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J21510-001

Bozhko S.D., Ershova T.A., Chernyshova A.N., Situn N.V.
DEVELOPMENT OF GRAIN PORRIDGES OF SPECIAL-PURPOSE
PURPOSE

Far Eastern Federal University

Now, intensive development of specialized production of food products with the ingredients, whose presence in food is unacceptable in certain medical indications (allergens, some types of proteins, oligosaccharides, polysaccharides, and others.). Food, gluten-free, are one of the segments of foodstuffs. Gluten is a protein component of the cereal gluten - water-insoluble complex of proteins with a low content of lipids, sugars and minerals [3, 4]. Most cereal grains contained 7-16% proteins [1, 2]. Fibers of cereals incorporate 4 fractions: albumins, globulins, prolamin and glutenins. The last two fractions are called «gluten» [3, 4]. Many products contain so-called hidden gluten; marks of products with hidden gluten can be absent. Presence "hidden" gluten causes inadvertent infringement of patients of a diet more often. Such products can be many sweets, the tinned products, dry soups, cubes, seafoods, crab sticks, sauces, ketchups, a meat sauce, mayonnaise, ice-cream, yoghurts, etc. the Diet of the patient depends on age, weights of a condition, the period of disease and is under construction on the basis of the general principles: a carbohydrate component make due to groats (rice, гречки), corns, vegetables, a potato, fruit and berries; albuminous and fatty – due to meat, eggs, dairy products, vegetative and a butter [5, 10].

The question on inclusion of an oats in a diet of patients with celiac disease remains debatable. According to some authors, the oats can be included in a diet the adult [11] and to children [12]. Clinical supervision and histologic research of a mucous membrane of thin intestines have allowed authors to come to the conclusion, that the moderate quantity of an oats (up to 70 г in day) is maybe included in a diet [13]. Long-term results of the observation of these twelve patients within 5 years led the authors to suggest the safety of oat consumption by patients with celiac disease [14]. The main producers of gluten-free products on the Russian market, the company is: Glutano (Germany) - supplied by company "GEK - MSC», Dr. Schar (Italy), Gullon (Spain), Bezgluten (Poland), "McMaster" (Russia). Now starting to enter the food market domestic production of specialized products intended for patients with celiac disease, among which are the products of the milling industry [6].

Currently, the Russian Federation has no regulations governing the level of gluten in foods. Production of gluten-free products must meet strict requirements of international standards. In many countries, there is a code of standards (Gluten-Free Foods), which regulates the maximum permissible dose of gluten in foods.

By «gluten-free» can be classified products containing no more than 200 mg of gluten 1 kg of the product based on the dry sample. Typically, the content of gliadin in gluten is at 50%, so the norm for gluten 200 mg / kg (0.02%) corresponds to a limit gliadin concentration of 100 mg / kg (0.01%). Only under that level on the label may be submitted sign «gluten-free products». However, it discusses the possibility of reducing the allowable level gluten in such products to 20 mg / kg [1, 7].

If currently abroad are widespread gluten-free products, which has appropriate labeling, in Russian manufacture of such products is virtually absent. In this regard, urgent problem is the food industry to develop new technologies multi-gluten-free products with a long shelf life. At the same time the most important condition for the establishment of prescription formulations should be their high nutritional and biological value, with simultaneously low cost.

For products with a long shelf life in a fully include dry cereal porridge. The nutrition of the population, they occupy a priority position and are in great demand. Dry grain cereals, are products consisting of a mixture of different cereals (flakes), fruit and vegetable additives, dried fruits, berries, sugar or sugar substitutes, milk protein, prebiotic or a mechanical mixture of prescription ingredients intended for human consumption as cereals dishes. Combinations of these additives can be extremely varied [8, 9]. In this sense, porridge significantly different from other food concentrates rich in complex nutrients: protein, fat, carbohydrates, minerals and vitamins. In addition, a significant proportion of raw materials for cereals account for cereals, with them in the human body get dietary fiber. This makes it possible to recommend the porridge people to prevent diseases of the gastrointestinal tract, cholesterol metabolism and other metabolic disorders.

In developing the recipes cereals into account the availability of local raw materials, standards of consumption of basic nutrients, especially production technologies and consumer properties of the finished product. Formulating the compositions of dry mixes for the production of gluten-free cereals was carried out from the ground (rice flakes, millet, buckwheat, oat) and additional materials (fructose, salt). As additives that improve food and biological value of the product used: milk protein, cheese whey powder, royal jelly, pollen, flower, flax meal, flour, pumpkin, pectin). In addition, to extend the range of the prescription formulations of dry mixes for the production of gluten-free cereals as additional sources of dietary fiber have been included fruit and vegetable supplements (powders and dried pieces of vegetables, fruits and berries, mushroom powder).

Depending on the raw materials have been developed following types of dry mixes for the production of gluten-free vegetable cereals:

- Dry mixture number 1, 2 and 3, based on millet and rice cereal;
- A dry mixture of number 4 on the basis of buckwheat cereal;
- Dry mixture number 5 on the basis of buckwheat and oatmeal.

The main ingredients of the formulation are mixed with the powder of carrots, flax flour, dried pieces of pumpkin, parsley and dried milk protein and added table salt (mixture №1); with pieces of dried pumpkin, apples, apricots, added milk protein, royal jelly, pectin, salt, fructose (a mixture №2); with blueberries, cherries, strawberries, added milk protein, flax flour, flower pollen, salt, fructose (a mixture №3); Maitake mushroom powder, reishi and shiitake, carrot powder, pumpkin and flax flour, dried dill, green onions and parsley, salt (mixture №4); royal jelly was added, cheese whey powder, powder goji berries, dried blueberries, cherries, strawberries and goji, salt, fructose (a mixture №5).

For the preparation of dry mixes of cereals prepared meals at home developed recommendations. The contents of the package into a container, add 150 ml of boiling

water or hot milk and stir. If necessary, add oil or butter. Cover and infuse for 3-5 minutes. The microwave mode: the contents of the packet into a container, add 150 ml of water or milk and stir. If necessary, add oil or butter. Cook 2 minutes.

Designed range of dry mixes cereal gluten-free cereals has a high nutritional value (protein content of 13-17,7 to 3.4-3.5 g / 100 g, the carbohydrate content of up to 14,6-16,2 60-66,9 g / 100 g), and the content of dietary fiber (from 69,8 to 91,0 g / 100 g).

The development of competitive specialized food is actual direction of development of the food industry.

In developing the recipes cereals into account the availability of local raw materials, standards of consumption of basic nutrients, especially production technologies and consumer properties of the product range of dry mixes vegetable porridge. Designed gluten-free mixes contain enough for an adult human body protein and carbohydrates, dietary fiber small amount of fat, rich in mineral and vitamin composition. In all samples of cereals there is a combination of vitamins: β -carotene, C and E, which protects the body from damage caused by excess free radicals. At the range of dry cereals developed standards organization and technological instructions on their manufacture.

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J21510-002

Nesterenko T.N.¹, Nesterenko O.N.²**EFFECT OF HYDROMETALLURGICAL PREPROCESSING OF SURFACE OF TITANIUM ALLOYS CHIP ON CHOICE OF RECYCLING TECHNIQUE**¹Zaporozhye State Engineering Academy²Zaporozhye Machine-Building Design Bureau Progress State Enterprise named after Academician A.G. Ivchenko (SE Ivchenko-Progress)

Abstract. Research results of formation conditions, composition and structure of oxidic films formed on chip surface of titanium alloys VT1-0, VT3-1, VT23, TS6 at short-time oxidation on air at temperature 700 °C are given. It is shown that the etching solution composition influence on the structure, morphology of chip surface after oxidic film removing and at choice of processing technology of deoxidated titanium chip.

Key words: oxidic film, chip of titanium alloys, hydrometallurgical deoxidation.

Introduction. The most widespread type of oxidated titanium scrap is chip, which is formed during a mechanical treatment of ingots and half-finished products and is subject to recycling.

The greatest part of chip appears in the oxidated state since the titanium at the heating inevitable during its treatment, reacts with oxygen of air. Thus titanium absorbs some quantity of nitrogen also. Utilization of the oxidated scrap in a charge for melting of ingots results to loss of titanium plasticity in these ingots and receipt of defective half-finished products. An off-grade scrap in form of the oxidated titanium chip, which surface is painted in interference colours (temper colours), involves in the turn of metallurgical titanium by means of multiphase and expensive technologies or at all output from its [1-3]. Production of titanium dioxide, processing to titanium slag, chlorination – reduction, electrolytic affinage, thermal affinage, melting of the secondary titanium alloys, hydrogenation – dehydrogenation, calcium thermal deoxidation are taken to the first group of technologies. The chip use in iron and steel industry (for manufacture of ferrotitanium, for deoxidizing effect and alloying of steels), production of ligatures for modification of aluminium alloys, manufacture of titanium carbides, nitrides and silicides are taken to the second group of technologies. The variety of processing methods of the oxidated titanium chip testifies to absence of rational scheme of its use.

As off-grade chip is of high quality titanium covered of oxidic film for chip transformation on a suitable metal and for giving back the titanium turn it is necessary to remove an oxidic film from a chip surface. Therefore researches of composition and structure of metal titanium surface layers will allow to find out an essence and features of oxidic films removing from a surface of the oxidated titanium chip and to choose subsequent its recycling technology.

Research task – to study the formation conditions of oxidic films on a titanium chip surface, to investigate the structure and composition of oxidated chip surface layers before and after oxidic films removing from its surface for the choice of processing technology of deoxidated titanium chip.

At oxidation on titanium chip surface two saturated oxygen layers are formed. There are dross and gas-saturated layer which is under it. Surface oxidated layer is named of "oxidic film" at a comparatively small thickness and "dross" at a large thickness. A gas-saturated layer is an oxygen-rich surface layer of metal. The oxygen content in it decreases from a surface into metal.

The oxidic films formation on a surface of titanium chip and their dissolution in a metal is the difficult physical and chemical process. A lot of factors influence on formation of dross: temperature and duration of oxidation, gas environment and its components, alloy composition, state of its surface, sizes of wares and other.

Materials and methods. For the study of influence of air access to the surface which is oxidated as the object for tests the VT1-0, VT3-1, VT23 and TS6 titanium alloys chip with sizes (25–30)x(6–10)x(2–3) mm is chosen. The chip samples are washed from rests of cutting emulsions and lubricating liquids in soda phosphatic solution, oxidated under equal terms in a tube electric furnace with changing speed of air supply. As a titanium chip is formed at mechanical treatment of ingots and **half-finished products** at temperatures 700 °C and higher, a dross which is flake appears on its surface at temperatures higher 800 °C the chip oxidation is executed at temperature 700 °C during 20 min.

The researches of oxidated chip microstructure are performed on the metallographic samples treated with an etching solution and without it by the microscope MIM-8M. The metallographic samples have been made in cross-section of oxidated chip, were mechanically polished and then etched in a mixture of water solutions of HF and HNO₃.

The microhardness of metallographic samples is measured by the Wickers method on the device PMT-3 at loading of 0,5 N on indenter. It is measured in direction from chip layer adjacent to cutting tool and toothed surface into chip depth.

The surface X-ray phase analysis is carried out by diffraction patterns received at CuK α -radiation by diffractometer DRON-0,5.

The oxidic film detaching from the chip surface is executed by etching in water solutions of HCl with addition of NaF for the electron diffraction study of their structure by passing method. The electrogram survey is obtained by electron microscope OMB-100A with constant 28,44 at the accelerating voltage of 75 kV. The researches of titanium samples surface are performed by electron Auger-spectroscopy method on the Ribber corporation LAS 2000 spectrometer at the accelerating voltage of 5 kV and electron probe diameter of 3–5 microns. Auger-spectrums are registered in a differential mode (dN/dE) at detector sensitivity of 2,5 mV, time constant of 0,3 sec, spectrum sweep speed on energy of 1,2 eV/sec. The level-by-level analysis through the sample thickness is fulfilled by argon ion beam dispersion with energy of 4 keV to surface. The morphology study of toothed chip surface is carried out by electron microscope MER-2 with resolution capability of 0,01 microns.

Results and discussion. It is established as a result of the researches carried out by us, that air access to an oxidated surface influences also the oxidic films formation on the titanium chip surface under equal terms (temperature, oxidation time). So oxidation at the hindered oxygen access to the chip surface causes to formation of yellowish colour film for α -titanium alloys (VT1-0), of maize yellow (VT3-1) and

yellow (VT23) colour films for α + β -titanium alloys, of dark yellow colour film for pseudo- β -titanium alloys (TS6). At an oxygen free access the oxidic film is painted in violet colour for α -titanium alloys (VT1-0), in violet-blue (VT3-1) and dark blue (VT23) colours for α + β -titanium alloys, in blue colour for pseudo- β -titanium alloys (TS6). Observable regularities in films colouring are possibly conditioned by difference of oxygen diffusion coefficients in α - and β -titanium, with influence an alloying elements on alloys oxidation also.

The oxidic film with thickness less than 0,03 microns is transparent, therefore the oxidated titanium surface has silvery-grey colour, i.e. colour of initial metal [4]. At the film thickness of 0,03–0,20 microns the sample surface is painted in interference colours. For example, at yellowish colouring of sample surface the oxidic film thickness is about 0,033 micron, at violet-blue colouring it is about 0,051 microns. At the bigger thicknesses the oxidic film become bright grey colour (at film thickness in 0,200–0,270 microns), then frosted grey colour (at film thickness in 0,270–0,300 microns) and at last white colour (at film thickness over 0,300 micron). Therefore the titanium surface colouring is used for thickness determination of oxidic films of the sample.

The dross structure on metal surface is closely joint with an oxidation kinetics. The crystal structure of the oxides forming a dross, and the defects of this structure determine diffusive permeability of layers. At air oxidation the titanium surface is covered by oxidic films of the following composition: at temperature 350 °C there is titanium monoxide, at temperatures 400–450 °C titanium monoxide completely turns in titanium dioxide in the forms of anatase and rutile, at temperature about 500 °C an anatase disappears and rutile remains only [4].

After long-term oxidation of the titanium at temperature higher 800 °C formed dross consists of external, average and internal layers. The dross layers have different morphology and mainly consist of nonstoichiometric rutile [4,5]. The friable intermediate layer which consists of oxides mixture TiO₂ with TiO, Ti₂O₃, Al₂O₃ and alloying elements (Mo, V, Sn and other) also in case of alloys oxidation can located between rutile and gas-saturated layer. A dross easily separates from metal. The gas-saturated layer has two areas which differ of oxygen diffusion coefficients in α - and β -titanium. At heating of titanium higher 1100 °C in dross there is titanium nitride which amount is decreased as far as deepening in dross.

For short-term (to one hour) oxidation of titanium at temperature less than 800 °C the oxidic film formation with constant content of rutile is characteristic. In this connection the oxygen concentration in it is near to 40 % [4,5]. The film is directly above gas-saturated layer and is strong joint with metal. In the indicated terms the friable intermediate layer from titanium monoxide is not formed, the titanium nitride is absent in oxidic film.

For microscopic researches the TS6 alloy chip with the maximal thickness of oxidic film according to interference colouring is chosen. The oxidic film microscopical analysis is shown the presence of thin light film in different places of both surfaces – plane which contacted to a cutter and toothed (fig.1 a). The oxidated chip microstructure consists of α - and β -phases of titanium. Both on thickness and on height of chip a structure is non-uniform.

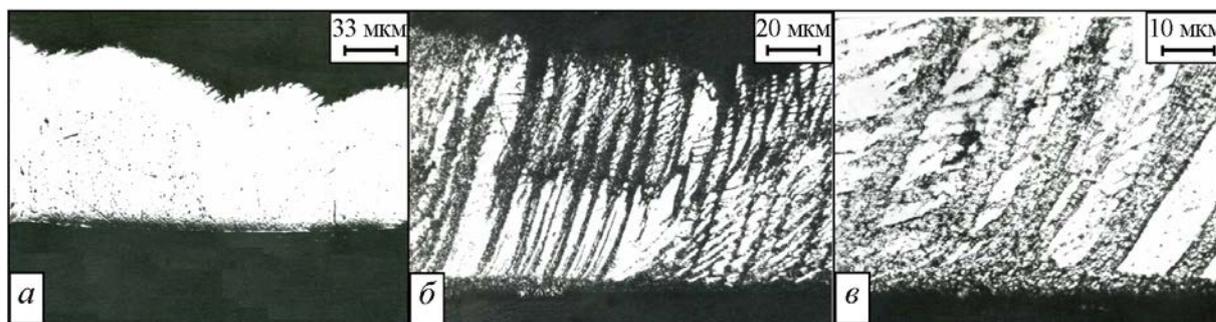


Figure 1. The oxidic film (a) and microstructures on oxidated chip section (b, c)

Along chip length the microstructure is characterised by alternating zones. There are a zone of stable β -phase (light areas in fig.1 b, c) and a zone of β -phase which has exposed to disintegration with the separation of α -phase disperse particles (dark areas). At the chip surface continuous zones with disintegration structure are observed (fig.1 b). At the surface which contacted to a cutter, such zone spreads deep into its cross-section approximately to identical depth (about 0,01 mm) along chip length. At toothed chip surface the zone depth is non-uniform, it is bigger in hollows often. The reason of nonuniform structure of oxidated chip probably is deformation heterogeneity on chip section. Zones of β -phase disintegration which have the bigger degree of deformation in it stimulate the disintegration process.

The microhardness of structure different zones of oxidic chip is distributed thus. The largest values of microhardness are available in the $\alpha+\beta$ -structure zone that more worked at the surface which contacted to a cutter. On the average a microhardness in such zones is 3,9 GPa. In the zones of analogical phase structure further on section the microhardness is equal 3,8 GPa, in zones of stable β -phase it is 3,1 GPa.

The phase structure of oxidic films at the free and hindered air access at oxidation is studied by electron diffraction analysis and with the Auger-spectroscopy application. By the calculation electrogramms it is determined, that oxidic film on examined alloys (VT1-0, VT3-1, VT23, TS6) samples of completely consists from titanium dioxide in rutile modification. The terms oxygen access to chip surface at oxidation do not influence on phase composition of oxidic films. The elektrogramms of oxidic films formed at surface of the VT23 titanium alloy chip at the free and hindered air access at oxidation are shown in fig.2. The elektrogramms have a considerable background which is caused by incoherent electron dispersion from oxidic films.

