Topic 10

"Open Topics"

Poster Presentation

The physics in the service of medicine. the healing of multiple chemical sensitivity with the use of bio-resonance

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Keywords: multiple chemical sensitivity (MCS), bio-resonance, quantum medicine, herbal medicine, homeopathy

Objectives
Given that this syndrome is very prevalent and difficult to treat and cases have all become increasingly prevalent, with the story of my experience is to demonstrate that you can heal from this terrible syndrome.

Methods
From my personal testimony I can prove that the optimal treatments for MCS are: homeopathic remedies, natural medicines and bio-resonance equipment made especially biolettronica and Quantum Physics, but the chemical medicines and traditional cures and accepted by the medical however, aggravate the symptoms of discomfort, so it's fair to use integrative and alternative medicine such as homeopathy, naturopathy and bioresonance and the choice of a healthy diet and also a genuine and sustainable lifestyle.
Getting sick, feel sick or have a need for intervention in the hospital for a company becomes sick due to MCS, disinfectants, insecticides, plastics, toxic emissions of machinery, perfume, but especially in the use of any anesthetic.
Many workers who work in petrochemical plants, industries, factories in contact with synthetic chemicals, they are sick, many of them are sensitive and may not know that it has acquired MCS, are being treated for depression for other things to exhaustion, from overwork.

Results
Multiple chemical sensitivity, can not be cured by traditional medicine, that is with chemically synthesized drugs, but can be treated with homeopathic medicines and natural medicines, all associated equipment usage biolettroniche bioresonance, I have reported to lead a normal life, because I weighed 89 kg of weight corpeo, after some of bioresonance therapy weighed 76-78 kg and are in constant from 2006 to 2010 today, I no longer have the emotional eating, I had before, I drink in moderation and I deleted all those sophisticated foods that contain additives, sweeteners, diet consisting of foods so I make little handled, processed, and simple, without frutture is also my diet.

The physics department of agriculture. the wheat first quantum biological product in a company in Sicily

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Abstract

Given that a company representative durum wheat conducted according to the specifications of organic agriculture in the year 2010-2011 there was an attack of Fusarium, planting corn, which being in a strong loamy soil, making the wheat attacked yellowish and making suffer, since the company was in organic farming, it was not possible to treat fusariosis prepared with chemical synthesis offered by the corporate market, for which the tests were carried out using natural products and diluted according to the principles of Hahnemann, with a system of dynamics and succussion with excellent results for the cultivation of wheat, safeguarding one's health that has perfused preparations and protecting the environment.

In June 2011, we created the first quantum product in an organic wheat in Sicily. The experiment was conducted in the territory of Piazza Armerina (EN) in Sicily and precisely in the district at the foot of Monte Navone Cucchiara about 560 msl. The varieties of durum wheat grown were two: the variety Simeto Rusticano certified organic, second generation with a red card.

The soil preparation was done with three processes, two of which in October 2010, and a third in the first week of November 2010, and finally at the end of November 2010 was carried out to sow.

Frequency meter with the sex were also tested the varieties of wheat grown, before sowing between cultivars Simeto and cultivars Rusticano, it is seen that the cultivar was Simeto in frequency by 55%, instead of the variety Rusticano was in frequency for 100 %, because at the end of harvest, as can be seen from Table 4, the yield was 9 Simeto q.li the yield per hectare instead of Rusticano varieties, sown in only two acres of the 10 acres, gave a yield of 25 q . them per hectare, so the variety was grown in Simeto that this company did not give productive results worthy of note, as in the past two decades (Benintende, 1998), when the business was conducted in the conventional, so for the year the 2010-2011 agricultural varieties to choose from was the Rusticano everything is double confirmation is made with a frequency counter that with the direct production.

Keyword: homeopathy, agro quantum, organic farming, frequentmeter, frequential analisys

Introduction

As you know, we know various types of agriculture: The conventional agriculture, organic farming, biodynamic farming, homeopathy in agriculture.

Conventional agriculture uses pesticides, herbicides, chemical fertilizers (pesticides), going to pollute the environment, groundwater, and so the residues of pesticides in the food chain we find them, use it more and more pesticide residues are in our agricultural products, they distribute less, certainly less pesticides even if we find these, the last generation, have higher dissipation but their residues remain.

Organic farming is sustainable agriculture, it is not used pesticides, fertilizers and herbicides are used for chemical synthesis and the precautions required by the regulations of organic agriculture for agronomic measures which are used to prevent weeds. Organic farming is environmentally safeguarding for example bees, in fact the subject of this experimental farm located in the territory of Piazza Armerina (EN) located in contr. Casale and Cucchiara, are holding fewer than 6 hives of bees in the wild trunks of 6 old olive trees on a total of 200 plants, the environment is healthier, in fact there are butterflies, pollinators, spiders, ladybugs, bees, wild etc.., and farms, where pesticides and herbicides are used, the first to disappear is the bee that is a very important environmental indicator.

Biodynamic farming is in the wake of organic farming but has superior characteristics, uses and cosmic forces that Schumann waves are captured and stored by the horn manure and horn silica, which are prepared in business, starting from composting and humification of manure produced generally in the same company. Indeed biodynamic farm we have the presence of DUAL, which is obtained from the manure produced by the cattle and is prepared by adding the appropriate biodynamic preparations, clearly the biodynamic farm is a closed loop in the sense that manure fertilizer comes manure their farms, so a company has its biodynamic 8-10 heads, not purchasing outside of the manure of the farm of dubious origin and biodynamic farming to follow the specifications are more stringent than the biological. The treatment of humans and plants follow the principle of homeopathy, in fact, the farm is biodynamic practice the process of dynamics of biodynamic preparations before deploying to shoulder with a pump specifically copper since the plastic is banned in frequency and interferes altering the quality of biodynamic products.

Homeopathy applied to agriculture, where some researchers (Betti et al., 1997; Betti et al., 2006, Speciani, 1985) have made some experiments using homeopathic products for human use according to the dilution of Hahnemann were applied at different dilutions with excellent results for plants, not only for their health but also increase their yield per hectare.

Instead, the new technique, at the level experimental, has been used with great success Quantum Agriculture that will be described below.

Purpose Of The Research

Given that a company representative durum wheat conducted according to the specifications of organic agriculture in the year 2010-2011 there was an attack of Fusarium, planting corn, which being in a strong loamy soil, making the wheat attacked yellowish and making suffer, since the company was in organic farming, it was not possible to treat fusariosis prepared with chemical synthesis offered by the corporate market, for which the tests were carried out using natural products and diluted according to the principles of Hahnemann, with a system of dynamics and succussion with excellent results for the cultivation of wheat, safeguarding one's health that has perfused preparations and protecting the environment.

Materials And Methods

In June 2011, we created the first quantum product in an organic wheat in Sicily. The experiment was conducted in the territory of Piazza Armerina (EN) in Sicily and precisely in the district at the foot of Monte Navone Cucchiara about 560 msl. The varieties of durum wheat grown were two: the variety Simeto Rusticano certified organic, second generation with a red card.

The soil preparation was done with three processes, two of which in October 2010, and a third in the first week of November 2010, and finally at the end of November 2010 was carried out to sow.

Then he waited for the germination and growth of seedlings. As farming operations were carried out in February two products with an organic fertilizer suitable for organic farming, a base of alginates and the other based on amino acids.

Towards the end of March 2011 there was an attack of Fusarium for the persistent rains that inhibited the growth of seedlings, the crop was in a state of almost complete yellowing and production was being compromised.

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Fig.1 - Wheatfield yellowed (Fusarium) in Contrada Cucchiara 2011 – 2012

Then in March we used a frequency that is the result of new technology called "QUANTUM PHYSICS COMPUTER" and is used to treat plants, animals and humans.

We know that the principle of quantum physics that every man and his body vibrates at a certain frequency when in good health, if it is in disease vibrates at a different frequency, so this frequency was used to check for nutritional deficiencies, see Table 1.

Table 1 – Chemical soil elements of green site	
2011 - 2012 in Cucchiara Country	
elements	**Value**
Calcium	115
Potassium	126
Sodium	55
Chlore	98
Magnesium	149
Iron	121
Solfite	69
manganesium	52
Chrome	54
Zinc	123
Selenium	121
Jodium	82
Fosfore	79
Borum	24
Molibdene	86
Silicium	66
Cobalt	51
Litium	72
Germanite	76
Arsenicum	99
Antimonium	82
Carbonium	77
Vanadimo	46
Aluminium	51
Rama	30
Nickel	83
Gold	65
Silver	107

value to 85 - 100 are optimal, on up 100 are over,
down to 60 carents.

Table-1 insert from which it was found that the soil was deficient in boron, copper and manganese, for which they were chosen as preparations were diluted in accordance with the principle of Hahnemann, dynamized and treated with succussion, two procedures for removing the water memory, then preparations were chosen frequency with soil and seedlings of durum wheat.

The preparations used for a distance of four treatments a week for 4 weeks in April 2011 were: BACH FLOWER: Wild Chest Bud-chet - Centoney - Holly, then Homeos 4 microgranules, Alpha Omega Dre 16 Labcatal for micro deficiencies of copper and manganese, Boric Acid for the deficiencies of boron, the dilutions are shown in table n.). Instead, the preparations used for the final one to two treatments per week for the first half of May 2011, were: The Bach Flowers - Elen - Gorse - Red Chestnut - Horene Here, Homes 29 and Fisioton, their dilutions and treatments are given reported in Table 2.

Homeopathic Products and Bach flower remedies used in the confield a.a. 2011 - 2012 in Cucchiara Coutry

Bach flowers	Chestnut Bud - Wild Chet - Centony - Holly Elen - Gorse - Red Chestnut - Horene Here	diluited 2 bottles	in 100 ml
HOMEOS 4 microgranules	5 scoops of the packs in 5 liters of water		
ALPHA OMEGA Dre 16	75 drops in 5 Liters of water		
		all in 5 liters in 6 times = 30 liters at the time	
LABCATAL (manganese-copper)	due tubes in 5 liters of water		
BORIC ACID	5 parts in 5 liters of water		

Omeopatyc products

HOMEOS 29	25 drops in 5 liters	
		All 2 in 5 liters for 6 were = 30 liters every were
FISIOTON	1/2 vial in 5 liters	

Fig. 2 - Grain site after the homeopathic treatment

Then it was used a small pump to the shoulder of copper to spray preparations. Treatment was carried out six times over an area of 10 hectares of arable land, was used each time a time of six hours to treat 10 acres. Clearly you could not do the treatment total for all 10 acres, but only in part of dealing with a row distance of 8-10 meters each, since the Law of Fractals in the micro is the macro, it just treating some strips, always for the Law of Fractals, once the strip is treated automatically improve the rows not treated with these treatments, the grain is improved and has reached the production and harvesting.

The wheat field was yellow like picture 1 was attacked by a fungus of the genus Fusarium due to strong clayey soil and frequent rains. Then I made a discovery of electromagnetic waves in my business, always with the frequency counter, and I reported the data in Table 3,

Tab. 3 - Electromagnetic waves observed in the field wheat 2011 - 2012 in Cucchiara Country	
Electromagnetic Waves	**Values**
Cosmo ELF below 1 Hz	100
Neutrin	126
EELF	140
ELF	178
50 Hz	123
60 Hz	116
70 – 500 Hz	94
501 - 1000 Hz	125
1001 - 1500 Hz	120
1501 - 2500 Hz	88
2501 - 3500 Hz	108
3501 - 4500 Hz	90
4501 - 5555 Hz	124
5556 - 7500 Hz	99
7501 – 10000 Hz	120
10 K - 100 K	129
101 K - 1 MegHz	126
1 Meghz - 100 Meghz	139
101 MegHz - 500 MegHz	126
500 MegHz - 1 Giga Hz	101
Giga Hz Range	147
XRAY	164
Gamma RAY	166
ALPHA - BETA	167
Mobile Phone Radiation	166
TV color	78
Computer	83
Geopatryc Stress	69

Values between 85-100 are excellent, above 100 is high, less than 60 are low

Results And Discussion

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Tab. 4 - Hard wheat varieties, frequencies and production 2011 - 2012 in Cucchiara Country

Cultivar	In Frequency	Production	ectare production
Rusticano	100%	50 q x 2 ectars	25 q ad ectar
Simeto	55%	80 q x 9 ectars	9 q ad ectar
Media		13 q ad ettaro	

The microelements, as reported in materials and methods, have been administered via the frequency homeopathic and not a quantitative level of weight and also the other preparations.

The liquid fertilizer with organic products allowed by the specification were instead given with a sprayer and tractor loader at a quantitative weight. If these treatments were not performed, the production would be compromised, but it was made threshing with an average yield per hectare of 13 quintals / Ha.

As is apparent from the attached photos from a visual inspection in the 10 acres we note the presence of bees, bumble bees, spiders and beetles, in the month of April-May, that if they used the synthetic chemicals they would be made to disappear.

This new agricultural technology is called Quantum Agriculture and is higher than Conventional Agriculture, Agriculture Biological; instead is closer Biodynamic Agriculture and higher, in fact, the quality of the grain understood as organoleptic characteristics was superior to other types of agriculture, In fact the tests were made, bringing a bit 'hard wheat to the mill, obtaining flour and no, it was found that the organoleptic characteristics of pizzas, breads and desserts made with flour from the varieties of Agriculture Quantum Rusticano are higher quality, since they have been naturally energized by connecting the cosmic waves and waves Schumann, which are so beneficial that are good for humans, animals and plants and in this case have been useful to the final quality of durum wheat.

