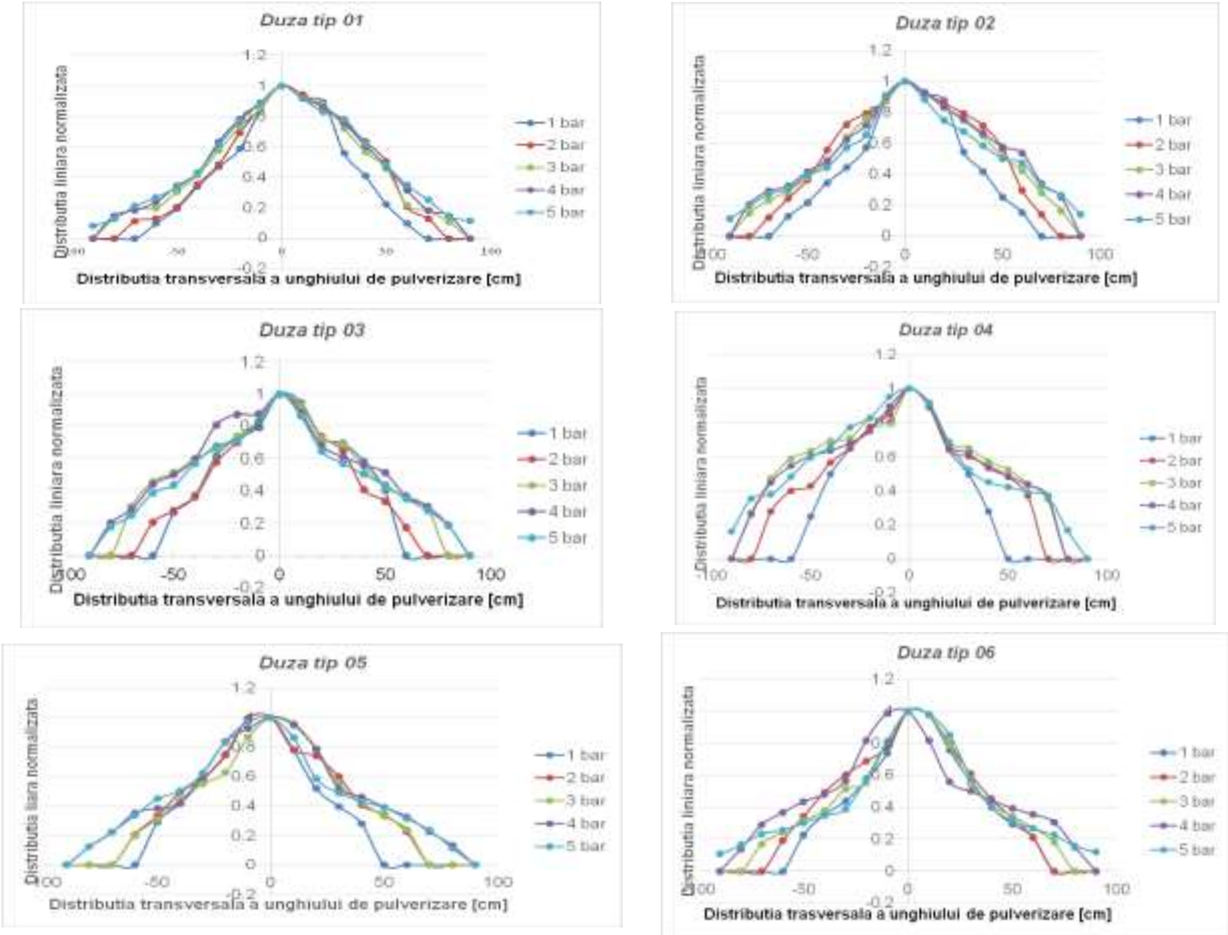


Fig.4 – Normalized distribution uniformity

From fig. 4 it is observed that by normalizing the results obtained in the experiments, the normalized linear distribution for all six types of nozzles, at the five working pressures, tends towards value 1.

It is also noted that even after normalization, the transversal distribution of the spraying angle increases with the increase of working pressure.

Uniformity of distribution differs depending on the nozzle type and on working pressure, for pressures of 3-5 bar and nozzle type 04, 05 and 06 ensuring a surface that is optimally treated by increasing the transversal distribution of the spraying angle.

CONCLUSIONS

Based on the results obtained in the present paper, the uniformity of the spraying distribution for a treated surface can be evaluated.

Compliance with distribution uniformity provided in agrotechnical requirements reduces environmental (water, air, soil) and agricultural products pollution due to soil retention in phytosanitary substances, protecting plants by optimally applying the quantities of phytosanitary substances.

The data presented is important for all agricultural specialists, especially for phytosanitary treatments applied to field crops.

ACKNOWLEDGEMENT

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Fig.1 – Test stand

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ACKNOWLEDGMENTS (***Arial 10 pt.***) of people. grants. funds etc should be brief (*if necessarily*).

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[1] Vlădut V.. (2009). *Study of threshing process in axial flow apparatus (Studiul procesului de treier la aparatele cu flux axial).* vol.1. ISSN/ISBN ………….. "Terra Nostra" Publishing House. Iaşi/Romania;

Journal Article: Names and initials of authors. year (between brackets). full title of the paper. full name of the journal (Italic). volume number. publisher. place. ISSN. page numbers:

[1] Lizhi Wu. Yan Di.. (2005). Demonstrational study on the land consolidation and rehabilitation (LCR) project of saline-alkali soil in arid areas: a case study of Lubotan LCR project in Pucheng County. Shaanxi Province (干旱区盐碱化土地整理工程实证研究-以陕西蒲城县卤泊滩土地整理项目为例). *Transactions of the Chinese Society of Agricultural Engineering*. vol.21. no.1. ISSN ………. pp.179-182. Madison/Wisconsin;

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Patents: Names and initials of authors. year (between brackets). patent title (Italic). patent number. country:

[1] Grant P.. (1989). *Device for Elementary Analyses*. Patent. No.123456. USA.

Legal regulations and laws. organizations: Abbreviated name. year (between brackets). full name of the referred text. document title/type (Italic). author. place:

[1] *** EC Directive. (2000). Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000. on the incineration of waste. Annex V. *Official Journal of the European Communities*. L332/91. 28.12.2000. Brussels.

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