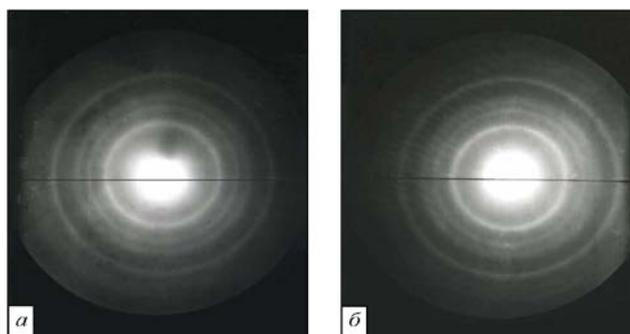


Figure 2. The elektrogramms of oxidic film of yellow (a) and blue (b) colours formed at surface of the VT23 titanium alloy chip

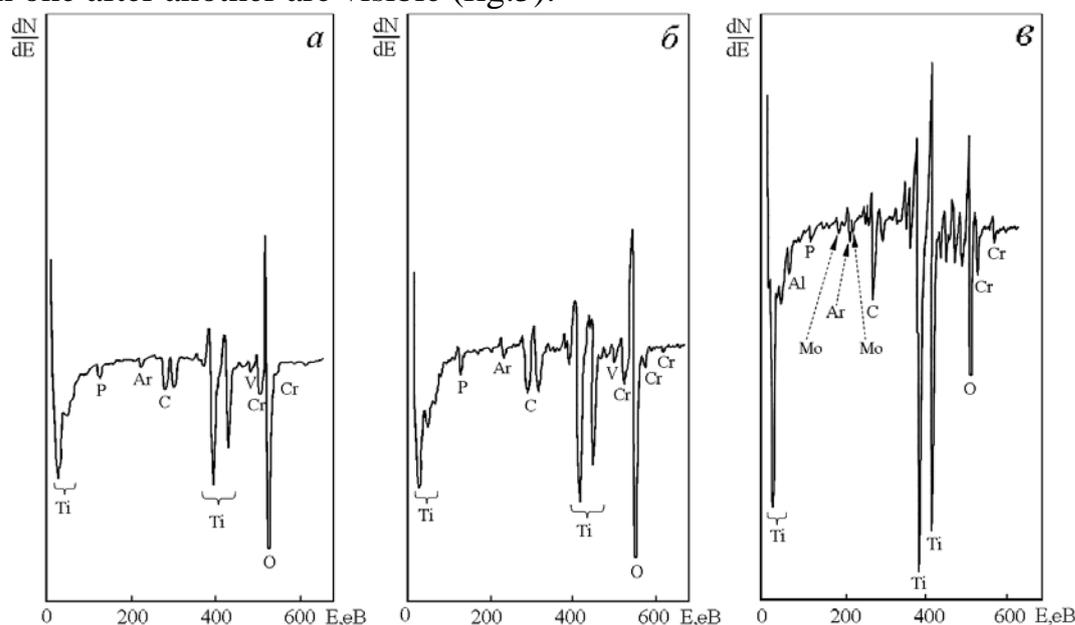
By researches of oxidic film structure by Auger-spectroscopy method also it is defined, that the film consists of titanium dioxide and is directly above the metal gas-saturated layer. By the element analysis of oxidic film it is pointed to the atomic concentration ratio of oxygen to titanium is equal 1,98:1, i.e. $TiO_{1,98}$. The thicknesses of oxidic films on the oxidated titanium chip of yellow and blue colours are 0,035 and 0,048 microns accordingly. The calculated thicknesses of oxidic films are close to the film thicknesses values defined by interference colouring of titanium samples.

The results of the analysis of elements distribution to chip depth with application of the ion sputtering are given in fig.3. The oxidic films of yellow and blue colours formed at surface of the VT23 titanium alloy chip at oxidation with the free and hindered air access in element composition are identical.

Phosphorus and carbon presence in surface oxidic film (yellow and blue colours) is related to degreasing in a soda-phosphatic alkaline solution. These components are present in the metal layer and the polymolecular layer physically adsorbed gas at the unoxidated chip surface also (fig.3 B).

The results of morphology researches of chip toothed surface with the Y-modulation by scanning electron microscopy method are given in fig.4 and fig.5.

The oxidated chip has more developed surface with the high Y-modulation coefficient in comparison with unoxidated chip. At the surface of yellow oxidated chip an oxidic film discharges as cloud-like deposits is visible (fig.4). In the photo of blue oxidated chip surface it is well visible the dense oxidic film as stratifications on corresponding relief of the chip surface. Also small crystals of rutile located on a chain one after another are visible (fig.5).



a – the oxidated blue chip (ion sputtering at the depth 0,016 micron);
b – the oxidated yellow chip (ion sputtering at the depth 0,014 micron);
B – unoxidated chip (ion sputtering at the depth 0,005 micron)

Figure 3. The analysis of elements distribution at VT23 alloy chip surface

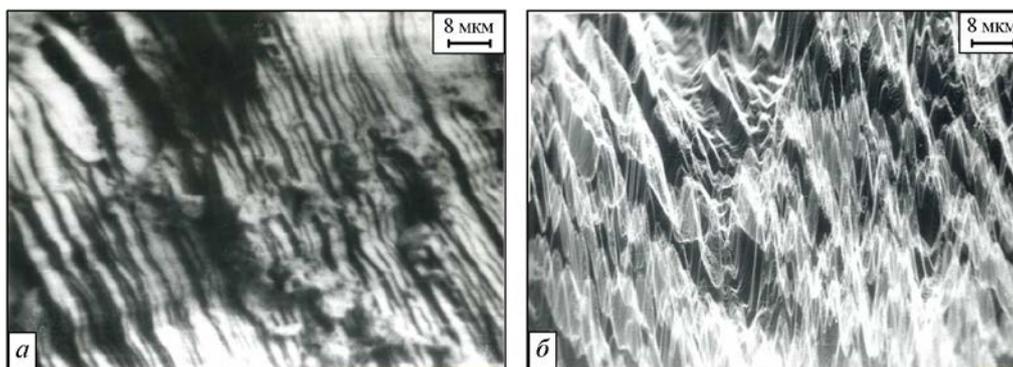


Figure 4. The microphotograms of the yellow oxidated chip surface in the scanning (a) and the Y-modulation (b) modes

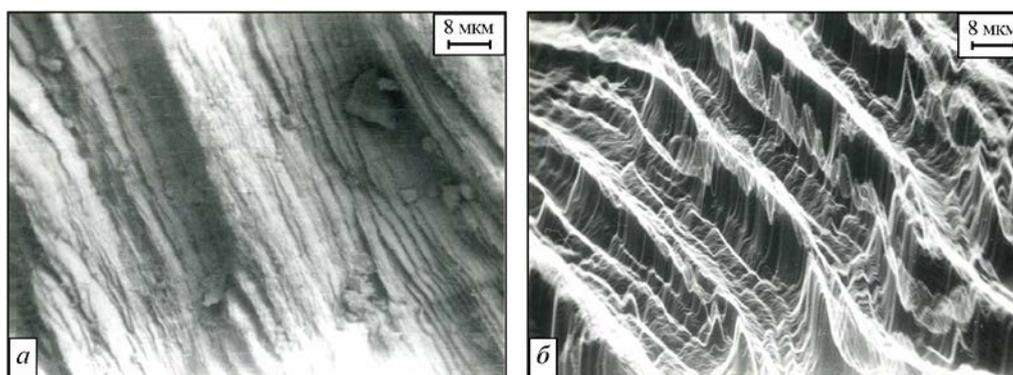


Figure 5. The microphotograms of the blue oxidated chip surface in the scanning (a) and the Y-modulation (b) modes

At oxidation the terms oxygen access to titanium chip surface do not influence phase composition of formed oxidic film and change the film thickness only.

The hydrometallurgical deoxidation of oxidated titanium chip at which film mainly removes as result of etchant penetration through heterogeneities and imperfections of oxide structure is enough simple and efficient at a proper choice of reagents. The film destruction occurs by layer detachment at the etching of metal backing.

As the base of etching solution it is chosen 10 % HCl solution with additive of NaF named the chloride-fluoride solution then. The chloride-fluoride solution (the A-solution) and chloride-fluoride solution with additive of H₂O₂ (the B-solution) are applied to investigate of composition, structure and morphology of chip surface after oxidic film removing.

In accordance with the X-ray phase analysis data the phase composition of TS6 alloy chip after etching in A-solution is presented one β -phase. The microstructure analysis points mainly one phase also, but the presence of the second α -phase is possible as a result of dispersity and because a negligible quantity of this phase is not found the X-ray phase analysis (fig.6 a, b).

Disappearance of the explicit zones of β -phase disintegration in the cleaned chip structure is caused the hydrogen absorption by metal at etching probably. The hydrogen being an β -stabilizer increases the β -phase amount and assists its stability.

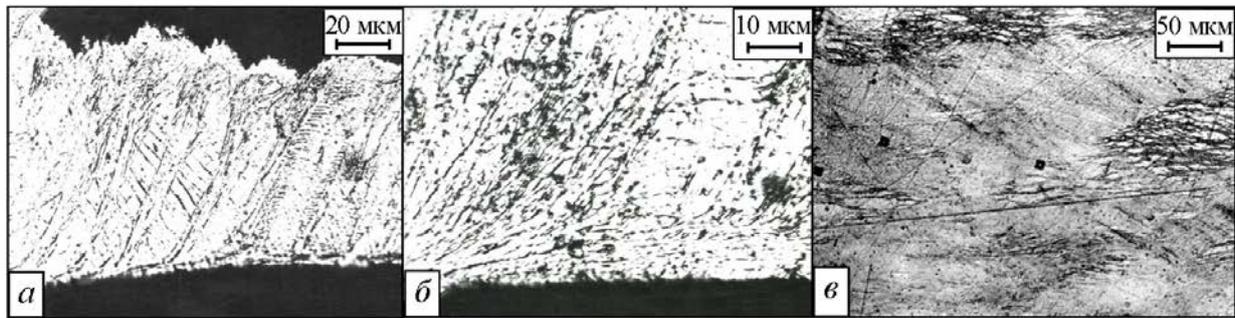


Figure 6. The microstructures of the titanium chip after deoxidation in the A-solution (a, b) and the B-solution (c)

The higher microhardness in all of chip section is also related to the hydrogen saturation of metal. The microhardness is on the average 4,5 GPa at the toothed surface and it is 4,2 GPa in the rest of section (a hydrogen absorption at the toothed surface could be more intensive as a result of less dense of oxidic film). The hydrogen absorption of titanium alloys depends both the etching terms (temperature, **etching solution** composition) and a structure, phase composition of alloy.

The chip microstructure after etching in B-solution is mainly presented the β -phase (light areas in fig.6 b). The zones with β -phase disintegration products which consist of disperse α - and β -phases mixture are also present. Appearance of these zones is caused the mechanical treatment terms of titanium **half-finished products**. The microhardness is on the average 3,0 GPa at the toothed surface and 2,5 GPa in the zones of stable β -phase (a core). The reduced microhardness values (in comparison with the microhardness values of chip samples after **deoxidation** in A-solution) is explained the soft etchant using and the surface oxidic film removing without excess etching and hydrogen absorption by metal.

The results of morphology researches of VT23 alloy chip surface after etching with the Y-modulation using by scanning electron microscopy method are given in fig.7 and fig.8.

The morphology of chip surface after etching in the A-solution is changed in comparison with morphology of unoxidated chip surface. The smoothed grooves of primary morphology are covered by a protective layer formed the etching products. Micropores observed on the surface, partially opened microflaw in the form of “wart cress” and also etching bubbles aggregations are the characteristic signs of the hydrogen saturation of titanium (fig.7 a).

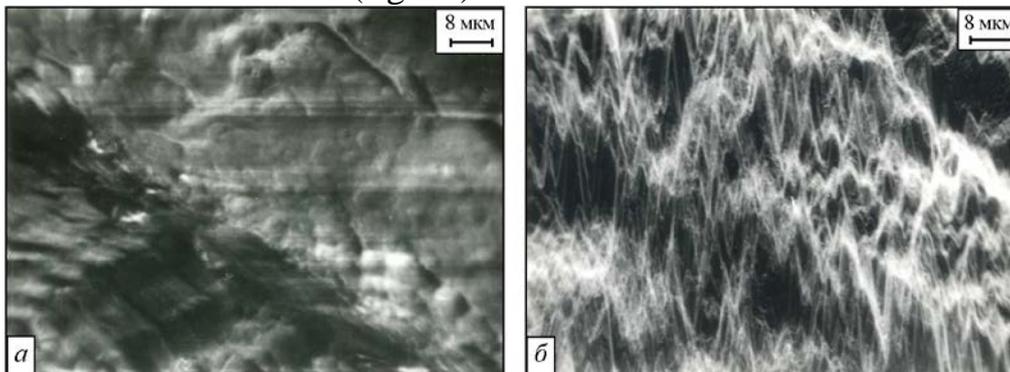


Figure 7. The microphotograms of chip after etching in the A-solution in the scanning (a) and the Y-modulation (b) modes

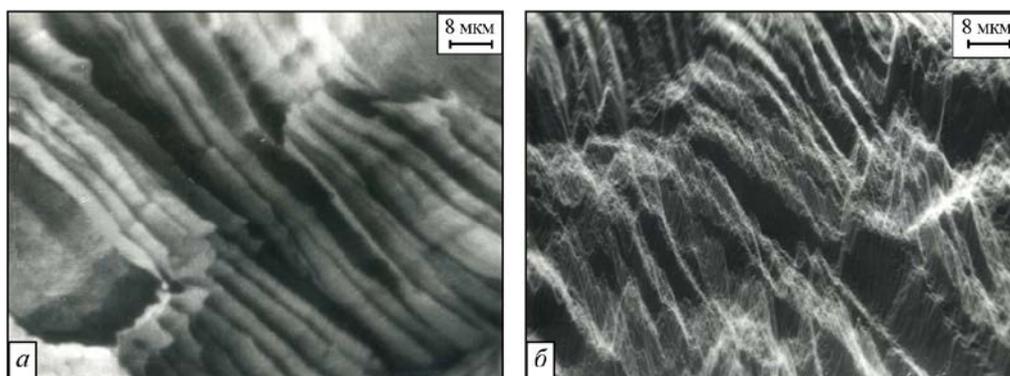


Figure 8. The microphotograms of chip after etching in the B-solution in the scanning (a) and the Y-modulation (b) modes

The chip after etching in B-solution has more homogeneous surface that means the uniform removing of oxidic film (fig.8). The surface such chip is corresponding of unoxidated chip by the morphology. The present deepening is related to the surface damage with extraneous including (fragment of concrete or gravel) which was separated during the titanium etching.

Conclusions

1. The oxidic film formed at surface of titanium alloy chip consists from titanium dioxide in the rutile modification and is directly above the metal gas-saturated layer. The colouring of oxidated chip surface is defined thickness of oxidic film. The thicknesses of oxidic films that are formed at the same oxidation terms at surface of titanium alloy chip depend on the phase composition of initial metal.
2. Prior hydrometallurgical treatment of oxidated titanium chip in chloride-fluoride solution without and with the hydrogen peroxide additive does not change a metal microstructure.
3. The deoxidation of oxidated titanium chip in chloride-fluoride solutions allows to use the chip as raw materials for the powders production by hydrogenation – dehydrogenation method. The hydrogenation can be combined with the hydrometallurgical treatment. A titanium chip after hydrometallurgical deoxidation in solutions with the variable acidity can be sent for melting of titanium alloys ingots.

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Skuibida O.L.

RECYCLING AS A WAY TO SOLVE ECOLOGICAL PROBLEMS OF ALUMINUM PRODUCTION

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Abstract. *Main ecological problems associated with the process of electrolytic aluminum production are described. Obtaining of primary aluminum is accompanied by depletion of natural sources, deterioration of health of population, development of occupational diseases of employees of aluminum enterprises, environmental degradation due to harmful ejections and accumulation of solid wastes. Recycling of metal wastes and scrap of aluminum alloys allows to eliminate and reduce the risks of aluminum industry with high efficiency. Thus the amount of emissions of harmful substances into the atmosphere are reduced significantly, compounds without class of danger or related to 3-4 classes are used, power consumption and expense of non-renewable raw sources are decreased.*

Keywords. *Recycling, aluminum, electrolysis, secondary alloy, danger, occupational disease.*

Introduction. Relatively high level of structural and operating properties leads to extensive use of aluminum alloys in a plenty of industries - mechanical engineering, electrical engineering, shipbuilding, aerospace, food processing, construction, etc. Aluminum has light weight. For example, aluminum parts are three times lighter than the steel parts of the same size. In specific strength aluminum alloys are not inferior the number of carbon and alloy steels. Aluminum alloys have a high corrosion resistance in air and in a medium of many liquids and gases. They have a high resiliency and do not embrittle at low temperatures. Aluminum is a good conductor of electricity and heat. By volumes of use of aluminum takes the second place after steel today. Thus, replacement of one kilogram of steel on one kilogram of aluminum alloy in automobile construction decreases the overall consumption of 8.5 liters of gasoline and emission of carbon dioxide of 20 kg [1]. A capability of aluminum to compete with steel, cast iron, copper alloys, plastics and concrete is provided mainly by one important feature - the ability to be recycled. When appropriate technologies are used once obtained from the ore materials aluminum can be repeatedly melted and used to make new products.

Due to the constant increase of production of products made from aluminum alloys and the accumulation of scrap and waste, there is a world problem use of secondary raw materials. This question is particularly relevant for Ukraine, which has developed aluminum-consuming alloys (missilery, aeronautics, automotive, civil and industrial building), but lost its own production of aluminum. Main disadvantages of secondary aluminum alloys are lowered technological and mechanical properties due to contamination of harmful impurities of iron, oil, plastics and others.

Basic Material of the Research. Production of aluminum from ore raw materials has the negative impact on the environment, which is related to the release of harmful gases and the accumulation of solid waste. When alumina from bauxite is obtained "red sludge" (solid waste based on silicates and metal oxides) is formed.

During electrolysis of alumina the greatest amount of harmful gases is allocated.

Acutely toxic sludge contains 25...70 % of carbon, 6...16 % of fluorine, 4...10 % of aluminum, 6...19 % of sodium, up to 1% of cyanide and other components. Sludge processing is not exposed and stored in significant quantities in landfills. Production of one ton of aluminum oxide is accompanied by the release of 360... 800 kg of sludge. Today the world has accumulated tens of millions of tons of such waste. At the same time achievement a perfect waterproofing of sludge fields is almost impossible, which adversely affects on ecological situation.

In the preparation process of aluminum fluoride and cryolite environment is polluted with gaseous HF, which is converted to a corrosive hydrofluoric acid. The atmosphere is also contaminated with the connection CF_4 , related to greenhouse gases. Participation in the biochemical processes CF_4 does not accept; its lifetime in the atmosphere is 2600...5000 years. Warming potential for CF_4 is in 6500 times bigger than that for CO_2 , which results in a strong influence on the temperature of the planet. Solid fluorides and sulfur dioxide negatively affect on flora, in particular covering of needles. When interacting with oxygen, sulfur dioxide is oxidized to SO_3 , which contributes to acid rains. Over the last few decades, the acidity of rain water increased to 40 times.

According to [2] the level of occupational diseases of workers reaches 43.8 cases per 10,000 people, which is almost three times bigger than the level of occupational diseases in steel industry. The stuff of electrolysis sections is affected by fluoride compounds, coal tar products, magnetic fields, infrared light, unsatisfactory climate conditions, physical load, etc. The penetration of harmful substances into the human body predominantly occurs via the respiratory tract, at least - by skin and the gastrointestinal tract.

The solids in the electrolysis have the form of dust containing Al_2O_3 , Na_3AlF_6 , AlF_3 , NaF and so on. Prolonged contact with dust alumina (Al_2O_3) may cause chronic illness of respiratory tract, leading to changes in the lungs - pneumoconiosis, fibrosis, etc. The main components of the electrolyte are cryolite $3NaF \cdot AlF_3$, aluminum fluoride AlF_3 , sodium fluoride NaF , calcium difluoride CaF_2 , lithium fluoride LiF and magnesium difluoride MgF_2 . Cryolite worsens blood composition, leads to diseases of bones and teeth. Aluminum fluoride adversely affects the circulatory system. Sodium fluoride is poisonous, toxic, it affects the central nervous system. Calcium difluoride impairs the blood, affects the proteins in the human body. In acute poisoning CaF_2 affects the central nervous system and gastrointestinal tract. With long-term effects of lithium fluoride and magnesium fluoride fluorosis appears.

Such compounds as CO , CO_2 , HF , SO_2 , SiF_4 as gaseous substances during electrolysis are emitted. Carbon oxide (over 80% of the total emissions) may change blood composition and lead to asphyxia, consciousness loose, convulsions. Carbon dioxide increases blood pressure, causing dizzinesses and syncopes. Hydrogen fluoride affects the mucous membranes, causing bleedings, ulceration of the respiratory tract, nasal bleeding, pulmonary edema, purulent bronchitis, asthma, laryngeal spasm, convulsions, damage to the heart muscle, fluorosis, etc. Consumption of fluorine compounds with the production of 1 ton of aluminum

reaches 20 ... 45 kg [3]. Silicon tetrafluoride causes irritation of eyes, nose and respiratory tract. Sulphur dioxide irritates mucous membranes, causing a dry cough, burning and sore throat, and affects the lungs.