Conclusions

And 'right to practice this type of Quantum Agriculture., As it allows you to choose the optimal frequency range with the company, choose homeopathic remedies suited to the crop, check for any nutritional deficiencies, all in support of the environment thus creating a' sustainable agriculture very low environmental impact with good yields, even if low, considering that have not been used diammonium phosphate equivalent to about 2 q.li per hectare, also 2 q.li per hectare of urea and were not used herbicides for weed , then the yield per hectare which is obtained is good, because they are spared the cost of fertilizer at sowing, weeding, and the roof. Surely if we were in conventional farming yields would have amounted to 25-30 q.li per hectare, as shown by the average yields of the two previous decades when the business was conducted in the conventional 1978-1998 (Benintende, 1998), but they must support more economic costs and environmental pollution. It 'was another consideration is the malaise of the grain with the attack of furious was due both to strong clayey soil saturated with water due to frequent rains and also the anger of the owner, who has transferred to the company by lowering the anger immunity.

With the use Quantum of Agriculture has protected the environment and has spared no expense eliminating economically indifferent fertilization and weed control. Finally, all those who are interested in plants and treat their illnesses may contact Dr. Pio Benintende

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Evaluation of the volcanic soils pedogenetica some of mount etna with chemical analysis of soil; sat and frequential measurements and multispectral sat analysis

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Obiectives

It was considered appropriate to conduct this research on the volcanic soils of Mount Etna to determine the chemical analysis of soils to describe and classify soils, soil frequential analysis comparing the chemical analysis of soils and detection with frequential analysis to detect pollution by electromagnetic waves, and finally were carried out detections multispectral

Methods

10 sites were chosen and surveyed their profiles and horizons with a total of 40 samples (the samples exact count) in soils of Mount Etna, some of which are forest species, to evaluate their characteristics pedogenetiche with the chemical analysis of soils, frequential analysis and multi-spectral detection.

For chemical analysis of soils were used ansalisi Official Methods Of Soil (Various Authors, 1976, Various Authors, 1984). For the analysis of the soil that is frequencial pollution by electromagnetic waves of the environment has been used a frequency meter and for measurements multi spectral with TV-Vector, Oscilloschope with Sensitive sonde.

In the fields of soil from all 10 sites evaluating profiles and horizons have been determined the particle size analysis, which was equal to 90% of sand, a 5% silt and 5% of clay, have not been reported for each horizon because there is high homogeneity., the low proportion in% of clay and silt that we witness in the presence of young soils, since the processes of pedogenesis are recent.

Results

A satellite image is the result of a complex analytical task that summarizes the information given by a set of images collected on different radiometric channels, or on different dates, or other constituents *descriptions* of the area. It can import and use, together which chemical and analytical values of the soil obtained after analysis of soil sampling interest in order to be able to obtain reliable maps of soil, given the loyalty of multispectral images.

Study of the exploitable potential of Algerian Albian drillings

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Keywords: continental midsole, drilling, turbine generator

Objectives

The groundwater of Continental Midsole (CI) is coveted for its water as resources are widely exploited in the Algerian Northern Sahara.

We have noticed the immensity of this energy, the expanded volume of the aquifer and the importance of its use in agriculture. Unfortunately, this potential remains untapped to date. Fortunately, our research team was interested in familiarising the use of this energy.

Methods

This groundwater is characterized by a high flow and pressure at output. It goes from 0.05 to 0.4 cubic meter per second for flow, and 5 to 40 bars for pressure.

Our working method is to make an experience by installing a Pelton turbine on a drilling Albian to determine the electrical power resulting from the conversion of hydraulic power. The next step is to use this energy for agriculture (decrease water temperature from 70°C to 30°C before being used in irrigation).

Expected Results

The hydraulic energy is completely neglected. An investigation on the Northern Sahara Aquifer System (SASS) was essential to prove the existence of this potential. This energy is reflected by an artesianism which is very convincing in most drillings for a lasting time.

The expected results are directly related to the processing capacity of the turbine energy. We can provide up to 7 kilowatts at a rate of 12 liters per second, which corresponds to the energy sufficient to initiate irrigation of the farm nearby drilling.

A Long-Term Application of Conventional and Conservation Practices for Durum Wheat Cultivation

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Keywords: sustainable agriculture, management, cereals cultivation

Abstract

Conservation practices represent a solution able to cut down production costs of durum wheat cultivation and at the same time guarantee satisfactory yields while reducing CO_2 environmental impact in accordance with the directions of Community policy.

The long-term experimentation (2005-2010) aimed at evaluating mechanization and energy consumption aspects for the different combinations of machines and techniques distinguishing the experimental years, as well as soil moisture content and crop yield aspects for the cultivation of durum wheat.

Three theses were compared: "tillage" "minimum tillage" and "no-tillage" in a representative flat land area, which is mainly used for extensive cereal farming (Mineo - CT - Sicily). Two plot-scale repetitions were carried out for each thesis in plot of about 1800 m^2. The machines and techniques used over the five consecutive years of tests were alternated in accordance with those commonly adopted for the cultivation of durum wheat in the territory where the tests were carried out, excluding the sod-seeding machine.

In general, "no-tillage" thesis showed a better efficiency and timeliness because mean work capacities were always higher than other theses, as well as unit work time of this thesis. In all years, there were a remarkable increase in the yields of the "tillage" and "minimum tillage" thesis and particularly the differences were not significant statistically.

In the specific context the results show even if the average yield are lower in "no-tillage" than in "tillage" thesis, the variable costs are also lower. This is due to the greater work capacity in "no-tillage" thesis than in "tillage" thesis as well as the lower energy consumptions.

Aim

According to an estimate of the International Grain Council (IGC), Italy represents the second producer in the world after Canada and the first in Europe. At a national level, more than 20% of the surface used for durum wheat is in Sicily, the second producer after Puglia. The meagre profitableness of the crop, however, means that the cereal cultivators have to adopt cultivation and agronomic strategies suitably designed to reduce production costs, safeguard the environment, increase the yield and improve the quality of the product.

Conservation practices (minimum and no tillage) could represent a solution able to cut down production costs of durum wheat cultivation and also guarantee satisfactory yields while reducing CO_2 environmental impact in accordance with the directions of Community Policy.

The long-term experimentation (2005-2010) aimed at evaluating mechanization and energy consumption aspects for the different combinations of machines and techniques distinguishing the experimental years, as well as soil moisture content and crop yield aspects for the cultivation of durum wheat.

Methodology

Three theses were compared: "tillage" "minimum tillage" and "no-tillage" in a representative flat land area, which is mainly used for extensive cereal farming (Mineo - CT - Sicily). Two plot-scale repetitions were carried out for each thesis in plot of about 1800 m^2 each. The machines and techniques used over the five consecutive years of tests were alternated in accordance with those commonly adopted for the cultivation of durum wheat in the territory where the tests were carried out, excluding the sod-seeding machine. Sowing in the tilled lots was carried out with a 3 m wide seed drill with 16 tines, while the sowing in the untilled lots was carried out with a 2.5 wide sod seeding machine with 13 tines.

In order to assess the performance of the machines used for the various trials, standardized methods [1] were adopted. The work times for the cultivation operations (weeding, fertilising, tilling and sowing) were found and the work capacity (ha/h) and work unit times (h/ha) calculated. The energy consumption (kg/ha) of the tractors used was quantified by means of the "refilling in the field" method. The costs (€/ha and €/kg)) were calculated on the basis of current prices charged by third parties in the area under consideration.

At harvest time the productive yield was determined (kg/ha).

From the second trial year, after sowing, periodically samples of soil were taken for each hypothesis at a depth of 20 cm in order to determine the water content.

The energy return on investment (EROI) were calculated for each hypothesis and data were statistically processed.

Figure 1. Mechanical seeder

Figure 2. Sod-seeding seeder

Results

In general, "no-tillage" thesis showed a better efficiency and timeliness because mean work capacities were always higher than other theses, as well as unit work time of this thesis. With "minimum tillage", on the other hand, it is possible to obtain higher work capacities and equal or even lower unit times than those obtained with "tillage", given that fewer runs are carried out and an inferior depth required.

These results would imply that over a long period in the "tillage" cultivation of durum wheat there is a greater consumption of energy and work. On the other hand, these results show that the "no-tillage" hypotheses allow considerable savings of diesel consumptions, but it is right to consider the costs of the herbicide used in pre-sowing weeding.

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[1] See CIOSTA (Commission Internationale de l'Organisation Scientifique du Travail en Agriculture).

From the data collected, it would seem that ploughing and deep harrowing with a cultivator for the first tillage use the most fuel. The other cultivation processes do not seem to greatly affect consumption, but it is very important to highlight the importance of selecting a suitable tractor to trail the machines in order to reduce energy consumption.

In all years, there were a remarkable increase in the yields of the "tillage" and "minimum tillage" thesis and particularly the differences were not significant statistically. The earlier sowing permitted the no-tillage hypothesis to show its production potential.

Conclusions and perspectives

The results obtained demonstrate the adaptability of the conservation techniques because a significant reduction in energy consumption and in CO_2 was also obtained. The differences in cost per surface unit between the hypotheses appear to be irrelevant, especially for the years in which ploughing was not carried out.

In the specific context the results show even if the average yield are lower in "no-tillage" than in "tillage" thesis, the variable costs are also lower. This is due to the greater work capacity in "no-tillage" thesis than in "tillage" thesis as well as the lower energy input consumptions and best EROI.

Effect of spraying nutritional solution "PRO.SOL" and chelated Iron on growth and flowering of Gazania plant *Gazania splenden* L.

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Abstract

The experiment was premeditated to investigate the effect of supplying nutrients into plants vegetative system and study the improving response on plant growth and flowering. Gazania was selected as locally important ornamental plant.

The research was conducted at the Faculty of Agriculture Nursery, University of Kufa, Najaf Governorate, during the growing season 2010-2011 to study the effect of spraying nutritional solution "PRO.SOL" and chelated Iron on vegetative and floral growth parameters in Gazania plant. The experiment was designed utilizing Randomized Complete Block Design (R.C.B.D) in three replicates with two factors; the first was using three concentration levels of nutritional solution PRO.SOL (0.00, 5.00 and 10.00 mg. Liter $^{-1}$). The second factor was four concentration levels of chelated Iron (0.00, 30.00, 60.00 and 90.00 Mg. Liter $^{-1}$). The interaction between the two factors was also analyzed. The means were compared using L.S.D test at probability level 0.05.

The results showed that spraying PRO.SOL at concentration 10.00 mg. Liter^{-1} or chelated Iron concentration level 90.00 mg.Liter^{-1} improved growth parameters. There was significant increase in; number of total leaves per plant, shoot dry weight, leaves total chlorophyll content, number of offshoots, number and length of primary roots, length of the peduncle, number of flowers, petals and flower dry weight. Meanwhile leaf contents of carbohydrates and phosphorus percentage and Iron leaf content increased significantly in comparison with the control treatment (unsprayed plants) which gave the least values. The interaction results showed that spraying with nutritional solution PRO.SOL at concentration level 10.00 ml. L.$^{-1}$ with 90 mg. L. $^{-1}$ chelated Iron had a significant increase in all studied growth parameters; number of total leaves in plant, shoot dry weight, leaves total chlorophyll content, number of offshoots, number, length of primary roots, length of the peduncle and flower dry weight, i.e. the number of flowers and petals gave 8.33 flower and 18.67 petals compared with the control treatment (sprayed with distilled water) which gave 3.33 flower and 13.00 petals. Meanwhile leaf contents of carbohydrates, phosphorus percentage and Iron leaf content increased significantly in comparison with the unsprayed plants which gave the least values.

Results of the experiment may be concluded that spraying nutritional solution PRO.SPL with concentration level 10 ml.l^{-1} and chelated iron with concentration level 90 mg.l^{-1} improved significantly the growth and flowering characteristics of Gazania plant.

Prospects development of thermal power complex use renewable energy sources

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Abstract

The rise in price of energy resources has led to the need for the search alternative fuels. The purpose of the report is identifying innovative ways to develop thermal power complex.

Fuel briquettes every day gain increasing popularity in the world. The reasons for this – the growing expenditures for the traditional forms of fuel, comfortable maintenance and ecological advantages of boiler equipment for pellets, in connection with the signing of the Kyoto Protocol by the countries of Europe and the obligation to reduce the ejections of greenhouse gases. At present more than 15 million tons of wood pellets are produced in the world per year (excluding agro pellet). The utilized today amount of waste of wood processing and agro-raw material it is already insufficient. The competition of productions for the use of this raw material is strengthening. At the same time in Ukraine is produced over 2 million 3 per year of waste wood, about 1 million tons of the husk of sunflower and more than 10 million tons of straw of grains, the use of which is economically justified. In Ukraine, as of July 1, 2011 there are about 150 companies engaged in the production of briquettes and pellets. 640 tons of biofuel were produced in 2010. Exports of solid biofuel from Ukraine totaled 573.4 thousand tons, according to the consulting company Fuel Alternative. In 2010 export of wood pellets has increased   134.6% of wood pellets - by 76.2%, pellets made of sunflower to 133.4% of briquettes - by 23.8%. The main directions of export of Ukrainian biofuel are Poland, Germany, Denmark, Italy.

The analysis shows that there are considerable resources for reforming the sector by the global transition from old to modern, more efficient economically and environmentally, heat power equipment on biofuel.