It should be noted that obtaining of 1 ton of aluminum from ore materials about 3.0... 3.5 kg of CO, 11.0... 12.0 kg of NO₂, 6,5 ... 7,5 kg C_nH_{2n+2}, 2590 ... 2650 kg of (CO + CO₂), 2.0...2.5 kg of organic acids, 5.5...6.0 kg of carbon black [4]. Nitric oxide leads to decrease of blood pressure, headaches, dizziness and other ailments. When released into the atmosphere NO₂ contributes to the destruction of the ozone layer. Hydrocarbons C_nH_{2n+2} cause drowsiness, dizziness, breathing and circulation. When released to the atmosphere C_nH_{2n+2} forms photochemical fog or smog.

Working conditions at workplaces in electrolysis, anodic and casting sections are regarded to the 3rd class. As a result of exposure of harmful substances musculoskeletal system of employees of enterprises for production of primary aluminum is hit, chronic lung diseases, allergies and dermatitis occur. Numerous data indicate that emissions of aluminum production cause catastrophic damage to human health and its progeny. Growing tumors, endocrine system diseases and mental disorders are observed.

According to the research [5] the risk of chronic intoxication related to toxic substances pollution of air connected with aluminum production in the area of living and working areas air was 0.344 ... 0.408. The total cancer risk associated with air pollution of workspaces at aluminum plant and air of the city for one person was $2,89 \cdot 10^{-5} \dots 3,25 \cdot 10^{-5}$, which significantly exceeds the acceptable level of lifetime risk ($1 \cdot 10^{-5}$).

Remelting of aluminum helps to reduce the negative impact on the production staff and emissions of harmful substances into the environment significantly. It is accompanied by decrease of outlays of raw materials and energy. According to various sources for the production of secondary aluminum in 2,5 ... 6,0 times less raw materials should be used compared with the primary metal. Production of 1 ton of aluminum from ore requires the expense of 13,000 ... 16,000 kW/h of electricity, whereas the remelting of scrap and waste requires the expense of about 200 ... 550 kW/h only. Receive of 1 ton of recycled aluminum allows to save nearly 4 tons of bauxites, 700 kg of coke and reduce harmful emissions (including CO) on 35 kg [6]. Thus the cost price of aluminum alloys is reduced by 25 ... 50 %.

World leaders of use of recycled aluminum are the United States, Japan, Germany, France and Italy. To date, the EU produces about 5.1 million tons of primary and 5.2 million tons of secondary aluminum alloys per year. Motor vehicle contains on average more than 120 kg of aluminum, 60% of which refers to secondary. The terms "primary" and "secondary" increasingly characterize the source of the alloy, but not the quality of the metal itself.

Conclusions

Nowadays aluminum and its alloys are among the most claimed and promising structural materials. Light weight, high corrosion resistance, electrical and thermal conductivity, processability, strength and plasticity, and ergonomic characteristics of products from aluminum alloys cause their widespread use in mechanical engineering, food processing, electrical engineering, architecture, etc.

For production of aluminum alloys as mineral as secondary raw materials are used. Electrolytic method of producing of aluminum from alumina provides an output of high quality, but is associated with a number of disadvantages – exhaust of natural resources, occupational diseases of employees of aluminum industry, emissions, deterioration of health, accumulation of waste products, etc. Emissions of harmful substances into the atmosphere cause the greenhouse effect, destruction of the ozone layer, acid rains, photochemical fog, etc. Employees of aluminum plants suffer from chronic lesions of the respiratory tract, musculoskeletal system, poisonings, allergies and dermatitis. The population of industrial regions with electrolytic aluminum production lives at increased risk of cardio-vascular diseases and cancer.

Mainly to solve these problems allows the recycling of scrap and waste. There is an economy of energy resources near 80 %, decrease of emissions by 95 % and reduce of water pollution about 95 % [7] for production of secondary aluminum alloys. Besides scrap and waste products, which are used for recycling, otherwise, would be placed in landfills and special burials, which would lead to the degradation of natural ecosystems.

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POLICY OF SAFETY: TASKS AND DECISIONS*Poltava National Technical University named after of Yuri Kondratyuk*

Abstract. The problem question of policy of informative safety is in-process examined. A height of cyber crime is an engine to development of new directions and technologies in the field of defence and safety of information. It is direction of defence of programmatic foods, proactive protecting from harmful programs (task of defence to find out vulnerable places before hacker), defence of texts of internet pages, defence of bases given, control after the source of information and it is here impossible to do without the analysis of financial losses, volume, when an enterprise develops politicians of safety - it always individually, but classic theories and modern technologies are only for all. At development of any CAS development of policy of safety goes in parallel.

Key words: defence of programmatic foods, defence of bases given, politician of safety, cyber crime

Introduction. An analysis of security of the operating system (OS) is from the point of view of the system. The concept of the system consists not simply in creation of corresponding mechanisms of defence, but shows by itself the regular process carried out on all stages of life cycle of OS (for example, in obedience to a model «resources of the system are a violator»). OS must assist realization of safety measures or straight to support them. Examples of similar decisions within the framework of apparatus and operating system are a division of commands on the levels of privileges, protecting of different processes from a cross-coupling due to a selection each the virtual space, special defence of kernel of OS, control after the repeated use of object. A basic problem at defence and estimation of vulnerable places in the operating systems is access that will be realized at the level of user's control. In dependences on tasks, that needs to be decided by means of the computer system, the type of access that will be entered in the informative system control is elected. An error in the question of differentiation of rights between users can result in the source of important information, her distortion or complete loss. Lists of access control are one of possible methods of defence of informative resources in the operating system. As a number of users of the different off-line systems grow incessantly, the question of differentiation of their plenary powers becomes actual in the informative system. There are 2 types of lists of access control. The first works at the level of users and presents the mechanism of defence of resources, such as files and folders. The second type of access control is a system list of access control and control mechanism above reports to the public accountant that is related to the informative resource, etc. amount of successful and unsuccessful attempts of access. Work of lists of access control is based on creation of records of контроля access, in that the identifier of safety of user combines with the mask of access. The records of access control can how to allow so to forbid a right on the use of certain resource. Every record is kept in a database that is in the metafile of Secure of the file system NTFS (Windows NT and further). For development of the program, by means of that

the purpose of permissions will be realized to the resources of the operating system it is necessary to use API - function and library of classes .NET Framework, that contains space of the names of System security. Be available dependence of management of the programs safety is on the type of factors of danger. In differentiation of access to the objects of OS distinguish the discretionary (electoral) method of access control and plenipotentiary (capability-based). At discretionary access certain operations above a certain resource are forbidden or allowed to the subjects or groups of subjects. From the conceptual point of view current status of permissions at a discretionary management is described by a matrix there are the enumerated subjects in the lines of that, and in columns are objects of providing of security of the information placed in a computer environment (table 1).

Table 1

A table of permissions is to the resources

Объект \ Домен	F1	F2	F3	Printer
D1	read			
D2				print
D3		read	execute	
D4	read write		read write	

Analysing viral activity for 2013-2014 on the basis of appeals for service of technical support it was discovered: the use of the social engineering, use of vulnerability, appearance of the specialized threats. Analysing experience of exposure of vulnerability draw conclusion, that basic work assignment, it is verification of primary code of programs with a next certification. Using the multilevel system of defence, it is important to provide balance of reliability of all levels. If in a network all reports are coded, but the keys are accessible, then an effect zeroes from enciphering. And if in a network there is a device that analyses all entrance traffic and casts aside frames with a certain, in good time set reverse address, then at a refuse he must fully to block a net logon. Principle of only - admission mark point - all included in an intranet and weekend in the external network of traffic must to pass through the only site of network, for example gateway screen. In opposite case, when in a network there is an enormous amount of the stations of user, that have independent included in an external network, coordinate governed very difficult, that limit rights for the users of intranet at access to the servers of external network. Not a single system of safety guarantees the protection of data at the level of 100%, as it is the result of compromise between possible risks and charges. Determining politicians of safety, administrator of must to weigh the size of loss that can bear an enterprise as a result of violation of protection of data, and correlate it with the size of charges necessary on providing of safety of these data. It turned out that many users to this

day did not know basis of network safety. From it the social engineering (a management the actions of man is without the use of technical equipments) became the most popular tendency of 2013. Hackers actively used to vulnerability of platform of Java because it is one of the weakest elements in defence of the operating systems on that set. In light conceptions of cyber protection there is an issue of the day of violation in different countries issue of the day of violation of work of strategic objects, realization of network espionage, use of transit IP and erroneous proxy servers, no less important filtration at a net logon, clever use of firewalls, taking into account a presence "black boxes". A bank and financial sphere is not possible without network databases, here and problem of transactions and SQL - injection. In the theory of bases given integrity of data, it is correctness of data and their indisputable. Usually it also includes integrity of connections, that does impossible the errors of connections between a primary and secondary keys.

Conclusions.

The conducted analysis of potential threats and offered systems of protecting from them extend common maintenance of theory of defence. The safe informative system is the system that, firstly, protects data from an unauthorized division, secondly, always ready to give them to the users, and thirdly, reliably keeps information and guarantees invariability of data.

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RESEARCHES AND ANALYSIS OF PROBLEM OF APPROACHING OF VALUES OF PARAMETERS OF COMPUTER NETWORKS TO INTEGER

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Abstract. In the article we will consider the question of researches and analysis of problem of approaching of values of parameters of computer networks for the implementation of the complex of the informatively constrained tasks of the enterprise (establishments) to integer.

Keywords: complex of the informatively constrained tasks of enterprise (establishments), local computer network, methods of the nonlinear mathematical programming.

Entry. At planning of the system of automation of work of enterprise (establishments) a developer runs into the problem of providing of timeliness of decision of the urgent informatively constrained tasks, that have directive, objectively appointed terms of implementation and included in the complex of tasks that are decided within the framework of system of manage of enterprise (establishments) [1].

Optimization task [1, (1) - (7)] providing of timeliness of decision assumes determination for every task of complex of such possible terms of her implementation, that allow not only to decide this task within the borders of her directive intervals but also not violate at implementation the directive intervals of those tasks, that is related to this task informatively.

This task is put to the class of tasks of the nonlinear mathematical programming and characterized by large dimension. It is predefined of amount of tasks (what decide on a network and are in informative connection) and rarity of matrix of terms.

Review of literature. In the advanced studies for decision of tasks of the nonlinear programming of the large dimension it is offered generous amount of effective algorithms on principle of approximation approach, importance of that consists in that the decision of nonlinear task comes true as a result of decision of sequence of auxiliary tasks of the quadratic programming of more simple kind, than initial task.

The review of literature showed that method of linearizing [2] occupies among these methods the special place: it meets from any initial approaching, does not require strictly positive definiteness of matrix of second derivatives of Lagrangian and has a simple enough structure of auxiliary quadratic task.

In general case the method of linearizing has linear speed of convergence. However there are modifications of method [2, 3], for that (at the considerable large enough moving away from an extremum) speed of convergence is linear, and at a sufficient closeness to the decision - quadratic.

Basic text. As a result of decision of task that was set forth in [1], we got the value of powers of knots of network W_i , $i = \overline{1, N}$, and carrying capacity of communication channels λ_l , $l = \overline{1, L}$. A size W_i shows the amount of conditional

operations (units of labour intensiveness of decision of tasks of complex ω_i), that is necessary to be executed in time unit for providing of timeliness of decision of the tasks intended for treatment on knot i of network, that determines necessary power of knot i $\overline{W}_i = d \cdot W_i$, where d - coefficient of transition from conditional operations to the operations of power of knots (farther count $d = 1$).

A size λ_l shows the amount of bytes of information (units of volumes of information V_l , that is passed on a communication channel at an exchange), that must be passed in time unit, to execute all exchanges information for communication through network channel l in correct time. The scales of values of W_i and λ_l are discrete. Therefore is expedient to investigate possibility of approaching of values of descriptions of network to integer.

Will consider a next example that explains resolution of task.

Let at the decision of task of determination of descriptions the networks found W_i , $i = \overline{1,6}$, from that three are only integer (W_2 , W_4 i W_6), i λ_l , $l = \overline{1,6}$, from that also three are only integer (λ_2 , λ_5 i λ_6).

Will define through W'_p , $p = 1, 2, \dots$, power of knot p type (on a scale W) and through λ'_r , $r = 1, 2, \dots$, carrying capacity of communication channels r type (on a scale λ).

1. Will appropriate values $W_2 = W_3'$, $W_4 = W_1'$, $W_6 = W_5'$, $\lambda_2 = \lambda_2'$, $\lambda_5 = \lambda_4'$, $\lambda_6 = \lambda_6'$.

2. Will enter the next settings. Let J is a number of indexes of all tasks of treatment and information transfers that are decided in a network, $J = \{1, 2, \dots, n\}$.

And let J_m , $m = \overline{1,6}$, - indexes of tasks, that were distributed for implementation accordingly on 1, 3, 5 knots and 1, 3, 4 channels. J_m , $m = \overline{1,6}$, - subset of set J . Determine $J' = J \setminus \bigcup_{m=1}^6 J_m$.

Decide the optimization task of determination such t_j^H , t_j^K , that deliver minimum to the functional

$$C = \sum_{s=1}^Q \theta_{1s} \sum_{i=1}^6 \sum_{j \in J} \left(\frac{\omega_j \eta_{ji}}{t_j^K - t_j^H} \right)^{\beta_{1s}} + \sum_{k=1}^K \theta_{2k} \sum_{l=1}^6 \sum_{j \in J} \left(\frac{V_j \delta_{jl}}{t_j^K - t_j^H} \right)^{\beta_{2k}}, \quad (1)$$

at limitations

$$t_j^H \geq d_j^K, \quad j \in J, \quad (2)$$

$$d_j^K \geq t_j^K, \quad j \in J, \quad (3)$$

$$t_j^K > t_j^H, \quad j \in J', \quad (4)$$

$$t_j^K - t_j^H = \Delta t_j, \quad j \in \bigcup_{m=1}^6 J_m, \quad (5)$$

$$\bigcap_{j \in J_m} [t_j^H, t_j^K] = \emptyset, \quad m = \overline{1,6}, \quad (6)$$

$$t_j^K \leq \min_a \{t_a^H \mid H_a \in Y_j\}, \quad j \in J, \quad (7)$$

by analogy with the decision of task [1, (1) - (7)].

Here Δt_j is the known time of implementation of tasks that were assigned for

1, 3, 5 knots or 1, 3, 4 communication channels, $j \in \bigcup_{m=1}^6 J_m : \Delta t_j = \frac{\omega_j}{W_i}$, if z_j

is a task of processing of information, and $\Delta t_j = \frac{V_j}{\lambda_l}$, if z_j is a task of exchange

information, $i=1, 3, 5, l=1, 3, 4$.

As a result of work of algorithm get the values $t_j^H, t_j^K, j \in J$, of borders of mutually possible intervals of decision of tasks z_j .

3. On principle of observed $t_j^H, t_j^K, j \in J$, build the total partitions of loading of 2, 4, 6 knots and 2, 4, 5 network channels.

4. Carry out consistently the decline of maximal values of the specific loading of knots 2, 4, 6 and 2, 4, 5 network channels due to the redistribution of loading of transitional tasks from intervals of peak-loads on nearby intervals. For the decision of this task use the modified algorithm [3], that works by next rules:

1) if as a result of redistribution of loading of transitional task from the interval of peak-load of knots or communication channels, it will appear that it is necessary to enumerate the value of borders of mutually possible intervals of decision of tasks, that enter together with this task to the mutually constrained a set, that includes tasks with indexes $j \in J_m, m = \overline{1,6}$, then at a re-calculation take into account limitations (5), (6);

2) at correction of total partitions of load of knots and channels that arise up as a result of changes of values of borders mutually possible intervals of decision of tasks, take into account only distributions 2, 4, 6 knots and 2, 4, 5 communication channels.

5. Values $W_i, i=2, 4, 6, \lambda_l, l=2, 4, 5$, that were got in result smoothing of total distributions, check for integer on the scale of powers $W_p', p = 1, 2, \dots$, and on the scale of carrying capacity of communication channels $\lambda_r', r = 1, 2, \dots$. If it will appear at verification, that approaching is satisfactory, procedure is complete. In opposite case procedure recurs for those values W_i and λ_l , that are far from integer ones, other W_i and λ_l are appropriated values of those W_p' and λ_r' , to that they are near. The error of approaching δ will help to estimate the closeness of values W_i and λ_l to integer ones. It is inflicted a priori and is the function of such values, as:

- differences of divisions of discrete scales W and $\lambda - (W_{p+1}' - W_p'), p=1, 2, \dots ;$
- $(\lambda_{r+1}' - \lambda_r'), r=1, 2, \dots ;$
- costs of unit of power W and carrying capacity of channels λ accordingly p

and r types;

$$- \min_{i,p} |W_i - W_p'| \quad \text{and} \quad \min_{l,r} |\lambda_l - \lambda_r'|, \text{ where } W_i \text{ and } \lambda_l - \text{ values of powers}$$

of knots and channels that were got as a result of work of algorithm [3] and are datains for procedure of approaching of them to integer ones.

Procedure recurs until there will not be approached to integer ones all values W_i and λ_l . As a result of work can be folded, that some $W_i \rightarrow 0$, $\lambda_l \rightarrow 0$, $i = \overline{1, N}$, $l = \overline{1, L}$.

Conclusions.

1. A study of possibility of approaching is undertaken to the integer values of descriptions of computer network.

2. It is well-proven that the decision of the put task is arrived at as a result of frequent decision of task of determination of selective descriptions of network.

3. Exactness of decision is inflicted a priori and is the function of certain parameters.

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J21510-006**Abdulveleva R.R., Abdulvelev R.I.****COMPUTER PROGRAM MONITORING OF THE METHODOICAL
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Abstract. In work the computer program intended for monitoring of results of diagnostics of level of competence of future teacher of informatics in the field of the maintenance of a school course of informatics is considered. The program is created in the environment of Delphi, allows to carry out authorization, differentiates access rights of the teacher and the student, has access to the mode of diagnostics, training, statistics.

Key words: computer diagnostics of methodical competence, testing, monitoring of results of educational professional activity of students, competence diagnostics.

Quality management of training will be effective if the teacher owns means of receiving operational information about the level of knowledge of trainees. Methodical readiness of the teacher includes ability to carry out computer diagnostics of knowledge which allows to optimize process of expeditious definition of results of training, to carry out operational feedback, in due time to point out the defects of process of preparation and to react to them correction [1].

Implementation of monitoring of results of educational professional activity [2] of students initiates development of structure the program of diagnostics, requirements to measuring instruments and diagnostics procedures.

The computer program is developed with use of the visual environment of development of Delphi 7.0. As a database management system Microsoft Office S Access 2003 is used.

The main functions of the computer program are: authorization and differentiation of access rights of the teacher (administrator of system) and student; two operating modes. In regime of the administrator the teacher was given the following opportunities of the program: placement of the content of theoretical material, laboratory works, diagnostic tasks, additional materials according to the theory and a technique of training in informatics; viewing of results of diagnostics on each subject or on the certain student, studying of statistics of the received results. In the mode trained for students the program allows to study the content of theoretical material, a laboratory workshop on the chosen subject; to pass it is automated diagnostics on the chosen subject; to see the received results.

Formation of statistics on results of diagnostics happens on the following indicators: the best, worst results of diagnostics on each subject; results of diagnostics on the chosen subject of all students; the most active student (number of passing of diagnostics by each student).

When loading the program the window of inquiry of login and the password presented in figure 1 is displayed. The program allows to work in regime of the administrator and in the mode of trained (diagnosed). For each mode the login and the password is defined. It is made for the purpose of restriction of access to some

section of the program.

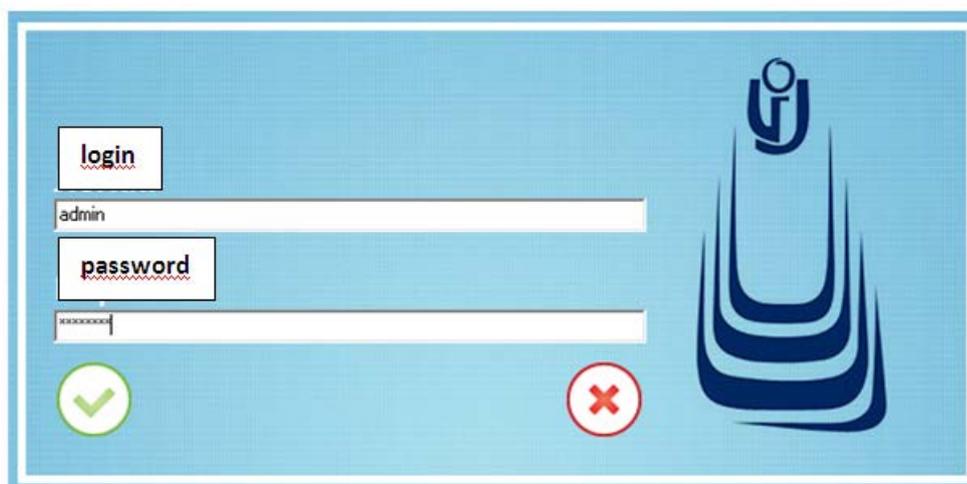


Fig. 1. Window of authorization of the user of the program.

Depending on the entered user of login and the password the form for work with the program in regime of the administrator of system (fig. 2) or a form for work with the program in regime of the student (fig. 3) opens.

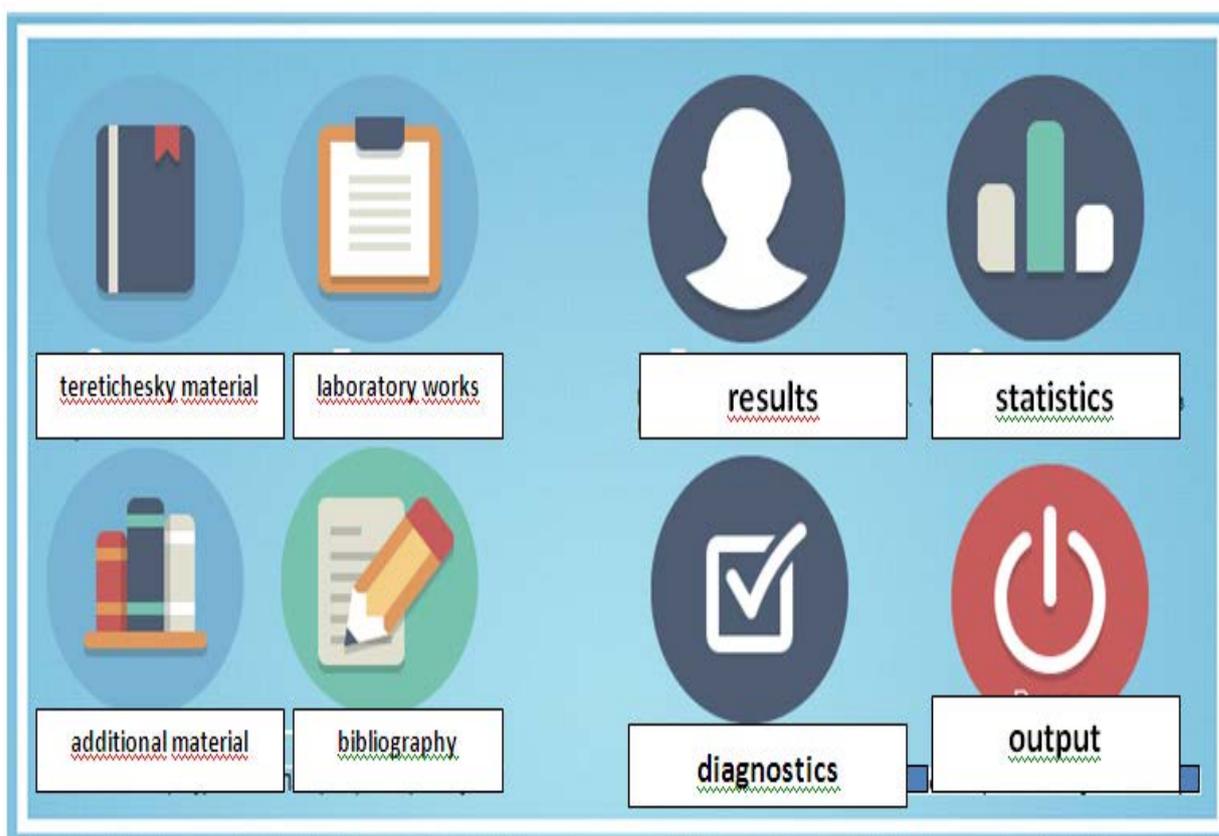


Fig. 2. A form for work with the program in regime of the administrator

Only the registered students can log in. Registration of the student is made by the administrator on the corresponding form.

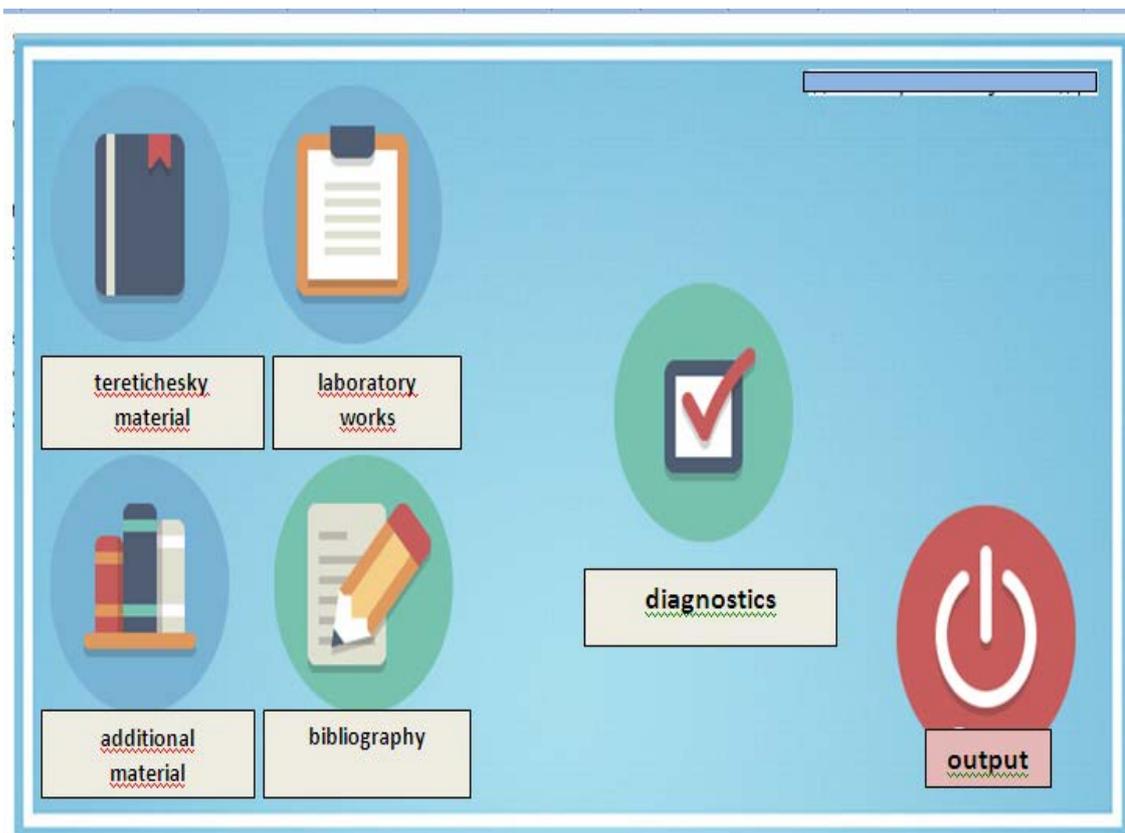


Fig. 3. A form for work with the program in regime of the student

Addition, removal or editing data on all forms is made by means of the corresponding buttons located on the lower panel of a form.

Pressing the Tests button on the main form the administrator causes the form allowing preparing diagnostic materials. On this form of the program the main sections of a school course of informatics contain: information, submission of information, logician, algorithmization, programming, information technologies, numeral systems.

On each subject tasks which decision allows judging the level of competence of future teacher of informatics [1] are developed. Complexity level in points is appropriated to each task. Quality of diagnostic tasks is checked by the administrator by means of the computer program [3].

The student pressing of the Testing button on the main form causes the Diagnostics Subject Choice form.

After a choice of dough and pressing of the Begin Testing button testing on the Test form begins. For a choice of the correct answer it is necessary to choose it from the list and to press the Following Question button.

After the answer to all questions the student receives the final message,

Diagnosed consistently questions on the chosen diagnostics subject are offered. For each correct answer various numbers of points is charged. The total number of the gained points, and also quantity of the correct answers is reported diagnosed after diagnostics passing. Results of diagnostics remain the program in a database for the subsequent analysis the teacher.

The student, in turn, can cause pressing of the Lectures and Laboratory Practical

Works buttons on the main form the forms of the same name available to it only for reading. For reading the necessary lecture it is necessary to choose a subject of lecture or a practical work, and then – the name of lecture or a workshop from the list on the chosen subject.

Any lecture and any practical work both in regime of the administrator, and in regime of the student, it is possible to unpack by pressing of the Press button then the corresponding text will be loaded into the document Microsoft Office Word.

On the Results form the administrator can adjust logins and passwords of students, to add new students. Not registered students can't log in. The list of the diagnosed students it is possible to unpack by pressing of the Press button.

In the form of "Statistics", given on figure 4, the following results are shown: the best results of passing of diagnostics on each subject; the worst results of diagnostics on each subject; results of diagnostics of all students on each subject; the most active student (number of passing of diagnostics by each student).

Pressing of the Tests button on the main form the administrator causes the Preparation of Tests form. On each subject there can be some questions, on each of which there can be some answers. The correct answers can be a little. At first diagnostics subject, then – a question on a subject and the list of possible answers is entered. Complexity level in points is appropriated to each of questions. The administrator can unpack the chosen diagnostics for students by pressing of the Press button then the corresponding text of dough will be unloaded in the document MS Excel.

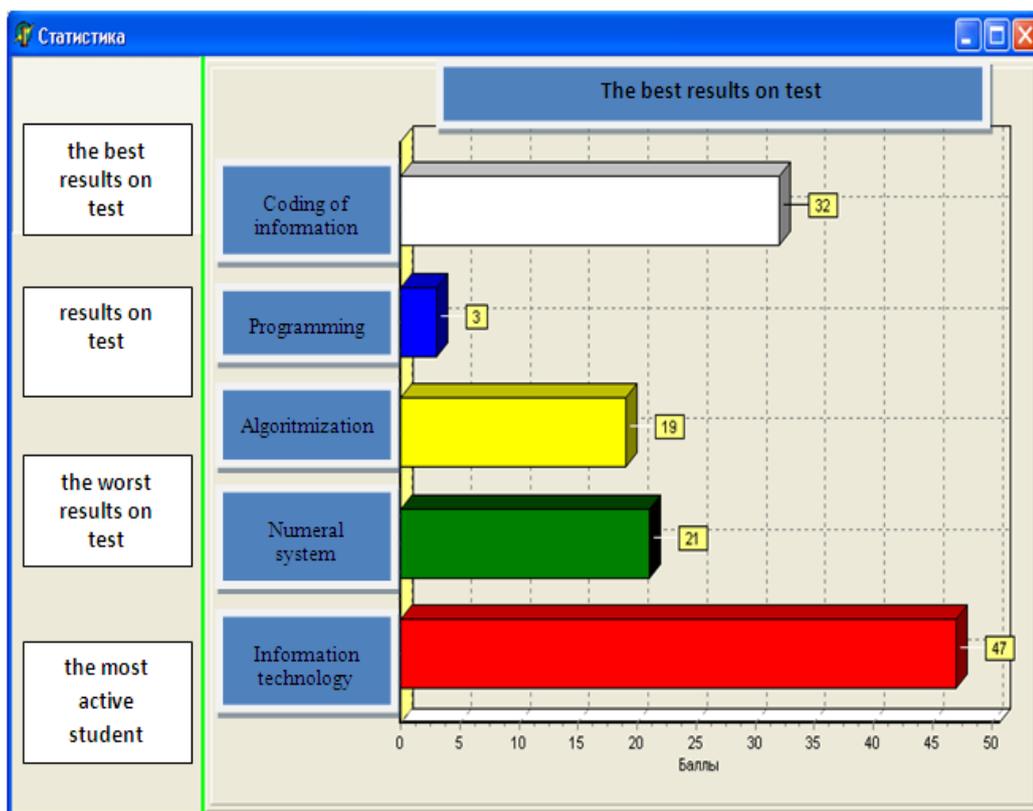


Fig. 4. Statistics form

Creation of any computer appendix demands a development well thought-out plan. The methodology of design includes a number of consecutive stages. Various charts of a look essence communication act as instruments of semantic modeling, one of them is ER – the chart (ER - Entity-Relationship).

In the system developed by authors it is possible to allocate the essence following: "Lectures", "Laboratory works", "Bibliography", "Answers", "Results", "Students", "Tests", "Subjects of tests", "Dictionary".

In the developed structure of a database the basic rules of integrity are considered. Identification of each essence is defined by a unique key therefore the system of external keys is developed. The database excludes the maintenance of uncoordinated values of external keys, it means that during the work updating of the connected fields happens to records consistently one after another and cascade removal of the connected records is carried out.

The program is event-driven. The structure of the program branching the event arriving from the user or generated by system carries out transition on each branch.

The minimum system requirements for MS Access 2000/2003/2008: Intel Pentium 300; Windows 95/98/2000/XP/NT; 128 Mb of random access memory; 100 Mb of disk space. Considering possibilities of modern computers, these requirements have declaration character. Microsoft Office Access ensures effective functioning on any modern personal computer.

The developed computer program is intended for diagnostics of methodical competence of the teacher of informatics, monitoring of the received results, the ranging diagnosed for the purpose of correction of process of the organization and the content of educational professional activity of students. A basic purpose of such programs improvement of quality of vocational training of students.

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J21510-007**Galushchak V.S., Bakhtiarov K. N., Kopeikina T.V., Petrenko S. A.,
Khavronichev S. V., * Samoilenko, Y. N., Holonijc B. A ******A MODERN DEVICE FOR REACTIVE POWER COMPENSATION****Kamyshinsky Technological Institute (branch) FGBOU VPO Volgograd State
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Introduction. The parameter characterizing the presence of reactive energy (power) in the network is a factor $\cos\varphi$ where φ is the angle between voltage and current. In General, the power factor is the electrical efficiency of the consumer. If your network includes a reactive current, power generator, transformer substations and networks is not fully used. With decreasing $\cos\varphi$ significantly increase the energy loss due to heating of wires and coils of electrical apparatus. Thus, the higher $\cos\varphi$ (ideally seeks to 1) of the consumer, the less power loss in the line and cheaper electricity transmission. Reactive current additionally feeds the power line, which leads to an increase of the cross wires and cables and, consequently, to increase capital expenditures on internal and external network. Reactive power along with active power is taken into account by the electricity supplier, and therefore shall be charged at current rates, therefore, is a significant part of electricity bills.

Industrial consumer in its activities on the use of electrical energy in production is limited by the energy supplying organization a number of regulations, with the requirements of the mandatory payment of the consumed reactive power in the electrical network 0,4 kV of consumer [1, p. 63]. Currently reactive power compensation the user is carried out with the use of expensive electrical equipment [2, p. 89]. At the same time, the emergence of a new light source is a solid - state led stimulated the complex development of energy-saving lighting devices with complex, not previously used, the power supply circuits of the lamps. Our researchers were tasked with creating energy-efficient led industrial lamp that serves as a stationary source of reactive power in the network supplying the lamp. As a result of such studies have been set up led light sources with the effect of reactive power compensation [3, 4]. Currently, several manufacturers produce led lamps for these schemes (figure 1) [5, 6].



Fig.1 Industrial led lamp "Bell" with the effect of reactive power compensation

Feature new lighting system embedded in the driver, supply led matrix lamp. Block diagram of the driver industrial lamp - source reactive power are presented in figure 2.

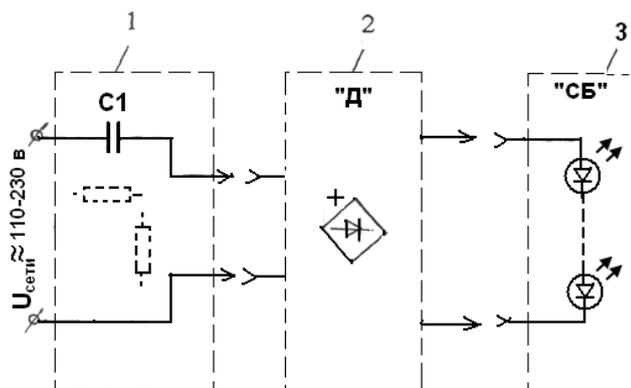


Fig.2 block diagram of the dimmer switch lamp "the Bell"

1 - condenser with protective resistors; 2 - driver with rectifier with a stabilizing device; 3 - led unit.

As follows from the above diagram, the led driver industrial lamp - reactive power compensator includes a capacitor voltage divider, covered by the high-resistance discharge resistors, uncontrolled rectifier "D" with a stabilizing device and an led matrix "SB".

Produced by the lamp reactive power is in the nature of capacitive reactive power and is given by:

$$Q_c = \frac{U^2}{X_c} \tag{1}$$

где, U- the voltage offset network user
 X_c – capacitive reactance using the formula;

$$X_c = -\frac{1}{2\pi f C} \tag{2}$$

где, f – the frequency of the AC network user;
 C – the capacitance of the capacitor.

Since, the consumer is significant inductive reactive power, reducing the power factor ($\cos\varphi$), then, in applying the proposed lighting device in the public network, it is compensated by the capacitive reactive power of the lamp, improving $\cos\varphi$ in the network 0,4 kV. The lamp generates a full luminous flux of 12,000-15,000 LM in the visible spectrum of electromagnetic radiation is exactly the same as the currently in industrial luminaires with lamps DRL . Active power losses in the network, consumers in General are determined by the expression:

$$\Delta P = \frac{P^2 + Q^2}{U^2} \cdot R = \frac{P^2 \cdot R}{U^2 \cdot \cos^2 \varphi} \tag{3}$$

where P is the active power consumed by the network;

Q - reactive power consumed by the network;

U - supply voltage;

R - is the equivalent resistance of the network;
the power factor in the network.

Therefore, the increase of the power factor on the magnitude of Δ leads to a quadratic dependence of the reduction of active power losses in electrical networks, and thus reduce the financial losses of the consumer without the installation of additional devices for reactive power compensation. Replacing in production the shops of legacy industrial luminaires with fluorescent lamps, the lamps DRL or ltpd industrial led lamp-reactive power compensator is possible to achieve a significant increase in the power factor, and as a consequence, the reduction of active power losses, reduced consumption reactive power and reach discharge current of the enterprise network.

Conclusions. Installation of new led lights with a compensating effect gave the following results: decrease of the consumption of active power by 8.6%; the decrease in the consumption of reactive power by 22.3%; lowering the total power consumption by 15.7%; increase $\cos\varphi$ 9.7%; the current reduction in network 18.4%. As follows from the above measurement results, the development of new industrial lamps have high efficiency and can be considered as a promising tool for energy savings [8].

Thus:

1. Developed and put into production a modern led lighting industrial lighting, which can be used in the enterprise as additional sources of reactive power.

2. Theoretically substantiated and experimentally confirmed the energy efficiency industrial led luminaires with the effect of reactive power compensation.

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J21510-008

Svidlo K.V.

MAKING OF GERO-DIETETICAL FOOD RATIONS

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Abstract. In terms of gero-dietetical nutrition, the problem of designing gero-dietetical food rations has been studied. The food rations of heriatric specialized residents of Kharkiv region have been analysed, the necessity of urgent modification of food condition for the special heriatric residents in Ukraine has been proven. A sample gero-dietetical diet has been worked out with its nutrient characteristics having been demonstrated. The compliance of the food rations with the current requirements of the gero-dietetics has been proven.