Mathematical modeling of the functioning of the catalytic heater for heating a bioreactor of anaerobic digestion of organic waste

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Abstract
Design features optimization of technical and technological systems for anaerobic digestion of organic waste is a promising trend in development processes of energy efficiency and conservation of agricultural production and organic waste recycling sector. In order to increase biogas installations efficiency, it is more productive to use complex solution mainly concerning the tasks of mixing and heating with the use of catalytic heaters that allow to distribute heat evenly in bioreactor, also to abandon hot-water heating system and special heat exchangers or heating casings that enabled to decrease bioreactor steel intensity and to simplify its construction.
On the base of work physical principals, the authors elaborated mathematical model of catalytic heater functioning during heating of organic waste anaerobic digestion bioreactor. According to elaborated mathematical model the computing experiment was carried out. With the use of the equation computational modeling was carried out with Microsoft Excel and Visual Basic. Cycles of heater work during heating biogas reactor were modeled.
The modeling results are presented in the graphs and described in detail.
The first graph present the cycles of the object temperature changes in range from minimum to maximum in the modeling process. One cycle of heater work includes: object heating up to maximum temperature; turning off the heater; gradual object cooling up to minimum temperature; turning on the heater.
There are graphs of methane consumption changes by catalyst in the modeling process. The graphs for three values of circulating gas temperatures are similar. They illustrate the graph of fuel consumption needed for circulating gas heating. In the process of object heating equal quantity of methane is consumed that proves circulating gas heating up to needed temperature. During free cooling consumption of methane is 0.
Also there are graphs illustrated methane volume consumed by catalyst in the every moment of time. In the graphs the heating-cooling cycles are presented as segments of linearly increasing volume of consumed gas for the heating processes and segments of constant volume for the processes of free cooling.
The results received during the computing experiment of catalytic heater functioning process illustrate physical processes in the bioreactor and catalytic heater. Developed mathematical model allows to optimize suggested constructive solutions of mixing and heating with the use of catalytic heaters according to the criterion of energetic efficiency at maintaining necessary temperature in the bioreactor.

Introduction

Design features optimization of technical and technological systems for anaerobic digestion of organic waste is a promising trend in development processes of energy efficiency and conservation of agricultural production and organic waste recycling sector. In order to increase biogas installations efficiency, it is more productive to use complex solution mainly concerning the tasks of mixing and heating with the use of catalytic heaters that allow to distribute heat evenly in bioreactor, also to abandon hot-water heating system and special heat exchangers or heating casings that enabled to decrease bioreactor steel intensity and to simplify its construction [1, 2].

On the base of work physical principals, the authors elaborated mathematical model of catalytic heater functioning during heating of organic waste anaerobic digestion bioreactor. That model is presented in the following form:

$$V_T = \frac{M_{ц.г.} * Cp_{ц.г.} * \left(T_{o.o.} - \dfrac{M_{ц.г.} * Cp_{ц.г.} * T_{ц.г.}^0 + k_{кат-ос} * F_{кат-ос} * \Delta t * (T_{нар} - \frac{1}{2} * T_{ц.г.}^0)}{M_{ц.г.} * Cp_{ц.г.} + \frac{1}{2} * k_{кат-ос} * F_{кат-ос} * \Delta t} \right)}{(C_{co2} + 2 * C_{h2o}) * (T_{кат.} - T_{o.o.}) + \dfrac{M_{ц.г.} * Cp_{ц.г.}}{M_{ц.г.} * Cp_{ц.г.} + \frac{1}{2} * k_{кат-ос} * F_{кат-ос} * \Delta t} * (Q_B^P -}$$

$$\overline{- Cp_{Cн4} * (T_{горения} - T_{ная}^{топ}) - 2 * Cp_{o2} * (T_{горения} - T_{ная}^{o2})}.$$

(1)

V_T - mass of fuel consumed, $M_{ц.г.}$ - mass of circulating gas, $Cp_{ц.г.}$ - specific heat of the circulating gas at constant pressure, $k_{кат-ос}$ - heat transfer coefficient of the catalytic – the environment, $F_{кат-ос}$ - heat transfer area of the catalyst – the environment, Δt - temperature change in the range of modeling, $T_{нар}$ - environment temperature, $T_{ц.г.}^0$ - circulating gas temperature before entering the catalyst, $T_{кат}$ - catalyst temperature, $T_{o.o.}$ - gas temperature required for object heating, C_{co2} - specific heat capacity of carbonic acid after burning, C_{h2o} - water specific heat capacity, Q_B^P - high specific heat value of fuel, $Cp_{Cн4}$ - methane specific heat at constant pressure, $T_{горения}$ - catalytic combustion temperature, $T_{ная}^{топ}$ - fuel temperature, Cp_{o2} - oxygen specific heat at constant pressure, $T_{ная}^{o2}$ - oxygen temperature.

Plan and results of the computing experiment

According to elaborated mathematical model the computing experiment was carried out in the following order:
1) input data selection;
2) selection of an elementary time period and a number of simulation runs;
3) model process launching for selected number of runs;
4) data table formation and plotting.
Input data used in elaborated mathematical model are related to five parameter groups:
1) environment characteristics (environment temperature);
2) object characteristics (area of object heat transmission, mass of object components);

3) heating regime characteristics (object maximum and minimum temperature, circulate gas mass, circulate gas mass at the entrance to the object);

4) parameters characterizing catalytic heater work (heat transmission area – the environment, catalyst temperature, fuel temperature, oxidan initial temperature);

5) parameters characterizing heat and mass interaction in the frames of model (coefficient of heat transmission from the object to the environment, specific heat capacity of the object components, circulate gas heat capacity, heat transmission coefficient of the catalyst – the environment, specific heat capacity of CO_2, specific heat capacity of H_2O, high specific heat of fuel combustion, fuel specific heat capacity, oxidant specific heat capacity, catalytic combustion temperature).

The selected parameters should make it possible to compare the results of mathematical modeling and experimental data.

With the use of the equation computational modeling was carried out with Microsoft Excel and Visual Basic. Mathematical model realization is given in picture 1. Cycles of heater work during heating biogas reactor were modeled.

The environment temperature is 20 ^{0}C.

Object heat transmission area is determined by its geometrical dimensions and mass – by its volume, multiplied by the density of components. For modeling a barrel with diameter 0.5 m and length 1 m was chosen. As object components it was taken substrate for anaerobic digestion made of cattle manure with solids content 15%. Reference data on the substrate are in the works [3, 4, 5].
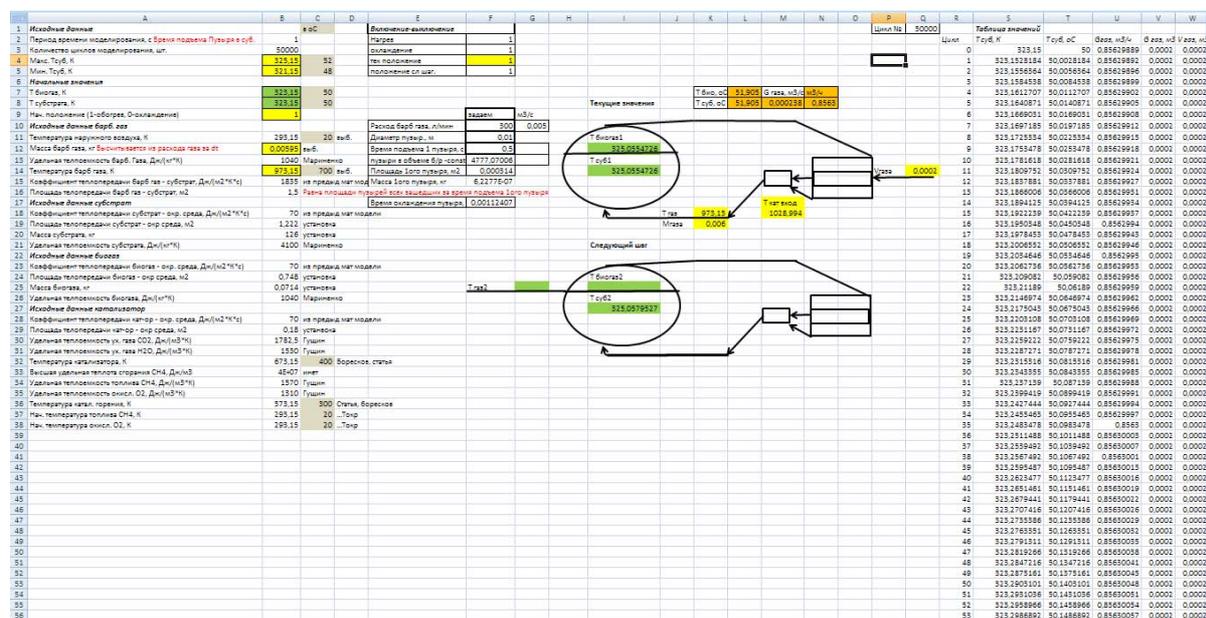
Figure 1 – Mathematical model realization in Microsoft Excel.
1 – input data, 2 – data received in the process of modeling, 3 – table of data received in the process of modeling.

The object maximum and minimum temperatures are selected in accordance with the optimum temperature for fermentation at the thermophile regime: the maximum temperature is 52 ^{o}C, minimum temperature is of 48 ^{o}C. The mass of the circulating gas is taken in accordance with estimated gas flow for bubble mixing of the average intensity [6, 7]. The circulating gas temperature at the inlet of an object is selected on the basis of a simplified heat

balance solutions for modeling object, the minimum required temperature of the circulating gas is determined to maintain constant temperature of the object. Modeling was carried out for three temperature values more than required minimum (461 ^{o}C): 500 ^{o}C, 600 ^{o}C, 700 ^{o}C.

The area of heat transmission between the catalyst and the environment is taken in accordance with the geometrical dimensions of the catalyst 0.18 m^2. The initial temperatures of fuel (CH_4) and oxidant (O_2) are taken as equal to the environment temperature 20°C.

The parameters characterizing heat and mass interaction in the frames of the model are calculated on the base of dependence [8- 10] in accordance with the literature for substrata [3-5], for combustion actions [11-13] and frame fillings [14].

Modeling interval for the three computing experiments at circulating gas temperatures 500 ^{o}C, 600 ^{o}C, 700 ^{o}C is equal to 1 second. The number of modeling cycles originally was 50000 repetitions but then it was reduced to 15000. For circulating gas temperature 700 ^{o}C two additional experiments were done with different intervals of modeling 0.5 seconds and 0.1 seconds.

The modeling results are presented in the graph (pictures 2-5).
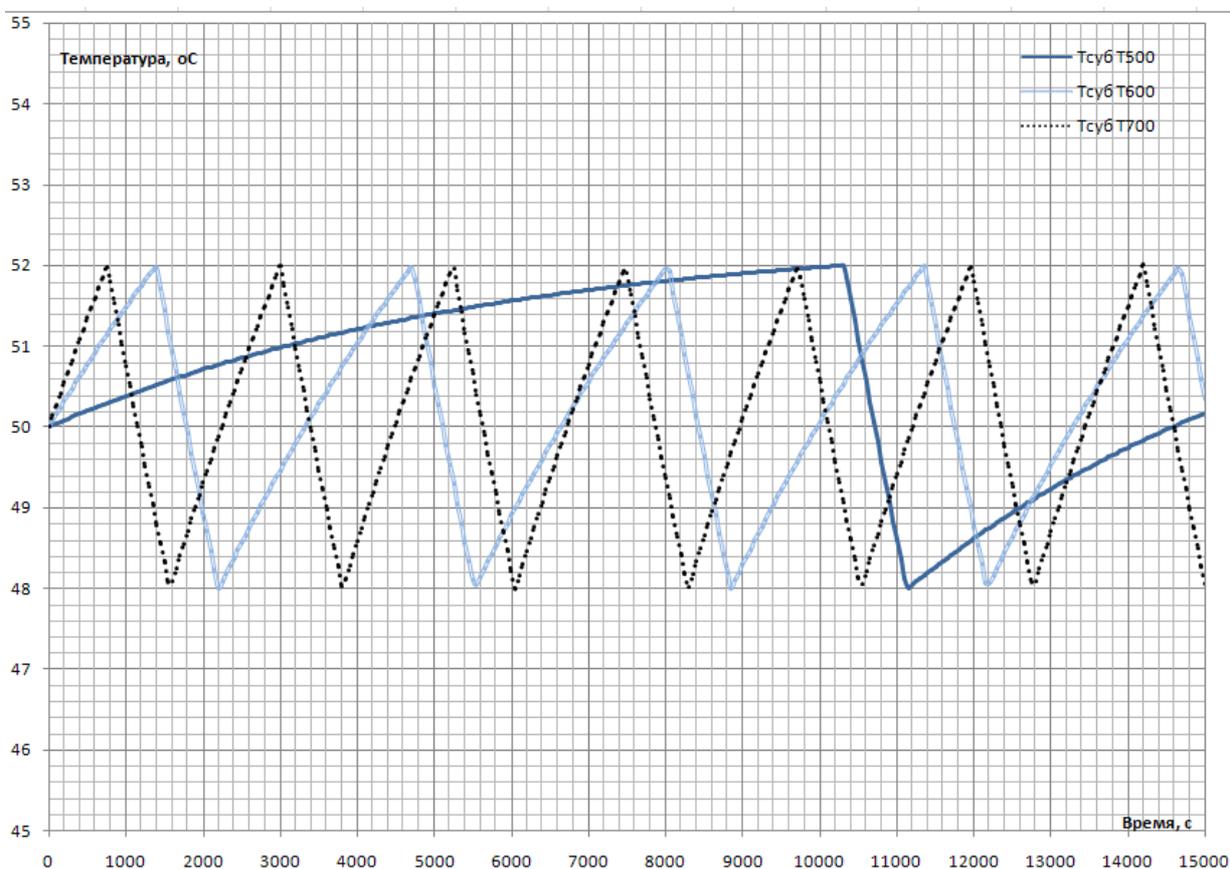
Figure 2. The graphs of the object temperature changes in the modeling process