Key words: gero-dietetics, ration, consumption norms

In Ukraine, the model outpatient health care services are regional social care centres for disabled and advanced age people and inpatient health care services are nursing homes and geriatric boarding houses. The aim of the latter ones is a full boarding and support for those living there with all kinds of medical and social help. Therefore, it is the matter of importance to expand social organizations which would favour senior groups letting them live in a habitual, homelike environment with established stereotype [2-3]. Over 70% of those living in inpatient health care centres have numerous chronic pathologies [4-5]. The disease ratio in these houses in Ukraine averages 4.7 per capita [6].

One of the most efficient factors to stop progressing pathology is rational nourishment which is one of the outside factors affecting human organism [7-8]. It is proved that feed correction can both impede and speed up ageing processes of the organism which affect the quality and duration of life. The dependence of death rate on the body weight is the cause of low immunity and frequent diseases. Insufficient nutrition of elderly people can result from both insufficient energy inflow and secular function changes of organs and systems, which must be taken into account when making up food rations [9].

Specific character of gero-dietetics about feed formulas demands radical changes in the concepts of developing gero-dietetic food. While making gero-dietetic food rations, we relied on the requirements concerning the relations between basic nutrients, simple and complex carbohydrates, vegetable and animal protein (Fig. 1).

Objective of the research is to study and evaluate food rations of operating geriatric houses, to reasonably design gero-dietetic food rations which must take into account up-to-date demands of gero-dietetics.

Materials and methods. The activities of geriatric houses of Kharkiv region were studied relating to the meals offered there for elderly people. To make a thorough estimate, ten-day food rations for 2013 were studied; they were used for calculating the average daily meal structure and individual food consumption. The obtained data were compared with the similar results of the research carried out by the scientists of the Gerontology Institute of the Academy of Medical Science of

Ukraine on 37 nursing homes in 2005. They took into account malfunctions in the feed of dwellers of the specialized geriatric houses and worked out measures to improve their food ration. They proposed a standard food ration, which contains gero-dietetic culinary products with higher gero-protector content.

Results of the research. Ten-day food rations for the year of 2013 were studied; they were used for calculating the average daily meal structure and individual food consumption (table 1).

Such food groups as rye bread, juices, cultured milk foods (cottage cheese and sour cream were) are not practically used in geriatric houses of Kharkiv region despite the fact that these products hold the bulk of biologically active nutrients and are the source of physiological functional matters (full-grown protein, food fibers, vitamins, and mineral substances).

A significant difference between real consumption and recommended norms was visible with consumption of wheat bread (in the geriatric houses of Kharkiv region – 2.6 times as much, in the research of the Gerontology Institute of the Academy of Medical Science of Ukraine – 1.9 times as much), tea (in the geriatric houses of Kharkiv region – 29 times as much, in the research of the Gerontology Institute of the Academy of Medical Science of Ukraine – 1.2 times as much), and cacao (in the geriatric houses of Kharkiv region – 15 times as much, in the research of the Gerontology Institute of the Academy of Medical Science of Ukraine – 13,6 times as much).

Fruit, berries, melons and water melons are consumed 3 and 3.4 times less than recommended amount in the geriatric houses of Kharkiv region and in the research of the Gerontology Institute of the Academy of Medical Science of Ukraine respectively.

In most cases, the tendencies discovered by the scientists of the Gerontology Institute of the Academy of Medical Science of Ukraine were also revealed by our research for geriatric houses of Kharkiv region. Significant reduction was in consumption ration of cultured milk foods (13...25% of the norm).

The cereal and bean consumption exceeds the recommended value 1.2...2.1 times, wheat flour is consumed 1.2...1.5 times and macaronis are consumed 1.1...1.2 times as much. Food rations hold sugar less than the recommended norm, but along with sugar-containing products its consumption is exceeded.

Potato consumption norm is exceeded (+17...19%), and consumption of vegetables in the specialized geriatric houses of Kharkiv region is 38% less than recommended. The ration has considerable deficiency of vegetables – beet is consumed 30% less, carrot is 26...48% less, cabbage is 47...56% less than the norm.

Meat and meat products are practically consumed a quarter less (22...26%), and fish and fish products are 11.5...58.0% less than the norm.

The research was conducted with eight-year discrepancy and shows that the food ration of dwellers of specialized geriatric houses of Ukraine is degrading, the recommended consumption norms are disagreed, and food rations demand immediate correcting. Therefore, an approximate gero-dietetical food ration which takes into account current gero-dietetical requirements has been developed (table 2).

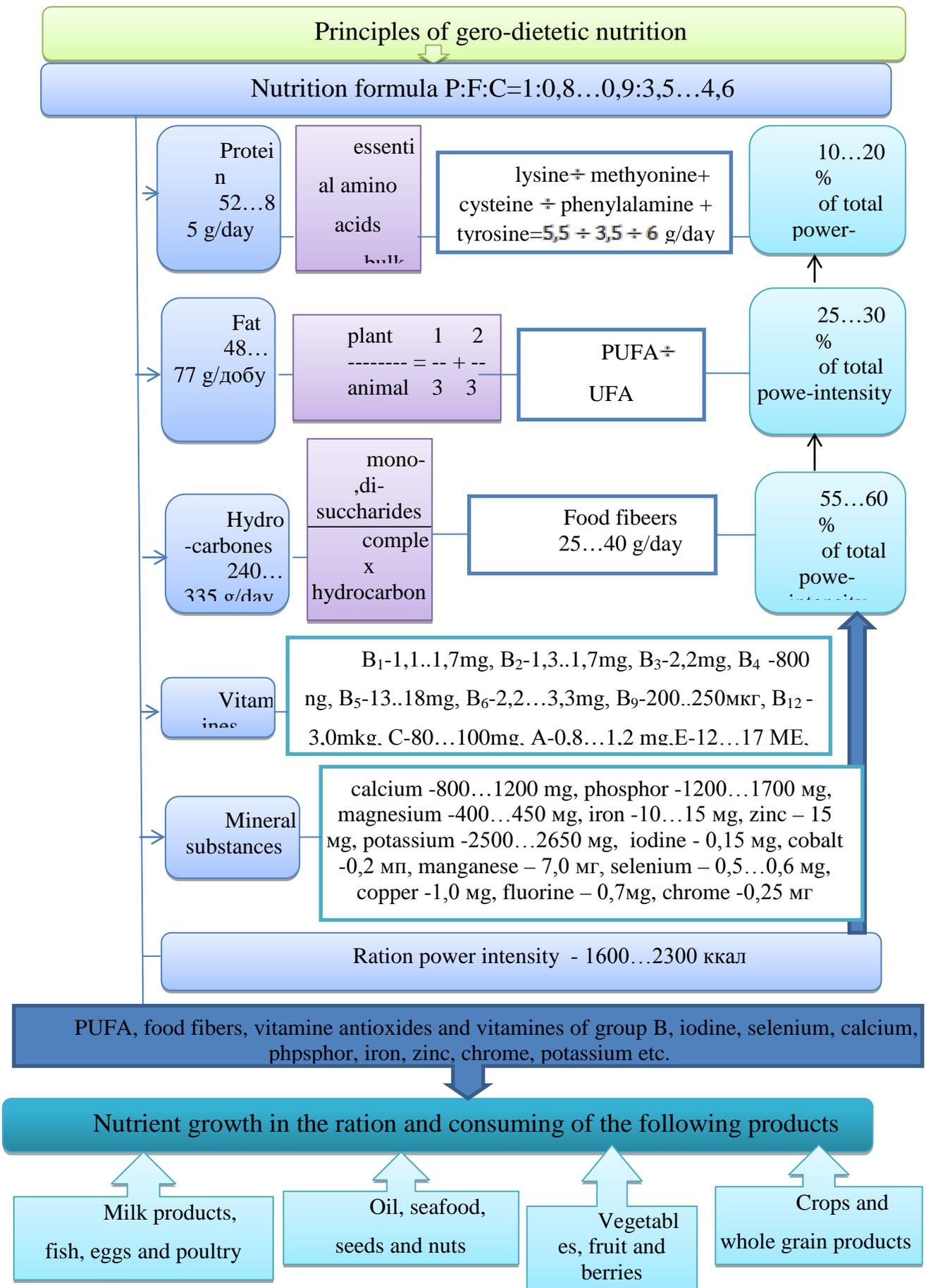


Fig. 1. Demands for making gero-dietetical food .rations

Table 1.
Food product selection and their deficiency in food rations of the specialized geriatric houses.

Products	Actual content in food rations		Recommended amount*
	Research of the Gerontology Institute of the Academy of Medical Science of Ukraine on 37 nursing homes in 2005 [9]	Research of geriatric houses of Kharkiv region	
1	2	3	4
Rye bread	107,3±15,8	-	150
Wheat bread	280,1±18,8	500,0±0,1	150
Wheat flour	30,1±2,0	24,0±12,0	20
Macaronis	24,4±1,9	22,1±1,9	20
Cereals, beans	95,9±3,4	53,3±42,7	45
Sugar	53,4±1,8	47,0±5,0	60
Sugar-containing products (sweets, preserves, halva)	8,9±1,2	19,0±6,0	-
Potatoes	409,4±17,6	419,4±58,0	400
Other vegetables, including	515,5±15,2	403,5±66,7	650
Beet	84,51±6,5	41,0±19,0	120
Carrot	57,3±4,8	46,8±26,8	90
Cabbage	127,1±9,6	105,3±66,7	240
Onion	39,4±3,3	62,4±7,4	60
Other vegetables	207,3±8,7	148,7±53,9	140
Fruit, berries, melons and water melons	70,2±14,2	87,5±32,5	270
Juices	58,7±7,7	-	150
Dried fruit	10,2±1,5	16,0±4,0	30
Meat, meat products	105,1±3,9	88,9±21,1	120
Fish, fish products	42,1±5,1	88,5±57,1	100
Milk	231,5±15,7	57,0±37,0	250
Cultured milk foods	49,4±8,7	39,5±3,5	200
Cottage cheese	24,1±3,6	-	50
Hard cheese	8,5±2,8	17,4±8,2	10
Sour cream	11,9±1,7	-	15
Animal fats (butter, fat)	22,5±1,8	20,0	25
Margarine	7,8±1,0	7,8±1,7	10
Oil	22,9±1,5	26,0±10,0	40
Eggs	17,8±2,1	16,0±8,0	15
Tea	1,12±0,11	28,9±1,1	1
Cacao	0,22±0,05	0,2±0,05	3

* food consumption norms in nursing homes for advanced age people and disabled

There, the ratio of protein to fat is 1:0.8-0.9:3, 5-4.6. The protein content in the total calorie content is 14-16%, essential amino acid content in total protein is 40-64%, the amount of tyrosine+methionine+cysteine+phenylalanine+tyrosine in the daily ration makes not less than 5.5:3.5:6 g.

Table 2

Description of the recommended two-week gero-dietetic food ration

Per day caloricity of two-week ration, kKal	Nutrient content							Ration formula (rotein:fat:carbohydr.)
	Protein, g		Fats, g		Carbohydrates, g		Cholesterol, mg	
	total content	incl. essent. amino acid	total content	incl. polyunsatur. fatty acids	total content	incl. food fibers		
2055,7	79,6	42,5	70,2	28,8	344,4	45,9	127,0	1:0,8:4,3
1987,6	83,4	54,7	69,4	40,1	332,5	41,8	149,4	1:0,8:4,0
1984,5	74,7	61,0	57,4	33,5	309,6	32,0	177,7	1:0,8:4,1
1714,4	73,5	44,1	56,5	31,4	263,2	27,6	169,3	1:0,8:3,6
1997,3	84,2	46,2	63,6	39,0	287,7	34,8	117,7	1:0,8:3,4
2158,7	79,8	47,6	59,8	39,8	350,5	35,4	166,6	1:0,8:4,4
2147,1	83,4	59,6	77,6	47,2	295,8	42,4	267,3	1:0,9:3,5
2048,5	70,8	45,8	54,2	35,7	331,6	41,0	165,2	1:0,8:4,6
1662,9	54,2	36,1	46,8	20,6	255,6	44,4	208,8	1:0,9:4,6
1830,5	79,6	57,2	63,5	41,4	283,9	33,6	112,8	1:0,8:3,6
1829,1	63,3	38,8	56,7	38,2	287,8	28,0	279,0	1:0,9:4,5
2012,5	77,5	51,9	59,8	35,5	269,9	34,5	231,7	1:0,8:3,5
1926,9	57,9	37,6	53,9	31,9	270,6	33,0	126,0	1:0,8:4,7
1884,4	58,2	35,9	47,0	28,4	273,0	35,4	185,2	1:0,8:4,7
1945,7	72,9	47,1	59,7	35,1	296,9	36,4	190,5	1:0,8:4,1

The fat component in the total caloricity is no more than 26-30%; oils make from one third to two thirds, polyunsaturated fatty acids (PUFA) make 60% of saturated fatty acids. The carbohydrate component makes 55-60% of the total caloricity, food fibers must be within 25-40 g per day, and the disaccharide mono-I component is from one seventh to one sixth of the amount of complex carbohydrates.

Conclusions. The research of the Gerontology Institute of the Academy of Medical Science of Ukraine on 37 nursing homes in 2005 and the research carried out in geriatric houses of Kharkiv region show that consumption rations of the gerontologic institutions of Ukraine exceed consumption norms by 114.3...166%; only two items (milk products and fruit) show considerable deficiency as to the standard requirements – it is 62.1% and 78.1% respectively. This state of nutrition is unsatisfactory and demands immediate correction.

The developed gero-dietetical food ration can be organized in the geriatric houses; it can be recommended for prevention of widely spread pathologies of elderly people.

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**PHYSICAL PROCESSES IN THE FOOD PLANT PRODUCTS DURING
TRANSPORT AND STORAGE**

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The article the basic physical characteristics of food products plant, which occur during transport and storage are present

Key words: plant material, physical characteristics, transport, storage, quality.

Introduction. Before reaching the end user plant products undergoes certain changes, particularly during harvesting, handling, transportation and storage (TandS). They are caused by quantitative and qualitative changes in their physical and chemical properties, and for the living goods and anatomical and morphological properties. Depending on the nature of the changes, such processes can be divided into physical, chemical, biochemical, microbiological and biological, anatomic and morphological [1,2,3,4].

The purpose of research. The aim of our work was a generalization and systematization of information on the impact of physical processes to change the quality of plant raw materials for scientific advice on the (TandS).

Physical processes - these are processes that cause changes in the properties of plant products under the influence of external factors: climatic and mechanical. These include: sorption processes - sorption and desorption of water, oxygen, volatile substances; Thermal processes - cooling, heating, freezing; deformation processes - mechanical damage (punctures, pressure, cuts, etc.), deformation, fight, crushing.

Deformation processes - processes caused by various loads and lead to changes in the internal structure and appearance. Varieties of such processes include crushing battle acquisition unusual shape, crumbs, chopping, pressing, pricking, etc.

Crushing product called destructive dispersed loads from exposure to products which completely lose their characteristic shape, integrity, and internal structure. This marked the critical qualitative and quantitative changes, resulting in such products can not be used for other purposes or needs some work or a specific purpose.

This process is most typical for products with low mechanical strength (berries, stone pome fruits, delicate vegetables). Crushed by the weight it can be used for industrial processing, if sustained optimum temperature and time periods during quiet and no significant microbiological spoilage. Prevents crushing use of special containers resistant to stress package.

Damaged products occurs most often to the destructive effects of concentrated loads exerted on the surface of the product or packaging. This is a violation of their integrity, which could lead to partial or total loss of production. The most frequently observed in battle products in glass containers (various canned food, drinks). To prevent a fight needed careful handling of products and the use of a mechanically

stable packaging.

Purchase unusual shape is due to non-destructive loads affecting products with high ductility. This product loses his peculiar appearance. This process is the cause of deformed defective products - bakery products, watermelons, products in tin containers.

Crumbled (breakage) is a consequence of non-uniform failure loads exerted on the product when it is quiet, the preparation for the sale, implementation and consumption. Formed in this crumb or scrap decrease the yield of standard products, because they relate to waste. Breakage observed in pasta, bakery products, cutting halva, flour confectionery products, packaging and weighing pastries, halva, dried fruit and vegetables. To prevent the occurrence of this process is necessary to apply the appropriate package installed to comply with the height of product placement or use power saving mode machining.

Cleaving (cracking) occurs when the concentrated destructive dynamic loads external or internal action. This cracks of different depths, sometimes so deep that the product breaks into pieces, loses integrity. This process degrades the appearance and retentive. Splitting or cracking is most common in fresh fruits and vegetables, especially root vegetables, cabbages, berries with excess water inflow or causing mechanical damage, bread (cracks in the crust during baking), baguettes and so on. Cracks can be both external and internal. Internal cracks may eventually turn into a void. The reason for their formation processes are gassing or internal pressure. Voids can be a process malfunction (for example, large gaps in the bread crumbs).

Pushes - mechanical damage, arising under the influence of non-destructive surface loads. They are concentrated on a certain surface area. Adjacent to the surface layers of the product or the cells under the influence of external mechanical flatten and move to the center, so there is pressure. This defect is considered significant because the deteriorating appearance, internal structure, or the structure, as well as keeping quality product. It occurs frequently in fresh fruits and vegetables with low hardness, flour confectionery products in violation of packaging methods, quiet.

Punctures - mechanical damage, arising under the influence of failure loads of solid objects which are concentrated in a small area. At the same time destroyed the surface and the underlying layers of the product, its integrity is violated. Punctures are put sharp objects (nails, stalk, probes, etc..), As well as pests. They degrade the quality, resistance to infectious lesions, and keeping quality are critical defects requiring immediate sorting and recycling.

Sorption processes occur under the influence of hydrothermal environment and are reversible. Vegetable materials contain water that may evaporate in consequence of the desorption process.

The evaporation rate depends on many factors: temperature and humidity, ventilation, content (mass fraction) of water, its activity, the presence of water-retaining substances, packaging for live production - anatomical and morphological properties.

Temperature and humidity quiet has a significant impact on the rate of evaporation of moisture, not only to high humidity. At the same time found a direct relationship between temperature and the amount of quiet water evaporated. With

relative humidity there is an inverse relationship: the evaporation of water increases with decreasing relative humidity of air (RHA). This is because at lower RHA decreases relative water vapor pressure above the surface of the product and causes intense desorption and diffusion of water molecules into their environment.

Air exchange causes intense evaporation of water, if done consistently low RHA. When the battery panel cooling air or the air is saturated with water vapor by evaporating water. On contact with moist air cooling surface batteries, coolers or panels condensation of water vapor and air drying. If the store is supplied humidified air, the ventilation does not play a significant role. Moreover, at high RHA and intensive air exchange can occur sorption of water vapor and moisture foods (until fogging).

Air exchange has no effect on the rate of evaporation of water when the products are in packages, particularly sealed, or having a protective surface coating. For example: waxing garlic, apple; coating of ice glaze green vegetables. For the upkeep of the water divide all products into three main groups: products with high water content (over 40%) (fruit and vegetable raw materials); Products with an average (10-40%) (raw material from legumes); products with a low moisture content (less than 10%) (oilseeds). In the production of high and medium moisture content most of the water is related to the different components of the dry matter. In our opinion, the classification given very enlarged group and does not include products with enhanced features, very high and moderate humidity. We have proposed a classification of food on the number of water contained in them into five groups:

- very dry products (0.1-12% water) containing mainly bound water (this includes nuts, tea, coffee, spices, sunflower seeds, pastries (liver, biscuits), and the like, the evaporation of water of these products is minimal, so they marked the lowest natural decline and decreased quality in (TandS));

- dry products (12-25%), contains some free water, but is dominated by the bound water (flour, cereals, pasta, rusks, Doughnuts, fruit and berry products, honey, dried fruit, vegetables and mushrooms). The natural loss and reduced quality in optimal conditions of quiet - the minimum; - Production of medium (moderate) humidity (25-60%) contain a substantial amount of free water (in some products in almost equal amounts with bound water). This group is represented by bakery products. Evaporation of water from these products is essential, and the shrinkage causes a deterioration in the appearance, structure, marketability and quality;

- products with high humidity (60-90%), the free water content is 80% (fresh and frozen fruits, vegetables and mushrooms, except for some species belonging to the 5th group and nuts, juices, sauces, canned food, etc.). Quiet is necessary under special conditions in order to avoid the loss of critical mass and quality;

- products with a very high water content (90-99,9%) consists mainly of water in free form (certain types of fresh and frozen vegetables and fruit (vegetable greens, tomatoes, cucumbers, strawberries, blueberries, etc.), pickled vegetables, soft drinks and beer. TandS should be carried out in special circumstances and to implement as soon as possible. Evaporation of water from these products very high, so they are stored in packages which prevent evaporation, or a short time. So, all fresh fruits and vegetables in this group are among legkouvyadayuschih and briefly stored products

(shelf life without plastic packaging 2-3 days).