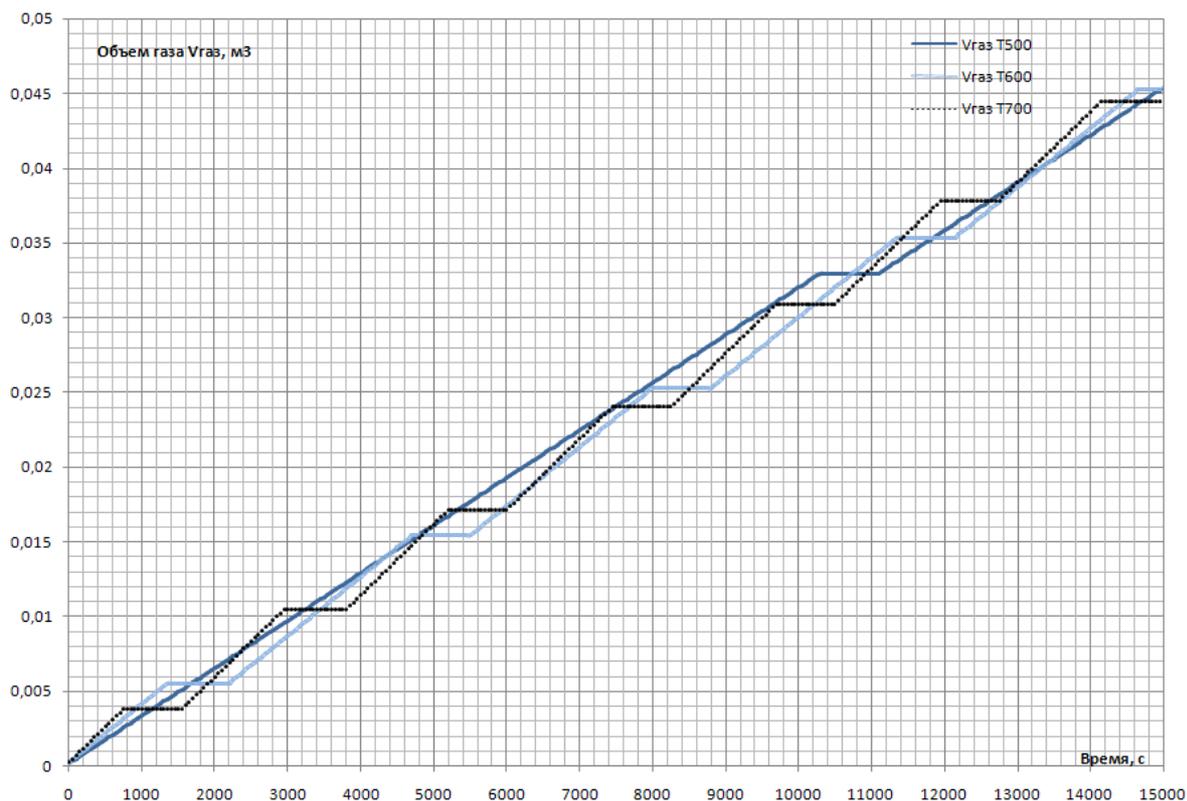**Figure 3. The graphs of the object temperature changes at different** Δt
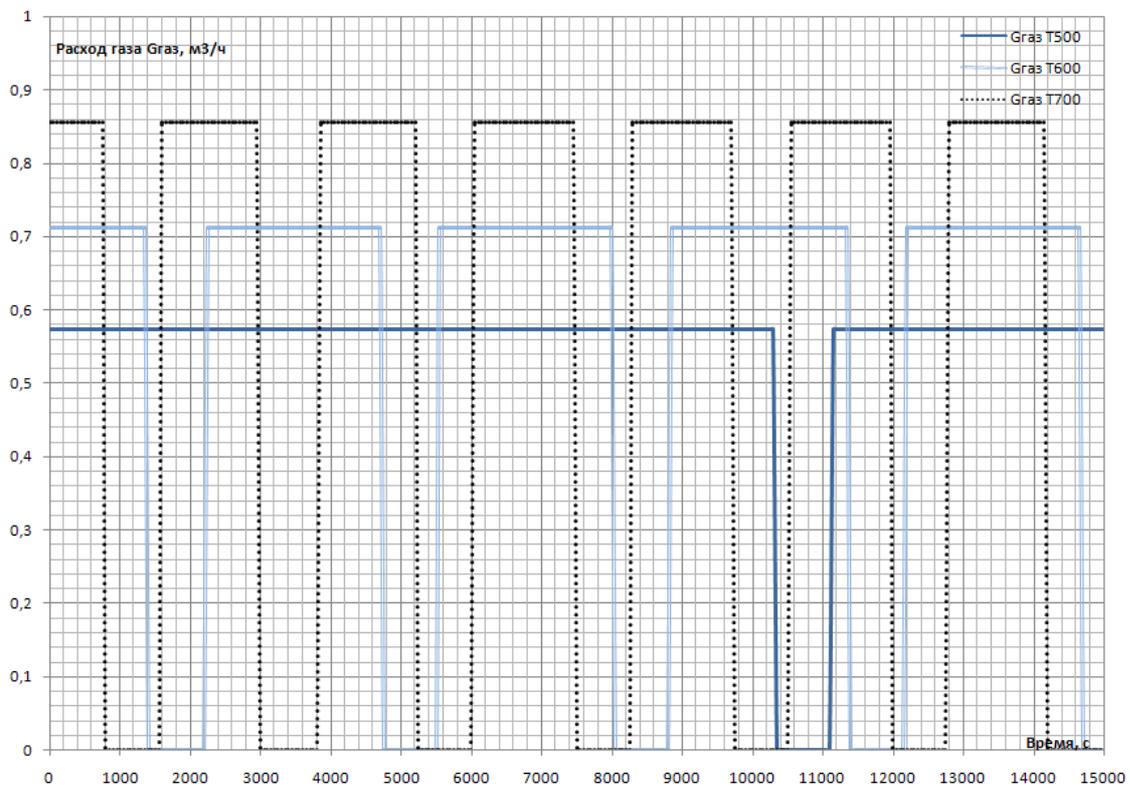
Figure 4. The graphs of gas consumption changes used by catalyst in the modeling process

Figure 5. The graphs of gas volume consumed by catalyst in the modeling process

Analysis of the received results

The graphs in the picture 2 present the cycles of the object temperature changes in range from minimum to maximum in the modeling process. One cycle of heater work includes:
- object heating up to maximum temperature;
- turning off the heater;
- gradual object cooling up to minimum temperature;
- turning on the heater.

For the heating process at circulating gas temperature of 500 ^{o}C heating-cooling cycle is 15000 sec., of which 14200 sec. is the object heating to maximum temperature, 800 sec. - free object cooling. This allows to conclude that the heat energy imparted by the flow of circulating gas with temperature of 500 ^{o}C, covers the object heat needs, but its value is close to minimum temperature of the circulating gas, at which there will be no heating and cooling.

For the heating process at circulating gas temperature of 600 ^{o}C heating-cooling cycle is 3400 sec. what is 4.4 times less than at 500 ^{o}C of circulating gas. Of these 2600 sec. is object heating to maximum temperature (5.5 times less than at 500 ^{o}C), 800 sec. - free object cooling. Reduced cycle time by reducing the heating time is connected with the increase of heat transferred by the circulating gas to the object for modeling interval.

For the heating process at circulating gas temperature of 700 ^{o}C heating-cooling cycle is 2200 sec. that is 6.8 times less than at circulating gas temperature 500 ^{o}C and 1.5 times less than at circulating gas temperature of 600 ^{o}C. Of them 1400 sec. is object heating to maximum temperature (10.1 times less than at 500 ^{o}C, 1.85 times less than at 600 ^{o}C), 800 sec. - free object cooling. In this case, there is a cycle time decrease by reducing time heating

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connected with temperature and heat increase transferred by the circulating gas to the object for the modeling interval.

The time of free cooling is constant for three graphs as it does not depend on the heating regime and is characterizing by the object parameters and environment.

In the picture 3 there are graphs of the object temperature changes in the course of time at different modeling intervals. It is shown that modeling interval change does not influence the accuracy of the data received as a result of modeling. It can be explained by the absence of fleeting processes in modeling objects. During these processes the time of parameters change would be equal to modeling time. Thus, modeling interval change in the range of 0.1-1 sec. does not have an important impact on modeling results.

In the picture 4 there are graphs of methane consumption changes by catalyst in the modeling process. The graphs for three values of circulating gas temperatures are similar. They illustrate the graph of fuel consumption needed for circulating gas heating. In the process of object heating equal quantity of methane is consumed that proves circulating gas heating up to needed temperature. During free cooling consumption of methane is 0. The heating and cooling cycles are similar to the graphs in the picture 2.

The graph for circulating gas with temperature 500 $^{\circ}$C is characterized by the lowest methane consumption at heating – 0.575 m^3/h. For circulating gas with temperature 600 $^{\circ}$C methane consumption at heating is 0.715 m^3/h. For circulating gas with temperature 700 $^{\circ}$C methane consumption at heating is 0.86 m^3/h. Methane consumption increase at circulating gas temperature increase is connected with heat quantity growth that is necessary to bring to circulating gas for modeling interval.

In the picture 5 there are graphs illustrated methane volume consumed by catalyst in the every moment of time. In the graphs the heating-cooling cycles are presented as segments of linearly increasing volume of consumed gas for the heating processes and segments of constant volume for the processes of free cooling. The equation of approximation line for all three graphs is the following:

$V_{газа} = 3*10^{-6}*t$,

the value of approximation reliability R² = 0,997.

The line characterizes methane consumption at circulating gas temperature equal to minimum needed (461 $^{\circ}$C) for maintaining the object temperature constant. Thus, the graphs in the picture 5 present that methane volume consumed for the object heating does not depend on heating regime chosen.

Conclusion

1. The results received during the computing experiment of catalytic heater functioning process illustrate physical processes in the bioreactor and catalytic heater.

2. Developed mathematical model allows to optimize suggested constructive solutions of mixing and heating with the use of catalytic heaters according to the criterion of energetic efficiency at maintaining necessary temperature in the bioreactor.

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Mathematical model of thermal mixing in the anaerobic fermentation of organic waste

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Abstract
The improvement of methods of organic waste anaerobic recycling is an important trend in biogas technologies development at the present time. In order to optimize constructive features of technical and technological systems used during anaerobic recycling for maintaining required temperature regime it is necessary to research heat exchange processes during all working regimes of the installation and in the whole volume of the bioreactor.
To increase biogas installations efficiency in the article [1] it is suggested using complex solution concerning mixing and heating with the use of catalytic heaters. In the suggested installation the mixture of gases escaping after combustion and produced biogas is used for bubble mixing of the fermentation substratum.
To solve the nonstationary problems existing calculus of approximations can be used especially finite difference method, elementary heat balance method, finite element method. To make the description of nonstationary heat exchange processes during heat mixing by heated gas in the bioreactor volume it is suggested using changed elementary balances method which means that the bioreactor volume is divided into elementary geographical shapes in the range of each shape the temperature is equal. Heat currents values, average for elementary time period, are taken as proportional to initial temperature gradient for the certain time period, and increase of heat volume content is proportional to increase of its temperature. It allows to restrict heat impact of bubbles with elementary volume where they are located in the initial moment of elementary time period.
To illustrate the processes happening during heat mixing the mathematical model was developed with the help of Microsoft Excel and Visual Basic.
Conclusions and Perspectives. Changed method of elementary balances allows to model temperature regime change in the whole bioreactor volume during the heat mixing by the heated gas with the help of the stationary heat and mass exchange equations. The developed mathematical model allows to optimize the suggested constructive solutions of the mixing and heating with the use of catalytic heaters according to the criterion of efficient maintenance of required temperature regime in the whole bioreactor volume.

Keywords: biogas, a bubble, the bioreactor, the thermal agitation, the catalytic heating, temperature balance

Introduction

The improvement of methods of organic waste anaerobic recycling is an important trend in biogas technologies development at the present time. The essential factor influencing the anaerobic recycling process efficiency is maintaining optimal temperature regime in the whole bioreactor volume for methane generation and anaerobic recycling. In order to optimize

constructive features of technical and technological systems used during anaerobic recycling for maintaining required temperature regime it is necessary to research heat exchange processes during all working regimes of the installation and in the whole volume of the bioreactor.

In work [2] on experimental bioreactor with the capacity of 2 m^3 with a water jacket the researches of the heat exchange during free movement were carried out. To describe the heat exchange in the volume of fermentation substratum at approaching boundary layer it is used the criterion equation:

$$\alpha = 0,398 \frac{c^{0,24} \rho^{0,5} \lambda^{0,6} \beta^{0,24} \Delta T^{0,24} g^{0,24}}{\mu^{0,24} l^{0,28}}, \tag{1}$$

where α - coefficient of heat diffusivity, m^2/sec, c – coefficient of heat capacity, kJ/(kg*K), ρ - density, kg/m^3, λ - coefficient of heat conductivity, W/(m*K), β - temperature coefficient, K^{-1}, ΔT - temperature difference, K/m, μ - viscosity of fermentation substratum, kg/(m*sec), g – acceleration of gravity, m/sec^2, l – bioreactor linear dimension, m.