The total amount of water, and the ratio of free and bound water affect water activity which, in turn, plays an important role in the process of water evaporation.

Water activity is determined not only by its general content and the ratio of free and bound water, but also the chemical composition and structure of the products. Water activity is a measure of its effective concentration in the product under conditions which are available for desorption of water vapor, as well as for the development of a number of chemical and microbiological processes. The higher water activity, the stronger it evaporates. The water activity depends on the presence of water-retaining agents, which contribute to increase the content of bound water. Water retention agents cause the occurrence of food adsorption, osmotic and chemical forms of the water connections. As a result, the product appears chemically related, adsorption-related and osmotically-bound water. Most are strong chemical bonds, so such water practically does not evaporate from the product. Adsorption-related and osmotically-bound water has an average bond strength and can evaporate from the products, although more slowly, after evaporation of the basic amount of free water.

There are products with low, medium and high water activity. For products with low water activity (less than 0.90) are dry ingredients: flour, cereals, fruits and vegetables Kiln. For products with an average water activity (0,90-0,95) include bakery products and others. In the group of products with high water activity (0,95-1,0) includes fresh fruits and vegetables, non-alcoholic, low alcohol and alcoholic beverages.

Packing of food products could delay the evaporation of water. And this is dependent on the type of packaging. Hermetically sealed with packing prevents the evaporation of water into the environment, so that the intensity of this process is minimal.

Containers and packaging materials capable of absorbing water vapor, and then give them to the environment, only slow evaporation of water. For this package include paper, cardboard, wood, tissue containers and similar packaging materials. The glass bottles with stoppers made from natural capping materials by evaporation of water occurs through the physisorption of its stopper.

Anatomical and morphological structure affects the rate of evaporation of water living plant products, as well as plant cells have a natural protective properties of the water loss. The presence of cell membranes to protect them excessive evaporation of water, and intracellular membranes, organelles and covering the core, cause a protective barrier that slows down the diffusion of water molecules into the surrounding environment. At the same time this arrangement makes it difficult and the sorption of water vapor and volatiles.

The result of the evaporation of water is the shrinkage of vegetable raw materials. The scientists found patterns of shrinkage of different products, depending on the intensity of moisture to the surface layer. The production plant moisture migration takes place relatively quickly, so the intensity of shrinkage is determined by the external conditions of evaporation from the surface of the product.

Simultaneously with the evaporation of water the food product may occur

sorption and desorption of water or other volatiles. In addition, production of live cells lose turgor and natural immunity. When water sorption mass of the product increases, colloids swell, filling cracks and voids, resulting in the appearance of the product is restored, its structure. Water activity is increased, which creates an increased risk of microbiological spoilage and reduced marketability.

Water sorption occurs at high RHA close to 100%, and also in packages restricting air exchange with the environment. The presence in the water-retaining products and / or water-absorbent (hygroscopic) substances intensifies desorption of water.

The sorption of oxygen is the first step of many oxidative processes. There is first his physical and then chemical adsorption or chemisorption. Thus, the process proceeds to the physical, chemical (rancidity, oxidation of vitamins, etc.). The result is a change in the chemical composition of food products. Live products are actively using atmospheric oxygen during respiration. The result is the release of energy needed to maintain vital processes of the body, including energy balance, as well as desorption of carbon dioxide CO_2 . This results in oxidative decay energy of substances and quantitative loss of solids.

The sorption of oxygen occurs in the non-living products in which it is used for the oxidation of a number of substances the chemical composition. This results in the oxidative deterioration of fat-containing products which rancid oils, and also due to irreversible oxidation destroyed ascorbic acid, carotene, carotenoids, anthocyanins, etc.

The result of the sorption of oxygen is in a number of products desorption of the carbon dioxide from the air in a confined space (e.g. in polyethylene bags, liners, etc.) accumulates and shows at a certain concentration aseptic properties. This prevents microbial spoilage of certain products.

Sorption processes: sorption O_2 and desorption of CO_2 reducing environmental concentrations of O_2 and increase - up to certain concentrations of CO_2 are essential when using the method of storage of fresh fruits and vegetables in modified atmosphere.

When TandS plant products lost volatiles (ethanol, flavors, volatile acids and the like) and deteriorate the organoleptic properties (smell, taste and sometimes goodies). Quantitative changes of weight and volume are observed only during storage of alcoholic beverages (wine and drinks) by volatilization of ethanol. This is one of the most important causes of such incomplete filling of beverages. The loss of aromatic substances and volatile acids in quantitative terms are small, so they do not affect the natural decline.

The sorption of volatile substances product if TandS note violations of the right commercial neighborhood with the fragrant products. This defect takes the standard non-standard products.

An increase in temperature accelerates the production of many physical, chemical and microbiological processes leading to deterioration and increased losses. For most food products is highly undesirable heating. However, heating of dry products has less negative impact than wet.

Freezing food occurs at a temperature below the freezing of water or solutions

of the substances contained in them. The freezing temperature depends on the total amount of water and substances dissolved therein, and the higher the concentration of the latter, the lower the freezing temperature. Therefore, products with a high content of soluble solids (sugar, salt, etc.) Can be stored at temperatures close to 0 °C, no freezing of water in a supercooled state. Dry products do not freeze, even at low temperatures, when they contain only bound moisture.

Cooling products occurs at temperatures above the freezing point, but lower than the temperature of the product itself. Thus processes in the products are slowed down, but to a lesser extent than by freezing. But there is no damaging effects of ice crystals, degrades the quality of the product.

Conclusions. Thus, all the deformation processes give rise to mechanical damage, mainly related to a critical or major defects. This reduces the quality and the keeping quality of products, increasing losses. Physical processes, along with the chemical are the most common and should be considered when planning the TandS or processing plant raw materials and finished products to avoid further loss of weight and quality. Foregoing material should be used to commodity and loggers to improve the efficiency of their profession and enhance the quality and competitiveness of the final edible product.

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CONDITION OF SURFACES PARTS AND METHODS OF HOLOGRAPHY

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Abstract. *The article contains results of determination of the technical state of surfaces made in determining their fitness for further operation. In the course of exploration work used methods and experimental base of holographic Defect inspection of agricultural machinery and road transport.*

Key words: *hologram, interferogram, speckle-interferometry, technical states, technique, loading, detail, PC, laser.*

Introduction. Provision of reliability of agricultural machinery is one of the most important and actual problems of modern Ukrainian agro-industrial sector. At present is not designed to experimentally - proven methodologies and is not received no reliable data regarding identifying probabilistic characteristics of physical and mechanical properties of materials, with which manufactured parts agricultural machines [1, 2, 3]. On the other hand, the absence of a target-minded state policy on revival of technical diagnostics in particular, has led to the fact that the state registry measurement devices of nondestructive practically do not replenished. This is not conducive to the policies of standard of Ukraine that issue metrology, standardization and certification means and methods of nondestructive inspection, which is especially important for agricultural purposes, practically the almost lost sight of.

The aim of the research: to determine technical state of surfaces made of agricultural machinery and automobile transport and develop methodology obtaining holograms.

The research results. For determine technical state condition (that reveal hidden defects) agricultural machines used nine basic methods of control: magnetic, acoustic, eddy current, radio waves radiation, optical, electric, thermal, as well as with penetrating substances. Each of these methods has its rational scope. An important factor in choosing method of control is safety rules when carrying out works, impact on environment, the opportunity to apply our intention is to the human body substances, non-contacting with revenue authorities on the surface of the parts, technological simplicity of implementation in production and others.

Special studies at the department of reliability of equipment made it possible to experimentally confirm and empirically realize computer holography. Conducted preliminary experimental research and expert assessment of control methods enabled them to establish that unlike other methods to control holography gives objective information about the technical states of the parts. Perspective direction in this at a modern level can be regarded as the application of holographic techniques using appropriate software and data processing with a computer.

Study can be carried out in two directions: study of the fleeting processes accompanied in most cases the destruction of superficial layers or entire part, when implementing speckle-interferometry - hologram is recorded on tape and slowly

occurring processes is the use of PC, when hologram watching on the monitor of computer. Holography parts taking place in two stages: fixation surface detail to load and after its devoting. In the case of speckle-interferometry, loading request is continuously acting factor, but holographic receive when using the same thing, but at different moments of time because of intervals from 1 to 100 ns. Due to interference on the surface of the parts are formed interferential stripes, which bear the information about the parts.

In the second case, computer hologram receive, when playing both sides objective exposition, surface parts, initially without activity - one painting that is fixed in computer memory and then apposition loading - the second picture. By means of execution of their occurs interference, which at first, perhaps observe in real time and then in the form of colored bars.

Each color or shade meet some level microdefomation. The hologram accumulated through speckle-interferometry wears three dimension image parts together with black and white stripes interferometry on it.

Anomalous warm different from normal, correct (drugs together parallel lines), entering called Newton strips on an object's surface indicates the presence of defect, damage or change physical and mechanical properties of the part material. Complex microdefomation at loading parts can be interpreted as the greatest effect of the entire range of the more simple microdefomation.

Studying their values has a considerable scientific interest as to identify changes in the parts of machines that has accumulated. Size microdefomation speckle-interferometry calculated according to methodology, when the rotation of the hologram around a certain axis of coordinates. At the same time, interference runway move while the picture part on hologram shows vibrant remains unchanged in space. Expand the opportunities speckle-interferometry substantial complications related to the specification of holograms - the complexity of calculation of bars that crossing any point on the surface of the details that serves as a base to determine the amount of microdefomation.

To set size microdefomation in each search point on the surface parts, hologram illuminate spot light source and return its axis (X or Y). When the ignition is relatively to axis, which was chosen for the guts, interference runway moved on the surface of the hologram. Thus, having numeric value of three components vector microdefomation for coordinate axis general vector microdefomation possibly find as vector.

$$\delta = \delta x + \delta y + \delta z \quad (1)$$

Mathematical data processing combination of separate points that were investigated by PC, grants an opportunity to play the materials microdefomation peculiarities bodies in space.

Then, received a holographic image quality spatial microdefomation in decomposition for coordinate surfaces, XOY, YOZ, and XOZ may be described in general the equation system with degrees polynomials:

$$U = A_1 \cdot x^n + B_1 \cdot y^n + D_1 \cdot x^{n-1} + E_1 \cdot y^{n-1} + P_1 \cdot x_1 + Q_1 \cdot y_1 + C_1 \quad (2)$$

$$V = A_2 \cdot z^k + B_2 \cdot y^k + D_2 \cdot z^{k-1} + E_2 \cdot y^{k-1} + P_2 \cdot z_1 + Q_2 \cdot y_1 + C_2, \quad (3)$$

$$W = A_3 \cdot x^m + B_3 \cdot z^m + D_3 \cdot x^{m-1} + E_3 \cdot z^{m-1} + P_3 \cdot x_1 + Q_3 \cdot z_1 + C_3, \quad (4)$$

where U, V, W – functions of microdeformation;
 $C_1; C_2; C_3$ - free polynomials members;
 $A; V; \dots; Q$ - rates in the unknown x, y , and z ;
 $N; k; m$ - degrees indicators at the unknown y and z ;
 X, Y, Z -fluid values on the surface part or holograms .

Specifying type equations (2- 4), enabled them to study the physical processes of the materials microdeformation peculiarities not discretely - the point from the point, and integrally, assessing the progress of the entire surface. When investigating surface specific parts functions well as acquire particular types of polynomials those or other degrees.

The deadline condition that he had made a loss of properties of the surface layers of product to fulfill their functions and is determined by the moment of their destruction (intense wear or fatigue destruction). Applying the size of the materials microdeformation peculiarities and having differentiation equations (2-4) data on microdeformation and expected energy, which accompanies the process of destroying the surface layers of all parts, describing critical values of technical state.

Work should be conducted in the following methodical order: parts mechanically was treated to creation of surfaces with the required for holografing roughness. The largest roughness of the surface layers of Rz 80 , Rz 120, Rz 320, mirror reflected much small and light or diffused as you view almost evenly in all directions. This situation is typical for mechanical processed surfaces agricultural machinery in all parts. In this and is fixed capital holographic nondestructive agricultural machinery and motor transport - each component structure made it may be checked

Then part or product installed on your desktop so as to avoid any unwanted exodus, deformations or vibrations of the used custom clamps or clueing using eva to the surface of the concrete stopper - monoblock. By adjusting the moving mirrors and polarizer light intensity, creating equal intensity of both - focused and supporting beams of light, achieving their concentration without turn on lens surface camcorder. Light intensity says was adjusted to obtain a minimum of white spots on the surface of the part, which looked in real time on the secondary monitor .

Summary. Holography allows you to set the technical condition of parts of agricultural machines and determine their possibility for further use.

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 Karabinesh S.

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V.N. Polischuk

**CULTIVATION OF ENVIRONMENTALLY SOUND
CROP PRODUCTION ON WASTE BIOGAS PRODUCTION**

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Abstract: The necessity of preconditioning manure before making it into the soil as organic fertilizer. The influence of sludge biogas production and nitrogen fertilizers on the yield of onion pen, and its content of nitrates. The optimum concentration of sludge biogas plants in a solution to feed plants

Keywords: sludge biogas production, onions on the pen, nitrates

Introduction. Manure, which is a waste product of livestock production are generally used to increase the fertility of the soil as organic fertilizer. However, in the first year of application of fresh cattle manure plants use only 18% of the nitrogen contained in it. Complete digestion of manure nutrients by plants occurs within three years. Upon decomposition of manure at least 70% organic carbon is converted to carbon dioxide. On the one hand, this improves the power plant through photosynthesis, but a substantial amount of carbon dioxide enters the upper atmosphere, increasing the greenhouse effect.

One way to prepare manure to a more complete assimilation of its nutrients by plants is methane fermentation, which yields a valuable organic fertilizer – biosludge, and much of the carbon is converted into valuable energy – gas methane produced by the mixture with carbon dioxide biogas, which is an alternative to natural gas.

Analysis of recent research. Investigation of the influence biosludge on plant growth was carried out in [1], which found that the sludge biogas production at plant nutrition should be added to the meager amount of water, so as not to provoke aggressive and even destructive effects on the development of culture. However, the work is not exactly specified biosludge concentration in the aqueous solution, which significantly increases crop yields and did not act detrimental to the plants. In addition, biosludge contains nitrogen in its composition, which can accumulate in plants in the form of nitrates, adversely affecting the health of the consumer of the product. Does not contain a study [1] of the effect applied to soils in the presence of biosludge in the production of nitrates.

Therefore, **the goal of our research** is to establish optimal biosludge concentration in the aqueous solution for feeding plants in order to obtain maximum yield with a minimum content of nitrates.

The results of research. Influence biosludge biogas production as organic fertilizer for growing onions determined on the pen. In the primer of Embodiment experience bulbs were planted with seven (Fig. 1) which were watered daily and biosludge pure water solution at different concentrations (Fig. 2). To control conducted research options when watering the plants with a solution of mineral fertilizers (ammonium nitrate) and clean water. Options experiments are as follows: 1 – biosludge solution with water at a concentration of 1: 500; 2 – biosludge solution with water at a concentration of 1: 100; 3 – biosludge solution with water at a concentration of 1:50; 4 – biosludge solution with water

at a concentration of 1:10; 5 – purely bioslam; 6 – solution in water nitrate concentration amiachnoy 1:25; 7 – water.



Figure 1. Pledged experience of growing onions on the pen

Figure 2. Watering onion aqueous slurry of biogas plants

The studies were conducted in the laboratory bioconversions in agro-industrial complex National University of Life and Environmental Sciences of Ukraine. Estimated yield of plants and the content of nitrates.

To feed the plants clean biosludge four plants of seven died. In other embodiments, the experiments were not observed destruction of plants. The highest average height of the plants growing on the seventh day was observed when feeding an aqueous solution of biosludge concentration of 1:50 - 1: 500 and fertilizers and ranged between 19-21,5 cm. It should be noted that when feeding pure biosludge height of individual plants that do not died, was 23 cm. The height of the bow on the pen on the seventh day of cultivation is given in Table. 1.

Table 1
The height of the bow-pen on the seventh day of cultivation (in cm)

Number of plants	Variant						
	№1	№2	№3	№4	№5	№6	№7
I	22,0	18,0	15,5	21,5	23,0	18,5	20,0
II	27,0	15,0	25,6	14,5	23,0	21,5	13,0
III	18,0	26,0	17,3	16,0	9,0	16,4	18,0
IV	24,0	19,0	15,5	26,6	23,0	23,0	19,0

V	23,0	26,5	18,0	14,5	died	22,0	19,0
VI	20,0	24,0	21,0	15,0	died	18,5	15,0
VII	17,5	5,0	24,5	17,0	died	27,5	13,5
Average	21,6	19,1	19,6	17,9	11,1	21,1	16,8

The average weight of the entire pen onions grown on the options is as follows: 1 – 11,65 g; 2 – 10,26 g; 3 – 10,12 g; 4 – 9,62 g; 5 – 5,73 g; 6 – 9,8 g; 7 – 6,04 g, and the average weight per plant: 1 – 1,66 g; 2 – 1,46 g; 3 – 1,44 g; 4 – 1,37 g; 5 – 1,43 g; 6 – 1,4 g; 7 – 0,86 g.

Thus, the highest yield was observed in plant nutrition aqueous slurry of biogas plants concentration of 1:500. With increasing concentration of biosludge and plant nutrition aqueous solution of fertilizer yield of onions on the pen is somewhat reduced. Fertilizing plants concentrated biosludge leads to partial destruction of plants and reduce crop. When watering plants with clean water yield of onions on the pen over option plant nutrition aqueous solution biosludge concentration of 1:500 was reduced by half.

The content of nitrates in plants grown. For this plant previously ground, then selected the average sample weight of 10 grams. A charge was placed in a glass homogenizer, then filled with 50 ml of a 1% solution of potash alum and homogenized for 1 minute while stirring at a frequency of 6000 rev/min. After homogenization, suspension pomeschalast in a beaker of 100 ml (Fig. 3).



Figure 3. The slurry mixture before performing measurements on nitrates

Method for determination of nitrate in the product based upon their extraction from green plant with a 1% solution of potash alum with respect to the sample solution in a 1:5 followed by potentiometric determination of their suspension in the brine using ion-selective electrodes. Potentiometric method is based on measuring the potential of the ion-selective electrode, the magnitude of which depends on the concentration of ions, which are defined in the solution. As an auxiliary electrode used saturated silver chloride electrode. The measurement of ion concentration rNO_3 held analyzer ions AI-123.

Before the measurement, the test samples were mixed with a glass rod (Fig. 3), after which they fell electrodes and measure the potential (every 1,5-2 min.). NO_3 value found in the samples, using a calibration curve constructed on the graph paper. NO_3 largest in the test samples using tables [2] determined the nitrate content.

NO_3 concentration in the plume bow on variants of the experiments were as

follows: 1 – 2,83; 2 – 2,67; 3 – 2,61; 4 – 2,49; 5 – 2,39; 6 – 1,85; 7 – 2,71, and nitrate content in onions on the pen: 1 – 504,4 mg/kg; 2 – 729,1 mg/kg; 3 – 837,1 mg/kg; 4 – 1104 mg/kg; 5 – 1390 mg/kg; 6 – 4817 mg/kg; 7 – 664,9 mg/kg.