In the work there is also an equation describing the heat exchange process in the volume of poultry waste fermentation near a boundary layer for geometrically similar bioreactors:

$$Nu = 0,398(Gr\,Pr)^{0,24}, \tag{2}$$

where *Nu* – Nusselt number, *Gr* – Grashof number, *Pr* – Prandtl number.

The authors study the heat exchange process during free bioreactor cooling but they do not research the heat exchange peculiarities during important (anaerobic fermentation) technological actions of mixing, substratum loading and uploading, discharging biogas.

In work [3] the authors study the heat exchange process in the bioreactor during mixing, there are results of experimental researches of biogas installation with the bubble mixing system. There are empirical formulas obtained with the help of regression analysis to determine kinematic viscosity (v) and surface tension (σ):

$$v = 6,75 + 0,03 * CB - 0,02 * T, \text{м}^2/\text{с}, *10^{-6}; \tag{3}$$
$$\sigma = 119,96 - 1,69 * CB - 0,02 * T, \text{Н/м}, *10^{-3}, \tag{4}$$

where CB – solids content, T – temperature.

There is also an equation describing the heat distribution process in the substratum fermentation from heat exchanging bioreactor wall for geometrically similar bioreactors:

$$Nu = 0,15 * (Gr_{\text{ж}} * Pr_{\text{ж}})^{0,33} * (\frac{Pr_{\text{ж}}}{Pr_c})^{0,25},$$

where *Nu* – Nusselt number, $Gr_{\text{ж}}$ – Grashof number for liquid, $Pr_{\text{ж}}$ – Prandtl number for liquid, Pr_c – Prandtl number for heat exchanging wall.

Obtained relations allow to estimate steadiness of heat distribution in the substratum fermentation from heat exchanging wall, however, it is difficult to determine temperature distribution in the whole volume of the bioreactor.

To increase biogas installations efficiency in the article [4] it is suggested using complex solution concerning mixing and heating with the use of catalytic heaters. In the suggested installation the mixture of gases escaping after combustion and produced biogas is used for bubble mixing of the fermentation substratum. For optimization constructive solutions it is necessary to research heat exchange processes in the bioreactor volume during heat mixing by heated gas.

To solve the nonstationary problems existing calculus of approximations can be used especially finite difference method, elementary heat balance method, finite element method [5, 6]. However, the use of the methods to describe the processes of heat mixing by heated gas is complicated by the following peculiarities of the described process: complex geometrical objects form participating in the heat exchange (elementary heat balance method, finite element method) and complex description of initial conditions (finite element method) connected with an enormous quantity of moving gas bubbles – getting cold heat sources and substratum movement in the bioreactor organized by them.

To make the description of nonstationary heat exchange processes during heat mixing by heated gas in the bioreactor volume it is suggested using changed elementary balances method which means that the bioreactor volume is divided into elementary geographical shapes in the range of each shape the temperature is equal. Heat currents values, average for elementary time period, are taken as proportional to initial temperature gradient for the certain time period, and increase of heat volume content is proportional to increase of its temperature. It allows to restrict heat impact of bubbles with elementary volume where they are located in the initial moment of elementary time period.

Mathematical model description

To illustrate the processes happening during heat mixing the mathematical model was developed with the help of Microsoft Excel and Visual Basic. The window view of the mathematical model in the programme Microsoft Excel is given in the picture 1.
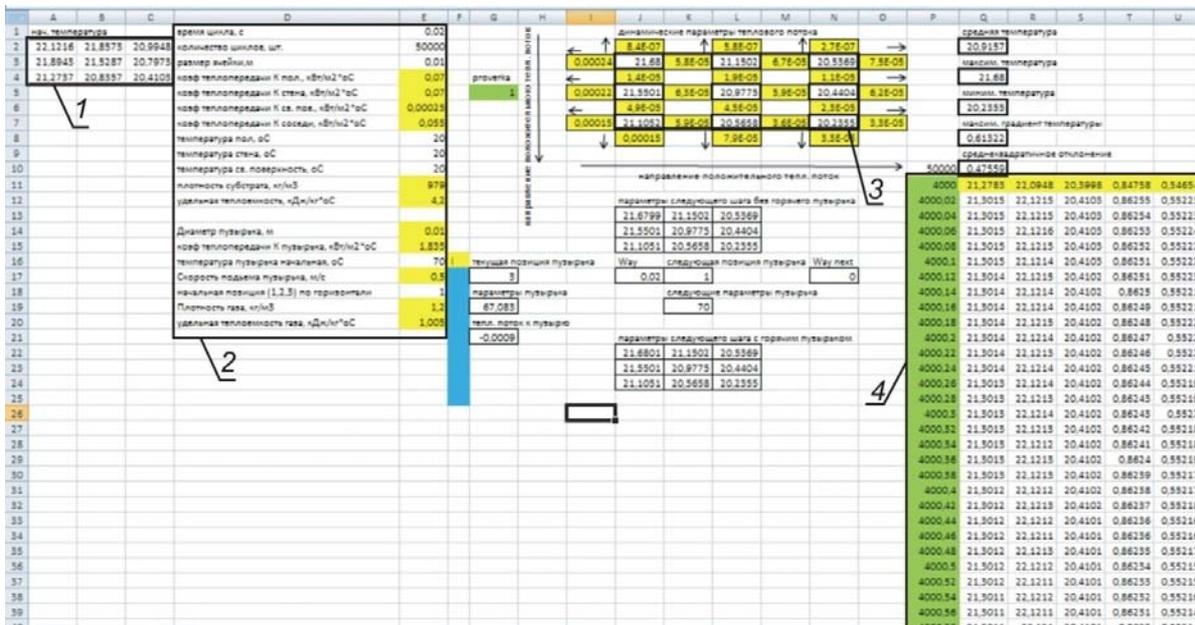
Figure 1 – the window of the mathematical model
1 – initial temperature values of the modeling area,
2 – input data, 3 – current temperature values of the modeling area,
4 – the values table forming in the process of modeling.

The basis of the mathematical model is equation of steady-state heat transfer. The equations of heat convection (Q) and heat flow (q) from liquid to gas through a separating wall:

$$q = k * F * \Delta T, \quad Q = k * F * \Delta T * t, \tag{5}$$

where k – coefficient of heat transmission, W/m^2*K, F – the area of heat exchange, m^2, $\Delta T = T_2 - T_1$ - temperature difference, K, t – time period, sec.

The equations of heat flow (q) and heat convection (Q) in the substantial medium:

$$Q = q * F * t; \quad q = -\lambda * gradT(x, y, z), \tag{6}$$

где λ - coefficient of heat conductivity, W/(m*K), $gradT(x, y, z)$ - temperature gradient, K/m.

The equations of heat flow and heat convection during flow:

$$Q = \alpha * F * \Delta T * t, \quad q = \alpha * F * \Delta T, \tag{7}$$

where α – coefficient of heat emission, W/m^2*K.

The equation of heat balance for steady-state heat transfer:

$$Q = c_1 * G_1 * (T_{11} - T_{12});$$
$$Q = c_2 * G_2 * (T_{21} - T_{22}), \tag{8}$$

where c_1, c_2 – specific heat capacity of heating and heated media at constant pressure, J/(kg*K), G_1, G_2 – mass flow of media, kg, T_{11}, T_{12} – temperatures of heating medium at the initial and final time period, K, T_{21}, T_{22} – temperatures of heated medium at the initial and final time period, K.

For the modeling the processes some volume of biogas installation is taken. It is nor limited by the shape peculiarities of the certain bioreactor, peculiarities of its shapes can be changed during the modeling. The modeling object presents a bioreactor component limited by two vertical planes (pic. 2). The chosen volume is divided into nine cells, the parallelepiped comes out with the cell dimensions of 3x3x1, the cells can have different volume.
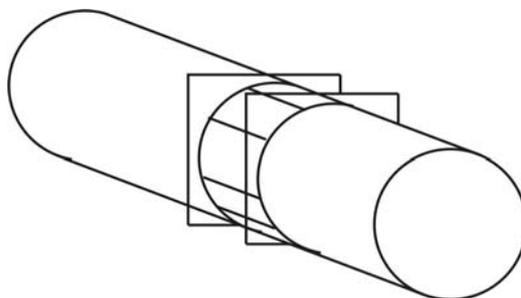
Figure 2 – Modeling volume

Each cell is homogeneous by structure, properties and constant form. In the modeling process out parameter is each cell temperature. In connection with the assumptions for each cell the equations of heat and mass balance, equations heat transmission through the wall and heat emission by flow, equations of heat conductivity in the substantial medium are composed. The equations allow to determine stationary heat flow between the heighbouring cells and between the cells and the environment for initial conditions representing the matrix of 3*3 temperatures at the initial time moment. At the same time heat exchange between chosen volume, sequent and preceding along the length of the bioreactor, is not taken into consideration. Sequent and preceding volumes along the length are analogous to chosen one in dimensions and processes happening, thus, in the case of their separation into nine cells in the each cell of sequent and preceding volumes the temperature values will be the same. Thereby, between the heighbouring cells of preceding, chosen and sequent volumes the heat flow will be zero.

In the process of the modeling elementary time period is chosen (*dt*), it is less than the modeling time. For the elementary time period with the help of certain stationary heat flows between the heighbouring cells, and also between the cells and the environment the values of transferred heat quantity are calculated. Then on the basis of composed heat balances the cells temperatures are determined at the end of elementary time period.

The obtained cells temperatures values are used to determine the heat flows and the quantity of the heat transferred at the next elementary time period. This cycle of the modeling is repeated till approaching set modeling time.

In the result of consecutive modeling with the use of stationary equations (5), (6), (7), (8) during N elementary time periods *dt*, much less than the modeling time, the state of the modeling volume (cells temperature values) will change. But the changes of the modeling volume state will have non-stationary character.

For them the equations of the heat exchange (*Q*) and heat flow (*q*) from liquid to gas through the separating wall (5) will be:

$$dq = k*F*d(T_1 - T_2), \quad d^2Q = dq*dt = k*F*d(T_1 - T_2)*dt, \tag{9}$$

where *k* – coefficient of heat transmission, W/m^2*K, *F* – the area of heat exchange, m^2, $d(T_1 - T_2)$ - change of temperature difference, K, dt – elementary time period, sec.

The equations of heat flow (*q*) and heat convection (*Q*) in the substantial medium (6) will be:

$$dq = -\lambda*d(gradT(x,y)), \quad d^2Q = dq*F*dt = -\lambda*d(gradT(x,y))*F*dt, \tag{10}$$

where λ - coefficient of heat conductivity, W/(m*K), $d(gradT(x,y))$ - changes of temperature gradient in the cells, K/m.

The equations of heat flow and heat convection during flow (7) will be:

$$dq = \alpha*F*d(T_1 - T_2), \quad d^2Q = \alpha*F*d(T_1 - T_2)*dt; \tag{11}$$

where α – coefficient of heat emission, W/m^2*K.

The equation of heat balance (8) will be:

$$dQ = c_1*G_1*dT_1; dQ = c_2*G_2*dT_2 \tag{12}$$

where c_1, c_2 – specific heat capacity of heating and heated media at constant pressure, J/(kg*K), G_1, G_2 – mass flow of media, kg, dT_1 – changes of heating medium temperature, K, dT_2 – changes of heated medium temperature, K.

For the modeling of the heat mixing by the bubble we used the formulas analogous to the equations of the heat flow and heat convection during the flow (7) and the equation of heat and mass transfer appearing during the transfer of a liquid part from one cell to another with the bubble. At the same time liquid transfer between the cells of chosen, sequent and preceding volumes is neglected because of similar schemes of liquid movements in each volume. The liquid transfer along the bioreactor axis will be seen only during the substratum loading and uploading.

The modeling process of the heat mixing is realizing in the following way. At the initial time period the bubble is in the one of low cells of the modeling area at option and has a certain size and temperature. With the help of the stationary heat and mass exchange equations the heat flows are determined connected with the heat exchange between the bubble and cell liquid and mass exchange between cells during the bubble moving. Then for the elementary time period (*dt*) we calculated the quantity of the transferred heat and cells temperatures values considering the heat transferred between the neighbouring cells, and also between the cells and environment. After that the heat bubble position is determined in the modeling volume at the following stage of the modeling by comparing the way passed by the

bubble and the cells size. The elementary time period should be less or equal to the time of the bubble presence in one cell to provide the bubble impact on each cell without missing any in the modeling process.