It may be noted that the nitrate content in onions on the pen increases with increasing concentration of biosludge in the solution used for plant nutrition. Nitrate content in plants does not exceed the maximum permissible concentration (800 mg/kg for growing indoors [3]) with daily supplements bow feather biosludge solution with a concentration of 1:100-1:500. When the concentration in the solution more biosludge 1:75 nitrate content in re onions exceeds the maximum permissible concentration and feeding concentrated biosludge is 1390 mg/kg. For example, the daily dressing of plants Nitrogen fertilizers leads to a concentration of nitrates in the pen bow 4817 mg/kg, which is 5 times higher than the MPC, watering with clean water – 665 mg/kg.

Findings

1. The highest yields observed in plant nutrition aqueous slurry of biogas plants concentration of 1:500. With increasing concentration of biosludge and plant nutrition aqueous solution of fertilizer yield of onions on the pen slightly less. Fertilizing plants concentrated biosludge leads to partial destruction of plants and reduce crop. When watering plants with clean water yield of onions on the pen over option plant nutrition aqueous solution biosludge concentration of 1:500 is reduced by half.

2. Nitrate in onions on the pen does not exceed the maximum permissible concentration at the daily supplements of plant onion biosludge with a concentration of 1:100-1:500. When the concentration in the solution more biosludge 1:75 nitrate content in plants exceed the maximum permissible concentration.

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J21510-012

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**THE METHODS OF TESTING OF NUMERICAL ALGORITHMS
FOR EDA TOOLS**

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Abstract. In the paper we present the methods for testing of numerical algorithms of transient analysis. Test problems are described in the form of circuit models so they can be applied to EDA tools. The main objective of article is to develop the testing methodology for numerical algorithms of transient analysis which will allow to estimate the reliability and accuracy of the results of numerical analysis. Suggested methods can be used for testing of both known and new algorithms of numerical analysis of electronic circuits in the time domain.

Keywords: numerical methods, transient processes, circuit simulation, simulation error.

Introduction. Research of transient processes in electronic devices is the important stage of their design. The problem of numerical analysis of transients in electronic circuits is solved by Electronic Design Automation (EDA) tools, also known as SPICE-simulators, which include Pspice, LTspice, Micro-Cap, NI Multisim and some others [1]. In SPICE-simulators several numerical algorithms of transient analysis are generally includes because the real electronic circuits are described by mathematical models with various properties (linearity, stiffness, stability, aperiodic or oscillatory solutions). To ensure the reliability and improve the accuracy of circuit simulation both new algorithms of numerical analysis of electronic circuits in the time domain and the methods of the specified algorithms testing is currently being developed [2, 3].

The aim of this work is to develop the methods of testing of numerical algorithms of transient analysis for EDA tools, as well as estimation of reliability and accuracy of the numerical analysis results.

Formulation of the problem. As known, the transient analysis of electronic circuits consists in solving of the systems of ordinary differential equations (ODE) that describe the mathematical models of circuits. Now it is known a large number of tasks for testing of algorithms of ODEs numerical solution, which are presented in the form of mathematical models [4 – 7]. In this paper for testing of SPICE-simulators is supposed to solve the following problems:

- To describe the test problems in the form of electronic circuits;
- To consider both linear and nonlinear test problems with different stiffness for testing of various numerical algorithms and propagation of the obtained results to a wide class of electronic circuits;
- To determine the analytical solution of the discussed test problems for evaluating of reliability and accuracy of numerical analysis results;
- To prove original, but rather simple methodology for evaluating of accuracy of numerical simulation algorithms, allowing to perform a comparative analysis of various algorithms effectiveness.

Models of the test circuits. First-order linear ODE – Dahlquist equation is widely used in mathematics to investigation of the properties of numerical methods for ODEs solving [7]. It is easy to show that Dahlquist equation corresponds to circuit model in the form of the linear serial RC-circuit, which is shown in Fig. 1, where $\tau_R = RC$ – time constant of the RC-circuit; v_0 – voltage of the capacitance C at time $t = 0$.

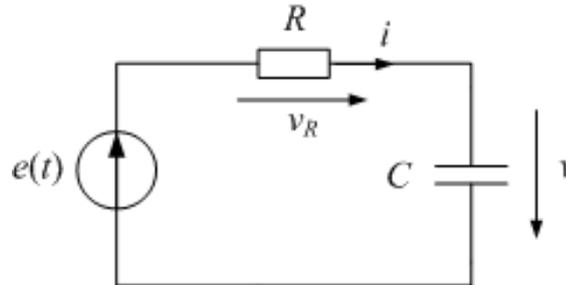


Fig. 1. Linear test circuit

Thus, the problem of numerical analysis of transients in linear serial RC-circuit is the simple test problem for SPICE-simulators which similar to numerical solving of the Dahlquist equation. The nonlinear test problem can be obtained by replacing the linear resistance R in the circuit of Fig. 1 by nonlinear resistance VD (Fig. 2), which is, for example, a diode.

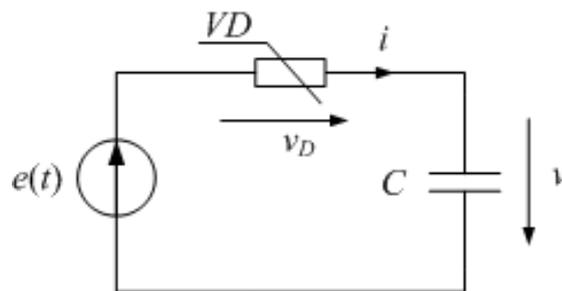


Fig. 2. Nonlinear test circuit

In the SPICE-simulators nonlinear resistance VD is most conveniently represented as a controlled current source (ABM_current) with nonlinear current-voltage characteristic (CVC). Assuming that the CVC of the nonlinear resistance is described by the ideal diode Shockley model: $i = I_s [\exp(v_D / \varphi_T) - 1]$ (i – diode current; v_D – diode voltage; I_s – saturation current of diode; φ_T – thermal potential), we receive the nonlinear ODE (1) instead of the linear Dahlquist equation:

$$\frac{dv}{dt} = \frac{I_s}{C} \left(e^{\frac{E-v}{\varphi_T}} - 1 \right), \tag{1}$$

where E – is voltage of the source $e(t)$ for $t \geq 0$.

It can be shown that the analytical solution of (1) has the form

$$v(t) = E + \varphi_T \ln \left[1 - e^{-(t-t_0)/\tau_{\max}} \right], \tag{2}$$

where $\tau_{\max} = \frac{\varphi_T C}{I_s}$; $t_0 = \tau_{\max} \left[\frac{v_0}{\varphi_T} + \ln \left(e^{\frac{v_0}{\varphi_T}} - e^{-\frac{E}{\varphi_T}} \right) \right]$.

It is known that the stiffness of model can be estimated by ratio of the largest and smallest time constants of the relevant ODE system [7]. The Dahlquist equation is described by only one time constant, so this concept of stiffness loses meaning for it. For nonlinear ODEs the concept «variable time constant» $\tau(t)$ is used instead of the term «time constant» [8]. For ODE (1) $\tau(t)$ has the following form:

$$\tau(t) = \tau_{\max} \left[1 - e^{-(t-t_0)/\tau_{\max}} \right]. \quad (3)$$

The stiffness of the nonlinear test circuit can be estimated as the ratio of the maximum and minimum values of the function $\tau(t)$ for $t \geq 0$

$$\eta = \tau_{\max} / \tau_{\min}, \quad (4)$$

where $\tau_{\max} = \tau(\infty)$; $\tau_{\min} = \tau(0)$.

Results of testing. The Gear algorithm is the main transient analysis algorithm for most SPICE-simulators [3 – 7], so the results of test problems solution using this algorithm are presented below. NI Multisim package was used for determine of the numerical solution of the test problems. Output voltage of the test circuits was considered as the analyzed variable. The momentary relative error of analysis was calculated to estimate the accuracy of numerical solution:

$$\varepsilon_k = |v_k - v(t_k)| / v_{\max}, \quad (5)$$

where $k = 0, 1, \dots, N-1$; N – number of calculated values of voltage; v_k – value of voltage received by the Gear algorithm; $v(t_k)$ – exact value of voltage; v_{\max} – maximal value of voltage.

The following parameters of investigated circuits are set for performing the tests:

- linear circuit: $R = 1 \text{ k}\Omega$, $C = 27 \text{ nF}$, $E = 1 \text{ V}$, $v_0 = 0 \text{ V}$;
- nonlinear circuit: $I_S = 1 \text{ }\mu\text{A}$, $\varphi = 0,027 \text{ V}$, $C = 1 \text{ nF}$, $E = 1 \text{ V}$, $v_0 = 0,07 \dots 0,81 \text{ V}$.

The value of v_0 for the nonlinear circuit is varied for the purpose to change its stiffness. The above-mentioned interval of v_0 corresponds to the stiffness of the nonlinear circuit $\eta = 10^3 \dots 10^{15}$. It is easy to show that for given above parameters, the time constant of the linear circuits are the same with the maximal value of $\tau(t)$ for the nonlinear circuit: $\tau_R = \tau_{\max} = 27 \text{ }\mu\text{s}$. On this basis, for simulation of the test circuits were chosen the same observation interval (time of analysis) $t \in [0; 50\tau_{\max}]$. The initial step of solution in all cases, also was set equal: $h_0 = \tau_{\max} / 1000$.

The simulation results of the test circuits show that the momentary error of modeling decreases with decreasing of the predetermined maximum permissible error (RELTOL) for both linear and nonlinear circuits. The form of the momentary error for linear and nonlinear circuit is substantially different. The momentary error for the linear circuit has a maximum value only at the end of the observation interval, and for the nonlinear circuit momentary error is close to maximum at the end and at the beginning of the observation interval.

At small RELTOL values (less than 10^{-9}) the maximal value of the momentary error for linear circuit is more than ten times lower than for the nonlinear circuit. At large RELTOL values (more than 10^{-3}) for the nonlinear circuit the momentary error significantly depends on the stiffness. The dependence on stiffness of the maximal

value of the momentary error for $REL TOL = 0,1$ is shown in Table 1.

It should be noted, that the following feature of the numerical algorithm was determined when the nonlinear circuit has been tested: the simulation process can be stop forced by the analysis program because of need excessive decrease of the step of the numerical solution at the high stiffness and small $REL TOL$. The dependence on stiffness of the minimum value of $REL TOL$, above which the program of numerical analysis works without failing, is shown in Table 1.

Table 1

The results of simulation of the nonlinear circuit

η	10^6	10^9	10^{12}	10^{15}
ϵ_{\max}	0,030	0,061	0,271	0,540
$REL TOL_{\min}$	$3,5 \cdot 10^{-13}$	$7 \cdot 10^{-12}$	$2,5 \cdot 10^{-11}$	$5 \cdot 10^{-11}$

Conclusions. In this paper the methods of numerical algorithms testing for simulation of electronic circuits in the time domain were presented. The presented methods of testing, unlike the methods described in [2], allow to estimate not only the reliability of numerical analysis but also its accuracy. The offered methods also allow to estimate the influence of nonlinearity and stiffness on properties of numerical algorithms and to set up the limit performance capabilities of numerical algorithms for solving of stiff problems.

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SIMULATION OF THE NOISE SUPPRESSING DEVICES INDUCED ON THE VEHICLE CABLE NETWORKS OF SPACECRAFTS IN CASE OF INFLUENCE OF ELECTROSTATIC DISCHARGES.*Samara State Aerospace University named after academician S.P. Korolyov (National Research University), Russia*

In article, results of simulation of the RC filter and diode limiter in the conditions of influence of the noise on the vehicle cable networks of the spacecraft caused by influence of an electrostatic discharge and useful signal are considered. Conclusions about possibility of application of these circuits for protection of inputs of onboard equipment of the spacecraft against influence of the noises caused by an electrostatic discharge are drawn.

Key words: onboard equipment, spacecraft, vehicle cable network, electrostatic discharge, range, filter, diode limiter.

Introduction. The space technique develops towards increase in period of the active existence, extension of the functional capabilities, lowering of overall dimensions and weight. Such tendency resulted in need of use of semiconductor items with high high-speed performance. Unlike electromagnetic relays, program mechanisms and semiconductor items with low high-speed performance they are more sensitive to the noises caused by different phenomena (as natural, and anthropogenous character).

Review of the literature. One of such natural phenomena is electrization of the spacecraft (S). Because of electrization not metallized elements of construction are loaded in such a way that potential differences are in between formed [1-4]. These potential differences reach values of 20 kV [3]. Last leads to origin of electrostatic discharges (ESD). ESD generate an impulse electromagnetic field, which influences both the onboard equipment (OE) and the vehicle cable network (VCN), causing aiming. In [5], a method of assessing the level of noise induced in the circuits of the S under the influence of ESD close to the body. However, it does not guarantee the necessary action. Aiming in VCN also influence inputs OE of S and can lead not only to failures, but also to irreversible failures. The irreversible failure OE can lead to loss of S.

Now the theoretical assessment is applied to determination of need and sufficiency of the taken measures for protection of onboard equipment of spacecrafts against factors of an electrostatic discharge at a stage of its design. For confirmation of resistance of onboard equipment of spacecrafts to factors of an electrostatic discharge, terrestrial tests are carried out [6].

The input data and methods. Harmful influence of aiming in VCN caused by ESD can be weakened, and in certain cases to exclude completely. It is for this purpose expedient to use special electrical circuits to which simulation the present article is devoted.

Experimentally it was set that aiming in VCN remind the fading harmonic oscillation. The form EMF of aiming in a cable is provided in fig. 1. For carrying out

the analysis, the specialized software was used. For the analysis, we use the unprotected two-wire line, as the level of induced noises in it the biggest. It too was set experimentally. Characteristics of this noise following:

- duration of leading edge of an envelope on levels 0,1 and 0,9 100 ns;
- envelope duration on level 0,1 1000 ns;
- signal amplitude 280 V;
- filling frequency 20...250 MHz.

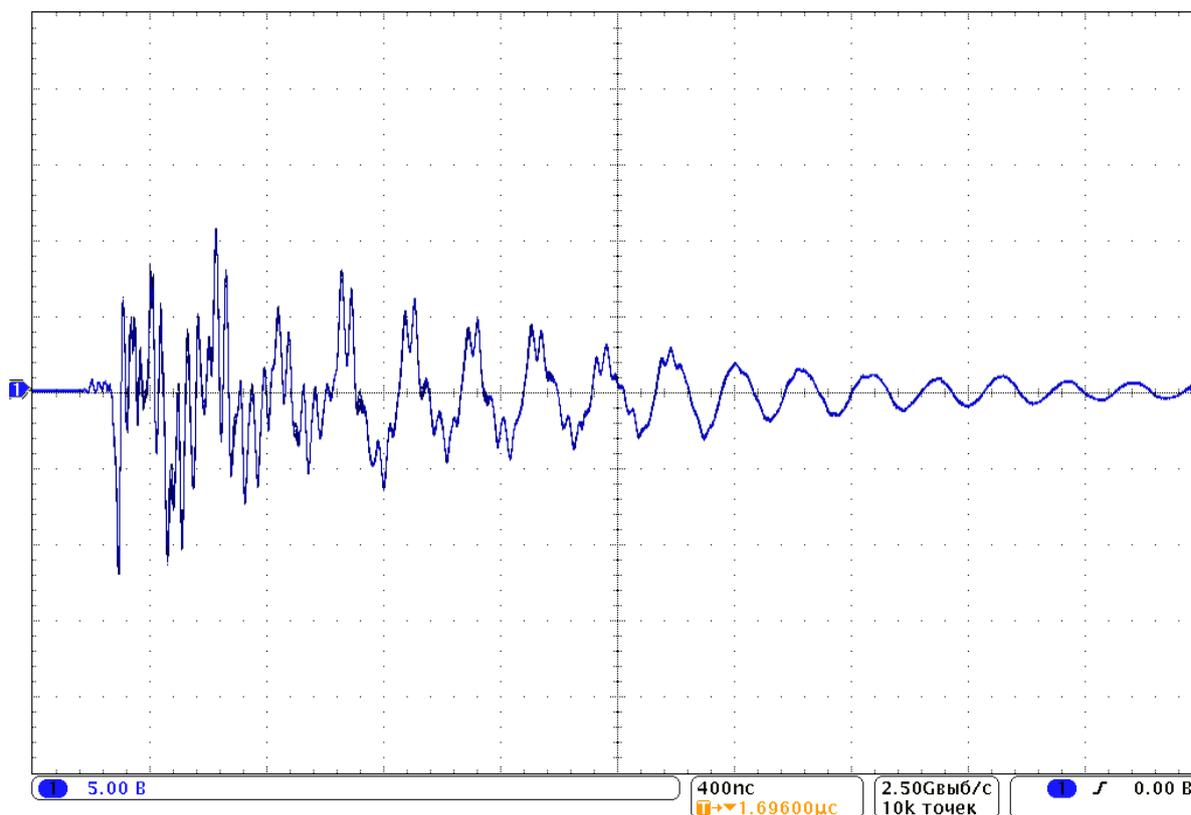


Figure 1. The oscillogram of a noise in a cable

Based on the data explained above the signal with the same parameters was created. Filling was created by modulation on frequency. Frequency of the bearing oscillations of 135 MHz. Deviation of the frequency of 115 MHz. Law of frequency change the harmonic. Index of the frequency shift keying 57,5. The signal can be described the following mathematical expression.

$$u(t) = U_0 (e^{-\alpha t} - e^{-\beta t}) \sin(\omega(t)t + \varphi), \quad (1)$$

where U_0 – noise amplitude; α and β – the coefficients characterizing time of rise and recession of the bending noise; $\omega(t)$ – angular frequency of harmonic oscillations as function of time; φ – initial phase of harmonic oscillations.

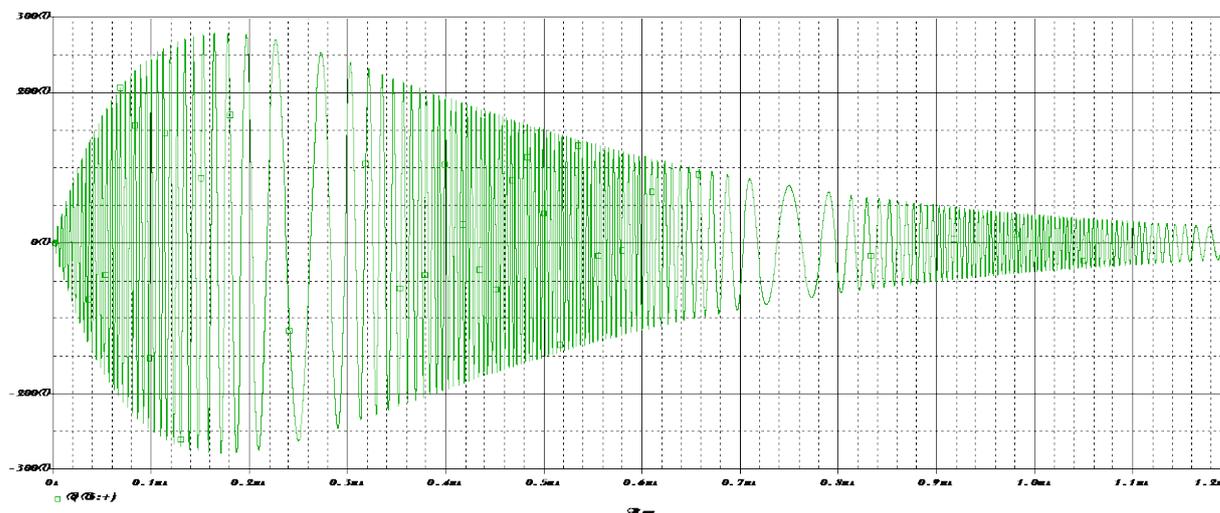


Figure 2. The time diagram of the signal imitating a noise in VCN

We will find a noise range (see fig. 3). From fig. 3 it is visible that the range of a noise and a range of the useful signal are superimposed if it is about a high-speed line of information transfer. Therefore, for example, if it is about a signal lasting front of 3 nanoseconds (the frequency band from 0 to 333 MHz), filtering a noise the frequency filters is impossible. The situation is complicated by that fact that noise amplitude considerably exceeds amplitude of the useful signal.