During the heat mixing modeling in the programme Microsoft Excel the macros was used written in Visual Basic. Its text is the following:

```
Sub Macros()
Sheets("List1").Select
    Cells(3, 10).Value = Cells(2, 1).Value 'assign to current values initial conditions'
    Cells(5, 10).Value = Cells(3, 1).Value
    Cells(7, 10).Value = Cells(4, 1).Value
    Cells(3, 12).Value = Cells(2, 2).Value
    Cells(5, 12).Value = Cells(3, 2).Value
    Cells(7, 12).Value = Cells(4, 2).Value
    Cells(3, 14).Value = Cells(2, 3).Value
    Cells(5, 14).Value = Cells(3, 3).Value
    Cells(7, 14).Value = Cells(4, 3).Value
    Cells(17, 7).Value = 1 'assign to current bubble position according to the height value
1'
    Cells(17, 10).Value = 0 'assign to the way passed by the bubble value 0'
    Cells(19, 7).Value = Cells(16, 5).Value 'assign to the current bubble temperature the
values of initial conditions'
    For I = 1 To Cells(2, 5).Value 'assign to the current values of the dynamic
parameters the values of the following stage'
    A = Cells(22, 10).Value 'assign the values of the following stage for the liquid
temperature variables'
    B = Cells(23, 10).Value
    C = Cells(24, 10).Value
    D = Cells(22, 11).Value
    E = Cells(23, 11).Value
    F = Cells(24, 11).Value
    G = Cells(22, 12).Value
    H = Cells(23, 12).Value
    J = Cells(24, 12).Value
    Cells(3, 10).Value = A 'assign to the current liquid temperatures values of variables'
    Cells(5, 10).Value = B
    Cells(7, 10).Value = C
    Cells(3, 12).Value = D
    Cells(5, 12).Value = E
    Cells(7, 12).Value = F
    Cells(3, 14).Value = G
    Cells(5, 14).Value = H
    Cells(7, 14).Value = J
    K = Cells(17, 11).Value 'assign the value of the following bubble position according
to the height of variable'
    L = Cells(17, 14).Value 'assign the value of the bubble way at the following stage
variable'
    M = Cells(19, 11).Value 'assign the bubble temperature values at the following stage
variable'
```

Cells(17, 7).Value = K 'assign variable value to the current bubble position according to the height'

Cells(17, 10).Value = L 'assign variable value to the bubble way at the current stage'

Cells(19, 7).Value = M 'assign variable value to the bubble temperature at the current stage'

Cells(11 + I, 17).Value = Cells(2, 17).Value

Cells(11 + I, 18).Value = Cells(4, 17).Value

Cells(11 + I, 19).Value = Cells(6, 17).Value

Cells(11 + I, 20).Value = Cells(8, 17).Value

Cells(11 + I, 21).Value = Cells(10, 17).Value

Cells(10, 16).Value = I

Next I

End Sub

Conclusion

1. Changed method of elementary balances allows to model temperature regime change in the whole bioreactor volume during the heat mixing by the heated gas with the help of the stationary heat and mass exchange equations.

2. The developed mathematical model allows to optimize the suggested constructive solutions of the mixing and heating with the use of catalytic heaters according to the criterion of efficient maintenance of required temperature regime in the whole bioreactor volume.

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The results of mathematical modeling of thermal mixing in the anaerobic fermentation of organic waste

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Abstract
The improvement of methods of organic waste anaerobic recycling is an important trend in biogas technologies development at the present time. The essential factor influencing the anaerobic recycling process efficiency is maintaining optimal temperature regime in the whole bioreactor volume for methane generation and anaerobic recycling.
To increase biogas installations efficiency in the article [1] there is a complex solution of the tasks concerning mixing and heating with the use of catalytic heating devices. In the mentioned installation the mixture of gases escaping after combustion and produced biogas is used for bubble mixing of fermentation substratum.
For optimization constructive solutions it is necessary to research heat exchange processes in the bioreactor volume during heat mixing by heated gas.
To illustrate the processes during heat mixing mathematical model was developed with the help of Microsoft Excel and Visual Basic.
According to developed mathematical model the computing experiment was carried out.
The modeling results are presented as graphs and described in detail.
Conclusions and Perspectives. During modeling of temperature changes in the bioreactor volume in the process of the time with and without mixing by a single bubble the results were obtained. They illustrate physical processes in the bioreactor volume during heat mixing by heated gas. The modeling results proves the use availability of the given constructive solutions of mixing and heating with the use of catalytic heaters for mixing by a single heated bubble allows to decrease values of maximum gradient and temperature roof-mean-square deviation in the modeling volume.

Keyword: Biogas, a bubble, the bioreactor, the thermal agitation, the catalytic heating, temperature balance.

Introduction

The improvement of methods of organic waste anaerobic recycling is an important trend in biogas technologies development at the present time. The essential factor influencing the anaerobic recycling process efficiency is maintaining optimal temperature regime in the whole bioreactor volume for methane generation and anaerobic recycling.

To increase biogas installations efficiency in the article [1] there is a complex solution of the tasks concerning mixing and heating with the use of catalytic heating devices. In the mentioned installation the mixture of gases escaping after combustion and produced biogas is used for bubble mixing of fermentation substratum.

For optimization constructive solutions it is necessary to research heat exchange processes in the bioreactor volume during heat mixing by heated gas.

To illustrate the processes during heat mixing mathematical model was developed with the help of Microsoft Excel and Visual Basic.

Plan and results of the computing experiment on developed mathematical model

According to developed mathematical model the computing experiment was carried out in the following order:

1) input data selection, introduction of initial criteria;

2) selection of an elementary time period and a number of modeling cycles;

3) model process launching for selected number of cycles;

4) data table formation and plotting.

Input data used in elaborated mathematical model are related to four parameter groups:

1) parameters of the modeling area (area and cells linear dimensions, substratum specific heat, heat conduction, initial criteria – temperature values of cells at the initial time);

2) parameters of the environment (temperature of environment, floor, over free surface of substratum);

3) parameters of heat mixing (bubble diameter, its initial temperature, uplift speed, initial position, bubble gas density and heat capacity);

4) parameters characterizing heat and mass interaction in the frames of model (coefficient of heat transmission from cells to the environment and floor, coefficient of heat emission from cells on free surface, coefficient of heat transmission from bubble to cells liquid, the bubble liquid quantity).

The size of the modeling area is 0.03x0.03x0.01m. Other parameters of the modeling area are chosen according to the literature for substratum [2, 3, 4] made of cattle manure with solids content 15%. Initial cells temperature is 50 ºC.

The temperature of the environment, floor and over free surface of substratum is 20 ºC.

A bubble diameter is 0.005 m, its initial temperature is 70ºC, the uplift speed is determined according to a bubble parameters and substratum (0.5 m/sec), bubble gas density and heat capacity is taken according to biogas literature [2, 3].

Parameters characterizing heat and mass interaction in the frames of the model are calculated on the base of dependence [6, 7, 8] in accordance with the literature for substrata [2, 3, 4], biogas [2, 3] and frame fillings [9].

Elementary time period is 0.02 sec that is equal to the time of bubble passing from one cell to another one. The number of modeling cycles originally was 50000 repetitions but then it was increased to 250000 repetitions for better illustration of the modeling process.

The modeling results are presented as graphs in the pictures 1, 2, 3, 4, 5.
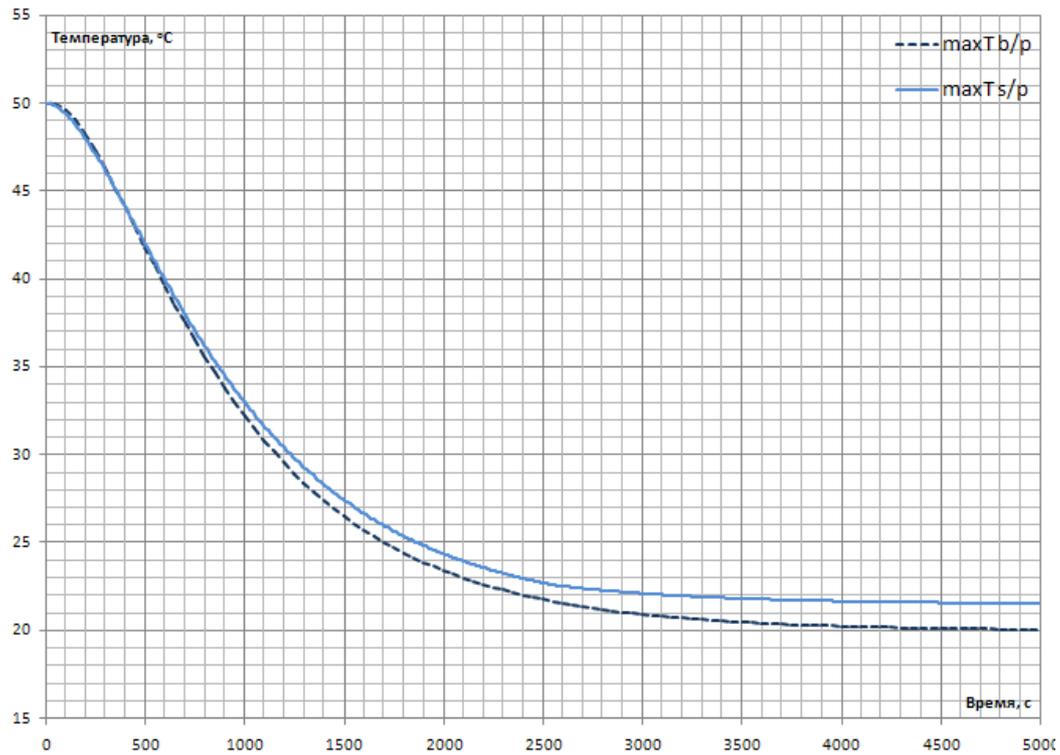
Figure 1. The graphs of maximum temperature changes in the modeling area in the course of some time with single bubble mixing and without mixing.
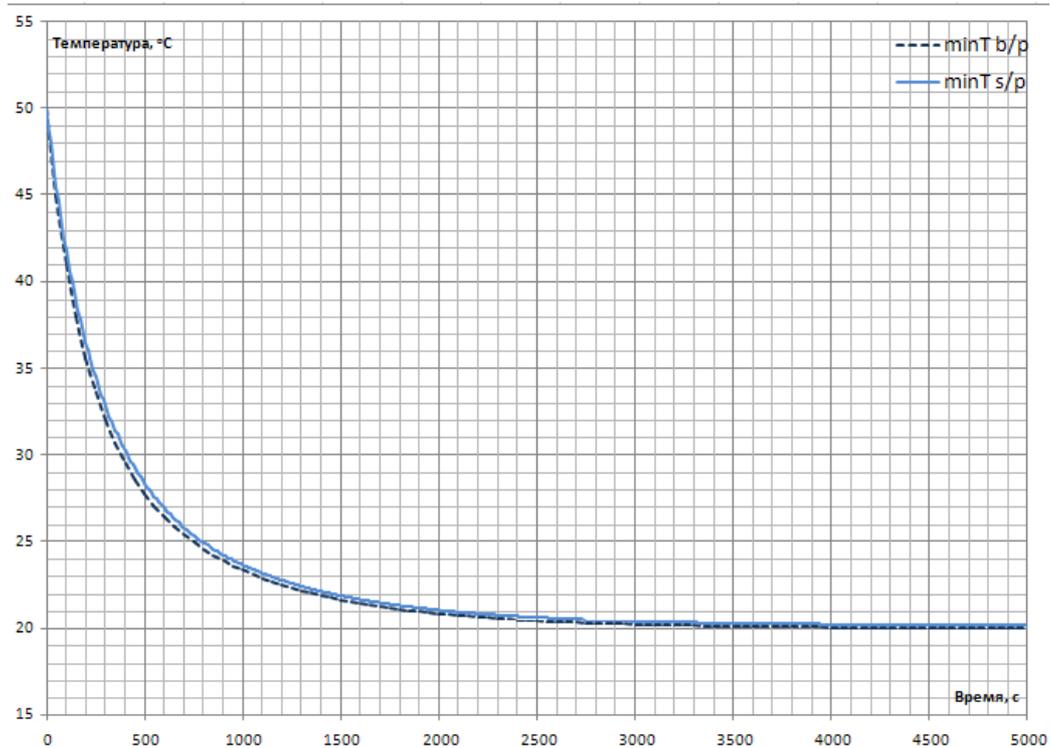

Figure 2. The graphs of minimum temperature changes in the modeling area in the course of some time with single bubble mixing and without mixing.
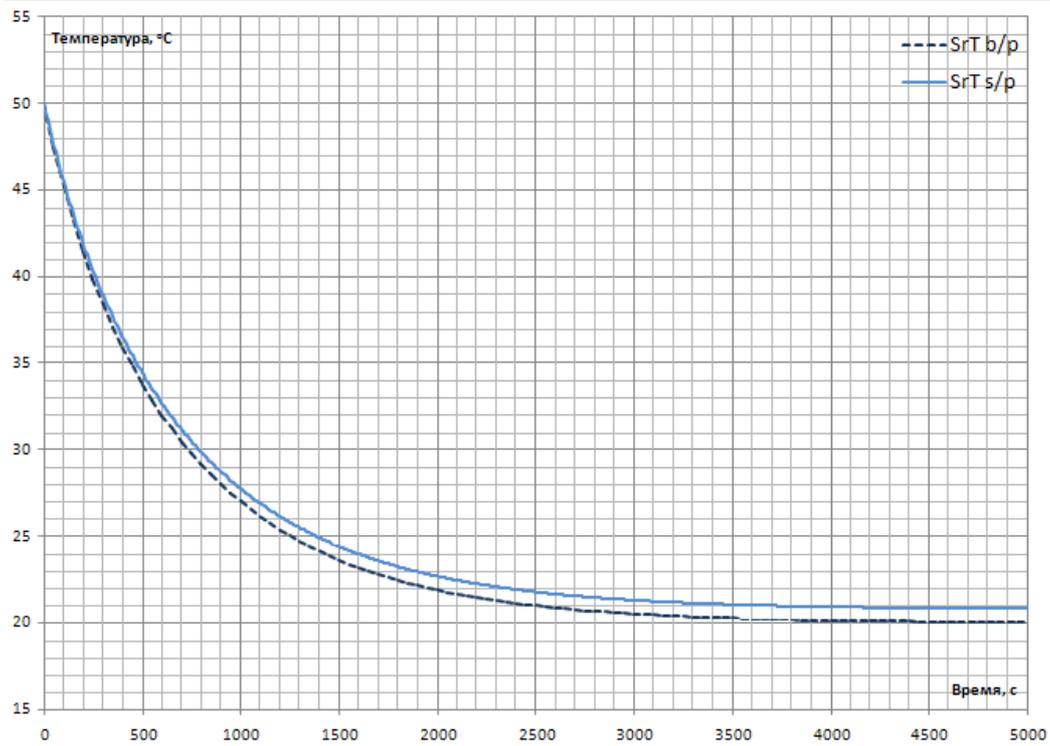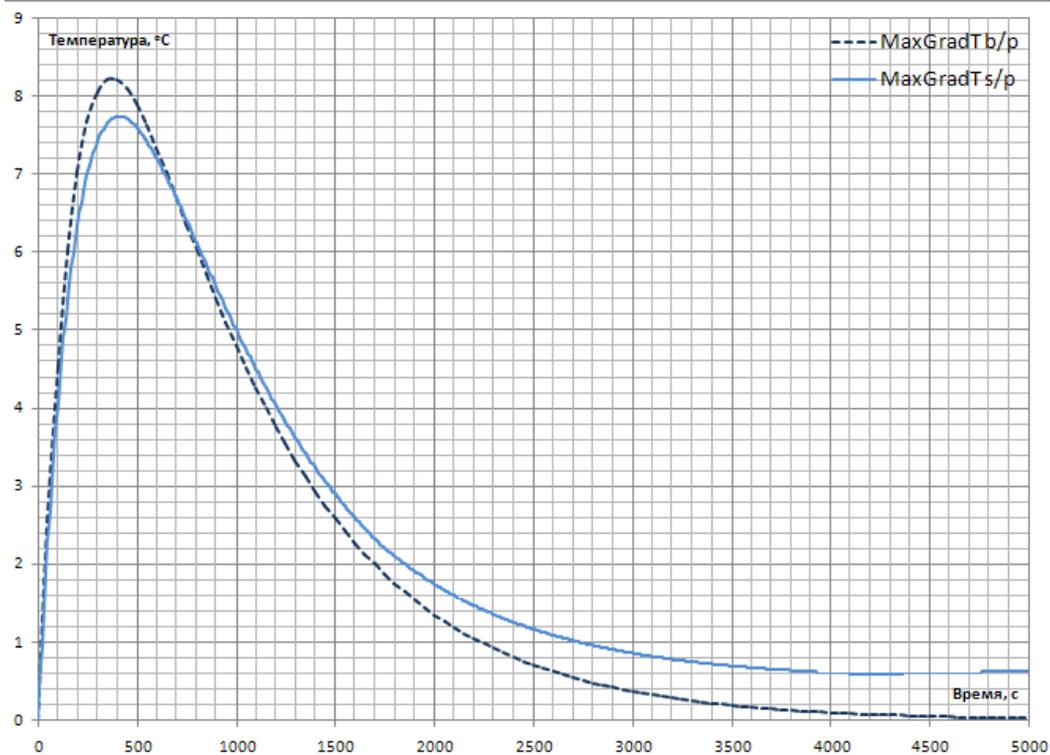
Figure 3. The graphs of average temperature changes in the modeling area in the course of some time with single bubble mixing and without mixing.
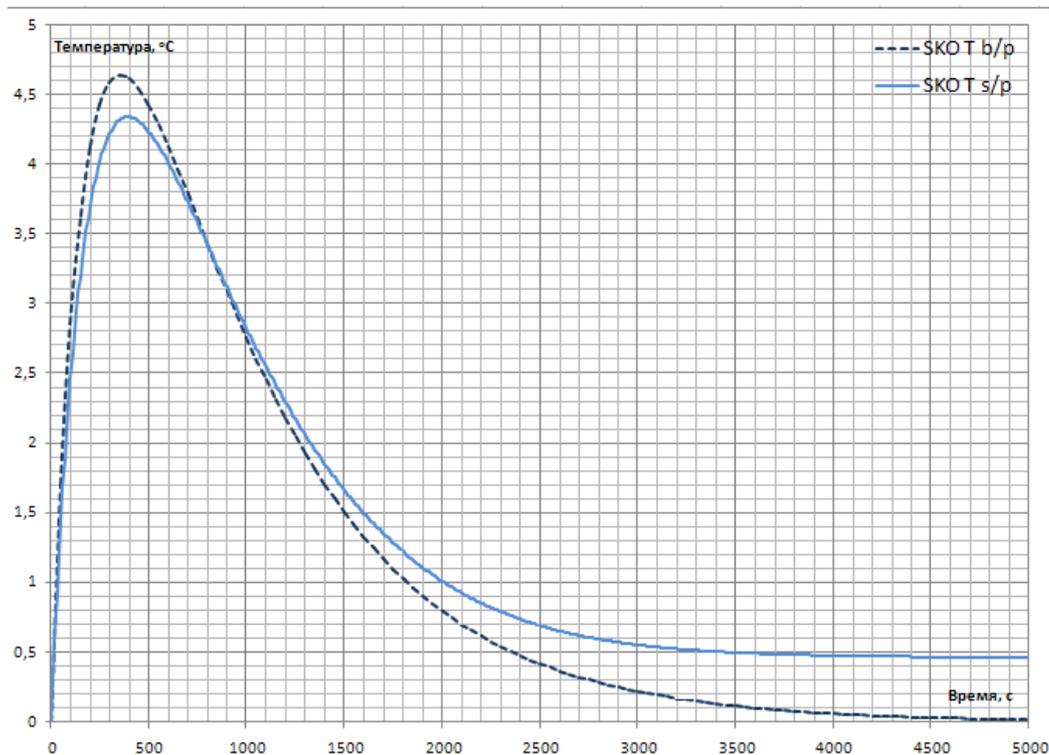

Figure 4. The graphs of temperature gradient changes in the modeling area in the course of some time with single bubble mixing and without mixing.

Figure 5. The graphs of temperature roof-mean-square deviation changes in the modeling area in the course of some time with single bubble mixing and without mixing.

Analysis of the received results

The graph of maximum temperature changes (pic. 1) in the modeling area without mixing illustrates the process of area nucleus cooling in the course of some time. The temperature decrease leads to cooling speed decrease. Mixing by a single bubble reduces the cooling speed of the modeling area. Area maximum temperature with and without mixing by a single bubble at the final moment of time differs by 1.5 ºC.

The result of graph approximation of maximum temperature in the modeling area without mixing:

$T = 2*10^{-6}t^2 – 0.016t + 48.56$.

The value of approximation reliability R² = 0.965.

The result of graph approximation of maximum temperature in the modeling area with mixing:

$T = 2*10^{-6}t^2 – 0.016t + 48.50$.

The value of approximation reliability R² = 0.965.

The graph of minimum temperature changes (pic. 2) in the modeling area without mixing illustrates the process of border area cooling in the course of some time. The temperature decrease leads to cooling speed decrease, however, at the initial stage cooling speed is much higher than for the area nucleus. Mixing by a single bubble insignificantly reduces the cooling speed of the modeling area. Area minimum temperature with and without mixing by a single bubble at the final moment of time differs by 0.3 ºC.

The result of graph approximation of minimum temperature in the modeling area without mixing:

$T = 4*10^{-13}t^4 – 5*10^{-9}t^3 + 2*10^{-5}t^2 – 0.037t + 43.59$.

The value of approximation reliability R² = 0.957.

The result of graph approximation of minimum temperature in the modeling area with mixing by a single bubble:

$T = -8*10^{-10}t^3 + 8*10^{-6}t^2 - 0.022t + 40.19.$

The value of approximation reliability $R^2 = 0.911$.

The graph of average temperature changes (pic. 3) in the modeling area without mixing illustrates the process of the area cooling in the course of time. The temperature decrease leads to cooling speed decrease. Mixing by a single bubble reduces the cooling speed of the modeling area and the areas average temperature with and without mixing by a single bubble at the final moment of time differs by one degree.

The result of graph approximation of average temperature in the modeling area without mixing:

$T = -8*10^{-10}t^3 + 8*10^{-6}t^2 - 0.024t + 45.67.$

The value of approximation reliability $R^2 = 0.98$.

The result of graph approximation of average temperature in the modeling area with mixing by a single bubble:

$T = 2*10^{-6}t^2 - 0.012t + 41.14.$

The value of approximation reliability $R^2 = 0.905$.

The graph of temperature gradient changes (pic. 4) in the modeling area without mixing illustrates the process of the area cooling in the course of time. At the initial stage of cooling process of extreme cells there is rather high temperature gradient between the nucleus and area periphery. In the sequel in connection with decrease of area average temperature and cooling speed the temperature of the whole modeling area improves and temperature gradient decreases.

Mixing by a single bubble allows to decrease a maximum gradient value by 0.4 degrees at the initial stage. However, considering further invention of heated and non-heated areas by a single bubble at the final moment of time there can be seen steady-state deviation by 0.6 degrees. At the same time without mixing temperature gradient at the final moment of time tents to zero.

The result of graph approximation of temperature gradient in the modeling area without mixing:

$T = -2*10^{-13}t^4 + 2*10^{-9}t^3 - 7*10^{-6}t^2 + 0.005t + 5.077.$

The value of approximation reliability $R^2 = 0.873$.

The result of graph approximation of temperature gradient in the modeling area with mixing by a single bubble:

$T = -2*10^{-13}t^4 + 2*10^{-9}t^3 - 7*10^{-6}t^2 + 0.005t + 4.936.$

The value of approximation reliability $R^2 = 0.886$.

The graph of temperature roof-mean-square deviation changes (pic. 5) in the modeling area without mixing illustrates the process of the area cooling in the course of time. At the initial stage of cooling process of extreme cells there is rather high cells temperature deviation from average value. Then in connection with decrease of area average temperature and cooling speed, the temperature of the whole modeling area improves.

Mixing by a single bubble allows to decrease maximum deviation by 0.3 degrees at the initial stage. However, considering further invention of heated and non-heated areas by a single bubble at the final moment of time there can be seen steady-state deviation by 0.5 degrees. At the same time without mixing temperature roof-mean-square deviation at the final moment of time tents to zero.

The result of graph approximation of temperature roof-mean-square deviation in the modeling area without mixing:

T = - $1*10^{-13}t^4$ + $1*10^{-9}t^3$ − $4*10^{-6}t^2$ + 0.002t + 3.011.

The value of approximation reliability R^2 = 0.882.

The result of graph approximation of temperature roof-mean-square deviation in the modeling area with mixing by a single bubble:

T = - $1*10^{-13}t^4$ + $1*10^{-9}t^3$ − $4*10^{-6}t^2$ + 0.002t + 2.895.

The value of approximation reliability R^2 = 0.889.

Conclusion

1. During modeling of temperature changes in the bioreactor volume in the process of the time with and without mixing by a single bubble the results were obtained. They illustrate physical processes in the bioreactor volume during heat mixing by heated gas.

2. The modeling results proves the use availability of the given constructive solutions of mixing and heating with the use of catalytic heaters for mixing by a single heated bubble allows to decrease values of maximum gradient and temperature roof-mean-square deviation in the modeling volume.

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Effect of tillage on soybean crop yield and physical properties on a chambic chernozem

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Abstract
Soil tillage is an important agricultural activity because of its impact on crop production and soil properties. The purpose of this study was to evaluate the influence of tillage on soybean yield and soil physical properties in the pedoclimatic conditions of the Moldavian Plain – Romania.
The study was carried out in 2010-2012 in an agroecosystem located at Ezareni – The Experimental Farm of the Agricultural University of Iasi (47°07' N latitude, 27°30'E longitude), on a cambic chernozem (SRTS-2003, or haplic chernozems WRB-SR, 1998), 6.8 pH, 2.7% humus content and a medium level of fertilization. The texture of the surface soil is clay-loamy (0–30 cm).
The experimental soil tillage systems were as follows: V_1 – disc harrow , V_2 – paraplow, V_3 – chisel plow + rotary harrow for seedbed preaparation, V_4 – plough at 20 cm (control variant) and V_5 – plough at 30 cm.
In 2010-2011 agricultural year (the 6th year of these technology testing), on fertilized variants, the soybean yield on chisel treatment was 9.90 % higher that the control treatment – plough at 20 cm meanwhile the paraplow variant only 5% higher.

Keywords: reduced till, penetration resistance, bulk density

Introduction

In the last decades, all over the world, the tillage systems for soil conservation have been extended on a large scale, being an attractive alternative to the conventional practices (Smart et Bradfort, 1999; Bran et al., 2008).

Tillage effects on soil properties are usually site specific and depend upon the interaction of soil and climatic conditions, with soil and crop management practices.

Intensive agriculture with heavy machinery can cause soil deformation by compaction and shearing which results in changes in soil structure. For a correct evaluation of the impact of management practices on the soil environment, it is necessary to quantify the modifications to the soil physical properties.

When we have to choice a tillage system we have to think at soil conditions, plant and climatically conditions which can influence or can be influenced by that system (Franzluebbers A. J., 2002).

Soil tillage systems affect mechanical behavior of soil layers. Horn R. (1986, 2004) determined that soils under a long-term conservation tillage induced changes in physical properties compared with conventionally tilled soils, being more resistant and thus less susceptible to deformation. Retention of vegetal residues of the previous crop on 30% of soil surface is considered the lower limit of the classification of tillage systems for soil conservation (Dexter A.R., 2004, Jităreanu G. and Bucur D., 2005, Rusu, T., et al., 2006).

Materials and methods

The study was carried out in 2010-2012 in an agroecosystem located at Ezareni – The Experimental Farm of the Agricultural University of Iasi (47^o07' N latitude, 27^o30'E longitude), on a cambic chernozem (SRTS-2003, or haplic chernozems WRB-SR, 1998), 6.8 pH, 2.7% humus content and a medium level of fertilization. The texture of the surface soil is clay-loamy (0–30 cm). The experimental soil tillage systems were as follows: V_1 – disc harrow , V_2 – paraplow, V_3 – chisel plow + rotary harrow for seedbed preaparation, V_4 – plough at 20 cm (control variant) and V_5 – plough at 30 cm. The main plots were represented by tillage systems and the subplots were fertilization rate, with two levels: N_0P_0 and $N_{80}P_{80.}$ Treatments were arranged in a "split plot" design with three replicates. All subplots were separated by a 1-m buffer zone. Plots covered an area of 60 m^2 with a rotation of soybean - winter wheat – maize, with the current experiment in soybean *[Glycine max (L.) Merr.]*.

The previous crop residue (so called secondary product) was threshed and uniformly spread during its harvest on conservation tillage plots. Long-term amount of precipitation at this site is 517.8 mm at an average air temperature of 9.4^oC.

Soil bulk density was determined on an oven-dry basis by the core method method (*Blake G.R., and Hartge K.H., 1986*). To determine bulk density at a soil depth of 0-10, 10-20, 20-30 cm, undisturbed 100 cm^3 core samples of 5 cm diameter were taken from all the five variants after sowing, during the growing period, and right after harvesting.

The penetration resistance of the soils was determined using a digital penetrologger (Eijkelkamp Equipment, Model 0615-01 Eijkelkamp, Giesbeek, The Netherlands) which had a cone angle of 30^0 and a base area of 1 cm^2. It was carefully inserted into the soil profiles in 1 cm increments from the surface to a depth of 50 cm by the same person following a rain event that satisfied the field capacity of the soils and avoiding wheel tracks. 10 parallel records were made in each plot and averaged for statistical analysis. Cone index data were digitized into the computer at 5-cm-depth intervals.

For water stable aggregates, the procedure of Kemper and Rosenau (1986) was used. Four grams of 1–2 mm air-dried aggregates were placed into sieves and wetted with sufficient distilled water to cover soil when the sieve is at the bottom of its stroke. The sieves were allowed to raise and low 1.3 cm, 35 times/min for 3 min (Eijkelkamp - Wet Sieving Apparatus). The remained material (stable aggregates) in the sieve was dispersed with 2g/l NaOH. The wet aggregation was calculated as the ratio of stable aggregates weight to total sample weight corrected for sand (*USDA, 1998*). All analyses were done in three replications.

The ANOVA procedure was used to evaluate the significance for a randomized complete block design with three replicates. Treatment means were separated by the least significance difference (LSD) test and all significant differences were reported at 5%, 1% and 0.1% levels.

Results

This paper reports the results of our research focused to determination of the influence of conservation tillage in comparison with the traditional tillage, on soybean yield and some physical soil properties in the pedoclimatic conditions of the Moldavian Plain. The experiment was initiated in 2005 but in this paper we will cover only the 2010-2011 agricultural year.

Previous research revealed that the soybean [*Glicine max* (L.) Merill] crops respond to the soil deep loosening and the applied tillage system and there is a certainty that these agricultural practices have also an influence on physical properties of the yield such as the seed size and weight, expressed as weight of 1000 kernels and test weight.

The total rainfall in 2010-2011 was of 444.4 mm, which was 73.4 mm less than the multi-annual mean, with severe contribution to a not normal crop evolution up to harvest.

The yield was corrected to 12% moisture content. In 2010-2011 agricultural year (the 6th year of these technology testing), on fertilized variants, the soybean yield on chisel treatment was 9.90 % higher that the control treatment – plough at 20 cm meanwhile the paraplow variant only 5% higher. The lowest yield was recorded on disk harrow variant, 986 kg ha^{-1} on N_oP_o fertilized level. The 2010-2011 is characterized as an unfavorable year for this crop, mainly due to the high precipitation deficit that occurred during the yield formation period (table 1). The droughty July-September period of 2010, with a 90.4 mm deficit compared to normal, diminished drastically the soybean yield

The analysis of variance indicates that the grain yield was significantly affected by tillage and fertilizing level.

Table 1. The influence of "tillage systems x nutrients level" interaction on soybean yield (2010/2011)

Variant		Yield		Differences to the control variant (kg ha^{-1})	Statistical significations
Tillage system	Nutrient level	kg ha^{-1}	Comparison with control variant (%)		
Disc harrow	$N_{30}P_{30}$	1344	49.81	-1354	ooo
	N_0P_0	986	36.55	-1712	ooo
Paraplow	$N_{30}P_{30}$	2834	105.04	136	**
	N_0P_0	1280	47.44	-1418	ooo
Chisel	$N_{30}P_{30}$	2966	109.93	268	***
	N_0P_0	1324	49.07	-1374	ooo
Plough 20 cm	$N_{60}P_{30}$	2698	100.00	0	control variant
	N_0P_0	1120	41.51	-1578	ooo
Plough 30 cm	$N_{30}P_{30}$	2769	102.63	71	
	N_0P_0	1198	44.40	-1500	ooo
LSD 5% = 79.1 kg		LSD 1% = 108.5 kg		LSD 0.1% = 147.6 kg	

Most of the soil compaction in intensive agriculture is caused by external load on soil from farm machinery or livestock. This causes considerable damage to the structure of the tilled soil and the subsoil, and consequently to crop production, soil workability and the environment (Defossez and Richard, 2002).

The dynamics of bulk density on the chambic chernozem from Iasi for all tillage treatments is shown in table 2. The BD increased with time and depth after tillage for all five tillage treatments as the soil gradually get compacted under the influence of rainfall and particle resettlement.

Analyzing soil bulk density (BD) in soybean *[Glycine max (L.) Merr.]* this indicator had the lowest value of the seeding time at 0-10 cm depth (1.11-1.15 g cm^{-3}). The values increased on 10-20 cm layer, recording the greatest intensity in the disk harrow variant (1.43 g cm^{-3}), highlighting a diskpan an this horrizon. Analyzing the 20-30 cm layer we observed that the biggest values have been provided by the control variant, plough at 20 cm and disk harrow (1.36-1.48 g cm^{-3}).

Right after the soybean harvesting, the , the mean values on 0-30 cm layer had the highest value on disk harrow treatment (1.47 g cm^{-3}).
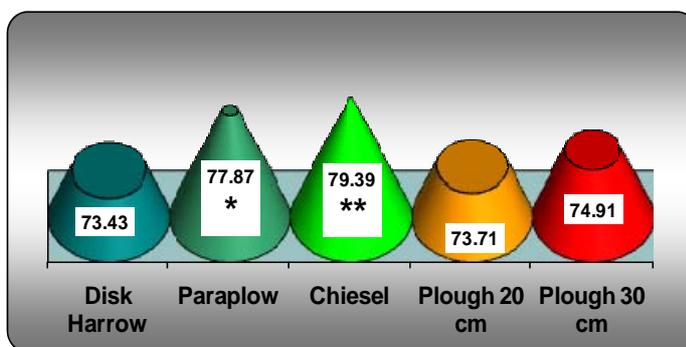
Table 2. The influence of tillage systems on Bulk density at soybean crop (2010/2011)

Variant	Deapth (cm)	Bulk density (g cm^{-3})		
		Sowing	Growing period	Harvesting
Disk harrow	0-10	1.15	1.25	1.33
	10-20	1.43	1.47	1.53
	20-30	1.48	1.50	1.55
Mean values on 0-30 cm deapth		**1.35**	**1.41**	**1.47**
Annual average		**1.41**	*******	
Paraplow	0-10	1.15	1.23	1.27
	10-20	1.21	1.32	1.43
	20-30	1.34	1.41	1.48
Mean values on 0-30 cm deapth		**1.23**	**1.32**	**1.39**
Annual average		**1.32**	**o**	
Chisel	0-10	1.11	1.20	1.25
	10-20	1.22	1.30	1.41
	20-30	1.32	1.41	1.43
Mean values on 0-30 cm deapth		**1.22**	**1.30**	**1.36**
Annual average		**1.29**	**oo**	
Plough 20 cm	0-10	1.13	1.22	1.27
	10-20	1.24	1.38	1.46
	20-30	1.36	1.47	1.54
Mean values on 0-30 cm deapth		**1.24**	**1.36**	**1.42**
Annual average		**1.34**	**control variant**	
Plough 30 cm	0-10	1.14	1.24	1.28
	10-20	1.25	1.38	1.47
	20-30	1.30	1.33	1.38
Mean values on 0-30 cm deapth		**1.23**	**1.32**	**1.38**
Annual average		**1.31**	**o**	

LSD 5% = 0.024 g cm^{-3} LSD 1% = 0.035 g cm^{-3} LSD0.1%= 0.053 g cm^{-3}

Several management systems can improve soil productivity. By studying aggregate stability it is possible to quantify whether or not the management is ameliorating the natural soil properties and the land capability for agriculture.

The mean values of WSA recorded during 2010-2011, right after harvesting, on 0-30 cm layer, reveal positive statistically significant differences between chisel, paraplow variants and the control treatment (plough at 20 cm), (figure 1). The effects of tillage system on WSA reveal a negative difference at Disc harrow (73.43% WSA) compared with
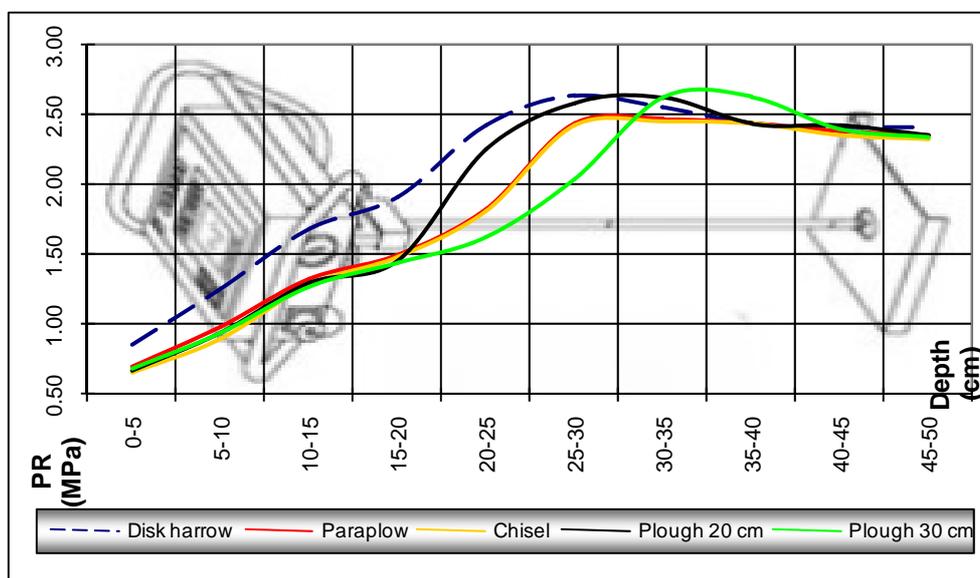

Figure 1 - The influence of tillage systems on Water-stable aggregates – mean values at soybean harvesting *(control variant – Plough 20 cm)*

control treatment, difference which is not statistically insured.

The stability of soil aggregates often decreases for soil under disk harrow treatment compared with the other variants of minimum tillage (chisel and paraplow).

In general, the higher the index value the better the soil's capacity to transmit water and air and to promote root growth and development.

**Figure 2 - The influence of tillage systems on Penetration Resistance –
mean values at soybean harvesting** *(control variant – Plough 20 cm)*

Penetrometer resistance is widely measured because it provides an easy and rapid method of assessing soil strength. The penetration resistance (Pr) of the soil varied with the method of tillage operations. Soil penetration resistance at different depths in response to tillage, at the harvesting time and 3–5 days after a rainfall, when the soil water content was nearly at field capacity, is shown in figure 2. The penetration resistance of the soil varied with the method of tillage operations. PR in the soil for all the five tillage treatments increased with depth.

Several researchers have reported that PR is reduced in conventional tillage compared to reduced tillage (Sidiras et al., 2000). The biggest PR in the 0-10 cm layer was found in disk harrow treatment while de minimum value was found in chisel variant. Also the disk variant had a higher PR at 10, 20, 30, 40 and 50 cm depths. It has been observed an increasing of PR on 20-30 layer on plough 20 cm, indicating an hardpan on that layer, also the phenomena has been observed on plough at 30 cm, at 30-40 cm depth. Crops roots growth can be depressed PR overpasses a threshold of 2.5–3.0 MPa (Hamza and Anderson, 2005), but these limits were generally not exceeded in.

Conclusion

Changes in soil physical properties due to use of conventional or conservation tillage, depend on several factors including differences in soil properties, weather conditions, history of management, intensity, and type of tillage.

We consider that problems of soil degradation and protection by conservation tillage should have a more extended place in the Romanian agriculture strategy and the results and conclusions of this research will help the Romanian farmers to increase their crops efficiency.

The changes produced by reduced tillage adoption on soil bulk density and cone index probably did not restrict severely roots growth, with a single exception – Disk harrow treatment where a subsoil compaction pan was detected at 30-35 cm. The potential effects of increased penetration resistance may have some influences on yield.

The results indicate that minimum tillage using chisel and paraplow in autumn can be considered as a substitute to conventional moldboard plowing.

Acknowledgements

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