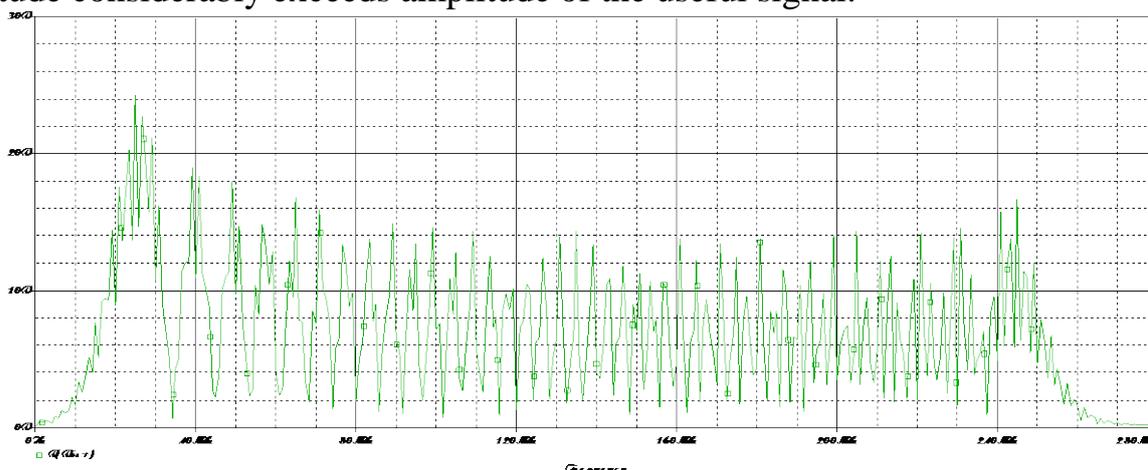


Figure 3. An amplitude spectrum of the signal imitating a noise in VCN

We will carry out simulation of the elementary RC filter with a resistance of 1 kOhm and with a capacity of 5,1 nF. Values of capacity and resistance were picked up so that effectively to suppress a noise. The filter circuit is given in fig. 4. In case of such parameters of a circuit duration of leading edge of the useful signal on level 0,1 and 0,9 can't be less than 12 microseconds. In case of simulation of the RC filter as an input signal, we will use the amount of the useful signal and a noise. We will understand periodic pulse sequence in the form of a trapeze with on-off time ratio as the useful signal, equal to two. We will understand voltage output as results of simulation. Last, it is fair for all researched circuits. We do not model loading of the filter. We consider that the functional assembly to which input the filter is connected has an input with a big resistance, and it can be neglected.

In fig. 5 results of simulation are provided. Apparently, the noise is very

effectively suppressed in spite of the fact that value of its amplitude reaches 280 V, and the useful signal of only 5 Century. Thus, use of the frequency filters possibly, but generally when processing slowly the changing signals. By transmission of such signals, the shielded cables can be not used. It will reduce the mass of VCN and labor input of its manufacture.

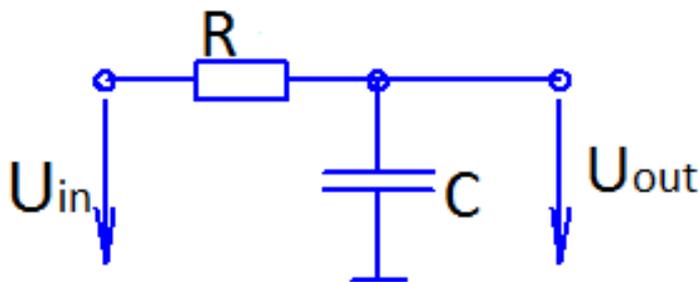


Figure 4. Diagram RC-of the filter of the lower frequencies

As other option, the LC filter can serve. Filters of the lower frequencies are suitable for noise cutoff on supply circuits, but are not suitable for high-speed lines. For last use of delimiters for the purpose of overvoltage, preventing OH is possible. The diagram of such diode delimiter is given in fig. 6. Results of simulation of the diode delimiter in case of influence of the amount of the useful signal and noise are provided in fig. 7a and, without noise – in fig. 7b

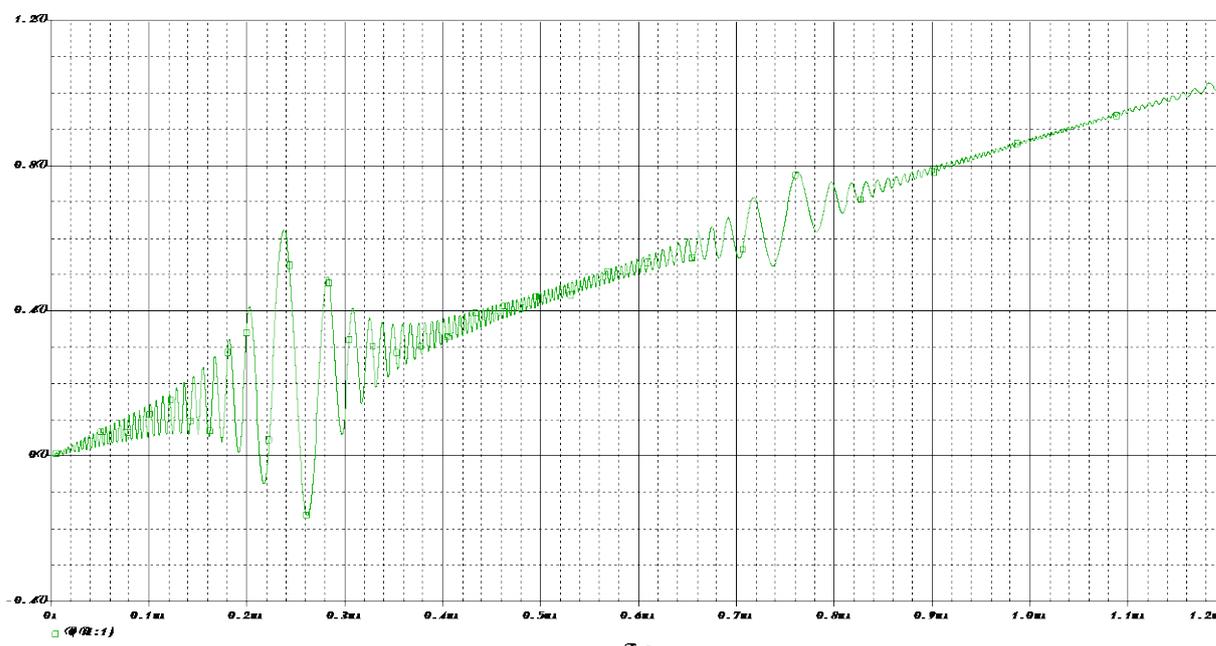


Figure 5. Results of simulation of RC – the filter

Apparently, from fig. 7 it is impossible to work with a signal in case of influence of noises. Therefore, it is necessary to take measures for protection of VCN: application of the screened lines; twisted pair cables; to lay out VCN in places where ESD will not occur or their influence will be feebler.

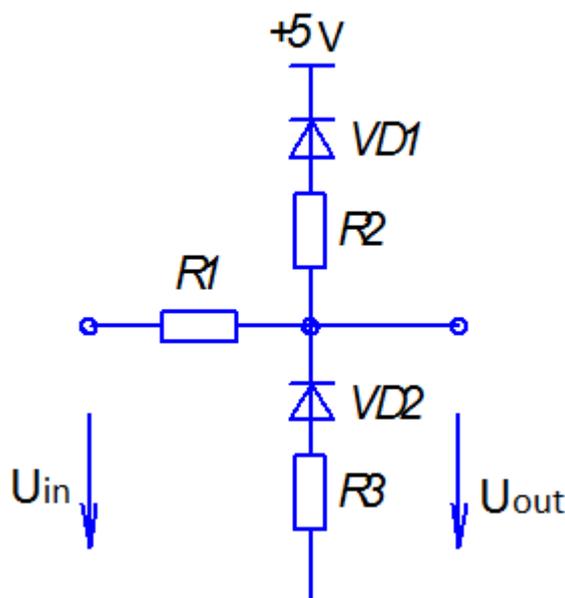


Figure 6. Diagram of the diode delimiter

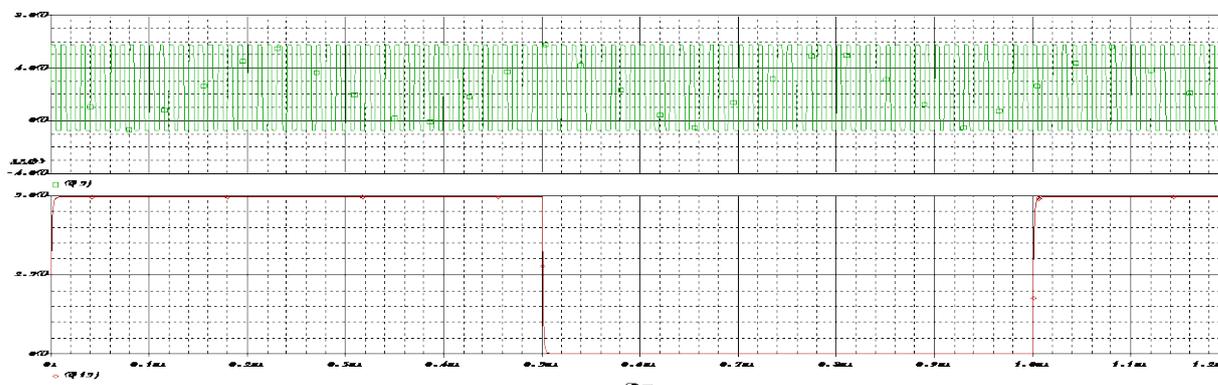


Figure 7. Results of simulation of the diode delimiter:
Above (a) – in case of influence of a noise, below (b) – without noise.

At first sight, the issue can be resolved if to use optical fiber cables. However, optical fiber is isolation material and in it charges can collect. Such cables need to be protected from a flow of particles. The screen from aluminum alloy protecting from a flow of particles can reach several millimeters [1]. At the coaxial cable as the screen, the wattled cable, as a rule, serves. The wattled cable is much easier than the mentioned screen. Moreover, it reduces noise level in MCT to units of volts (it too was set experimentally). In a different way, application of program and hardware methods of protection inside OE is (except filters and delimiters).

That is, if the noise came, failure in operation OE shall not lead to disastrous consequences, after not all ESD occur often or to apply noiseproof codes (with redundancy of information). It is also worth considering possibility of use of correlative or digital filters.

The results. Discussion and analysis. The simulation showed that reducing interference caused by ESD, it is advisable to use special circuits (filters, diode limiters and others.). The experimental waveform interference in the cable. It

resembles the fading harmonic oscillation. A comparison of the spectra of the noise and the useful signal.

It is necessary to carry out the deep analysis of methods of protection against ESD, which will be applied in case of design of KA, and it is desirable to do it in case of appearance study.

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FAULT DIAGNOSIS METHOD OF BLDC ACTUATOR USING STATOR CURRENT SIGNALS

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Abstract. *This report describes a fault diagnosis system for brushless DC (BLDC) motors realized through the combination of fast Fourier transformation, feature extraction, fuzzy logic, and neural network techniques. The fast Fourier transformation converts the state time series into the frequency domain. Features are extracted from the spectrum of the stator current. Fault diagnosis accomplishes the characteristic frequencies using the fuzzy logic in aggregate neural network. The combination of advanced techniques reduces the learning time and increases the diagnosis accuracy. The efficiency of the proposed method is demonstrated through the structure faults of mechanical origins arising within the BLDC based actuator. The experimental results indicate that the proposed method is promising for the actuator diagnosis.*

Key words: *diagnosis, forecasting, neuro-fuzzy model, stator current signals BLDC actuator*

Introduction. The modern development of automation and robotics demands the raised accuracy of the executive mechanisms. In this context the BLDC motors are widely used in the actuator systems.

Compared to brushed DC motors and induction motors, BLDC motors have multiple advantages and several disadvantages at the same time. Brushless motors require less maintenance, so they have a longer life compared with brushed DC motors. BLDC motors produce more output power per frame size than brushed DC motors and induction motors. The rotor inertia is also less compared with other types of motors. This improves acceleration and deceleration characteristics, shortening operating cycles. The linear speed/torque characteristics produce predictable speed regulation. With brushless motors, brush inspection is eliminated, making them ideal for limited access areas and applications where servicing is difficult. BLDC motors operate much more quietly than brushed DC motors, thus reducing Electromagnetic Interference (EMI) [1].

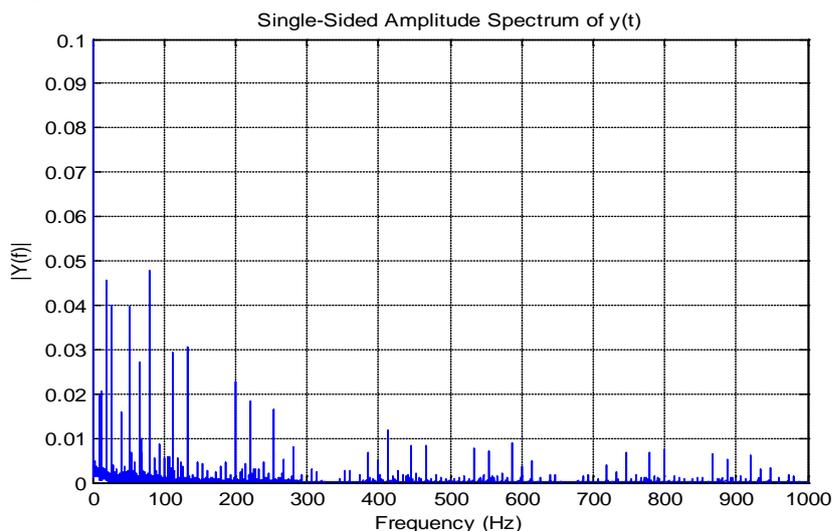
A typical BLDC based actuator is an electromechanical system including the electrical motor and a reducer connected by coupler. Long operation activity of the BLDC based actuator at the large reversed loads can produce faults. Therefore it is necessary to supervise periodically the BLDC actuator inspection done by means of a systematic diagnosing.

One of the most simple and accessible methods of diagnosing is the method of the spectral analysis of stator current signals, as it does not require additional material and time expenses and can be made directly on the working equipment.

The spectral analysis of the stator current signals allows to carry out diagnostics of the electric motor and the mechanical devices connected with it at which during the set time interval the steady-state currents consumed by the motor.

The received data are converted into the frequency domain using the Fourier

transformation (Fig. 1).



**Fig. 1. A frequency spectrum of the BLDC based actuator
The neuro-fuzzy based diagnosis model**

Characteristical frequency peaks contain the BLDC actuator faults and can be extracted from spectral analysis of the stator current. For the analysis the current signal of a new serviceable motor, which is accepted to be the basic reference standard, is measured once before the long-time exploitation. When faults advance there is a change in the common level and single amplitudes on the characteristic frequencies. The search of faults is carried out by comparison of a currently spectrum with the basic reference spectrum done by means of computational intelligence. Midrange current signal (1), which can be considered as a bias arising from process noise is obtained from all amplitudes of a current spectrum without characteristic frequencies.

$$a_{mid} = \frac{\sum_{i=1}^g a_i - \sum_{j=1}^h a_j}{g - h}, \tag{1}$$

where a_i - current signal amplitude ; i, j - frequency indices; g - frequencies of a spectrum interval; h - characteristic frequencies of diagnosing.

The spectrum analysts is restricted to the normalized characteristic frequencies under consideration.

$$k_i = \frac{A_i - A_i^0 + \Delta a_{mid}}{a_{mid 0} + A_i^0}, \tag{2}$$

where A_i - amplitude of the analyzed spectrum on the i -th characteristic frequency; A_i^0 - amplitude of a reference spectrum on the i -th characteristic frequency; $a_{mid 0}$ - midrange current signal of the reference spectrum; $\Delta a_{mid} = a_{mid i} - a_{mid 0}$ - absolute deviation of the midrange current signal; $a_{mid i}$ - midrange current signal of the analyzed spectrum.

If the analyzed spectrum is equal with the reference one then the normalized

factor $k_i = 0$. If a fault occurs then the change of the midrange current signal and amplitude on characteristic frequencies lead to a change of normalized factor [2].

If all normalizing factors are «nearby 0» the object is serviceable. If all normalizing factors are «nearby 1» that the object is corrupt. These data is written down in the form of predicate rules

If k_1 is B_1 and..... k_m is B_1 , then $x_i = f_1$;

If k_1 is B_2 and..... k_m is B_2 , then $x_i = f_2$,

where $k_1...k_m$ – current amplitude on characteristic frequencies; B_1, B_2 – S and Z shaped functions of sigmoid type (Fig.3); x_i – predicted output fault; f_1 – conclusion «object is supposed to operation»; f_2 – conclusion «object is not supposed to operation».

The output is defined by means of an algorithm of the fuzzy logic *Takagi-Sugeno* [3].

The simulated results of an exemplarily two-dimensional output surface are depicted in Fig.3.

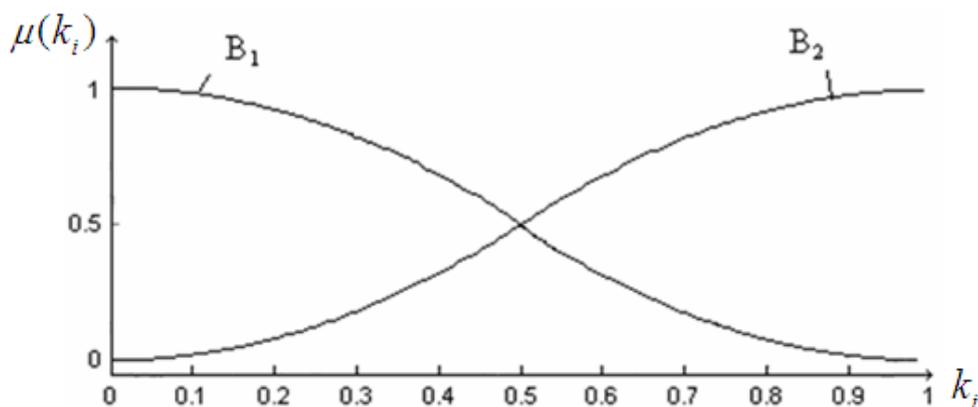


Fig. 2. Membership functions of the fuzzy sub model of diagnosing

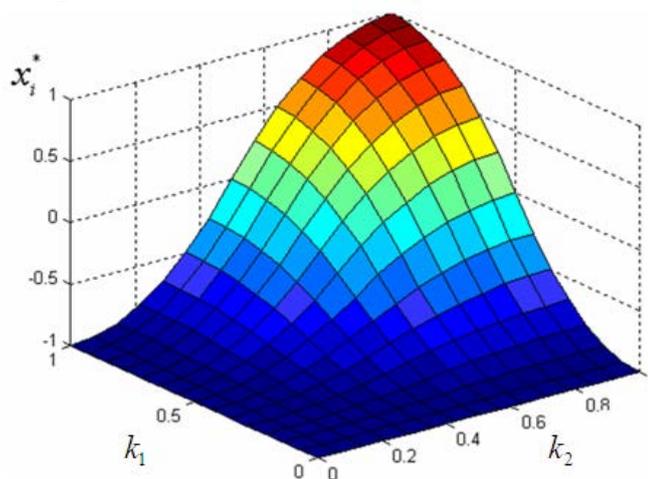


Fig. 3. A surface of the fuzzy sub model of diagnosing

Similar sub models are involved for making each fault decision, having received a set of current factors of faults progress $X = \{x_i^*\}$, $i \in [1, \dots, n]$. As a progress of any faults leads to the object refusal an approximating minimum function is chosen. The approximation is carried out by a radial basic network with Gauss functions of activation [4], with displayed target layer linear neuron (Fig.4).

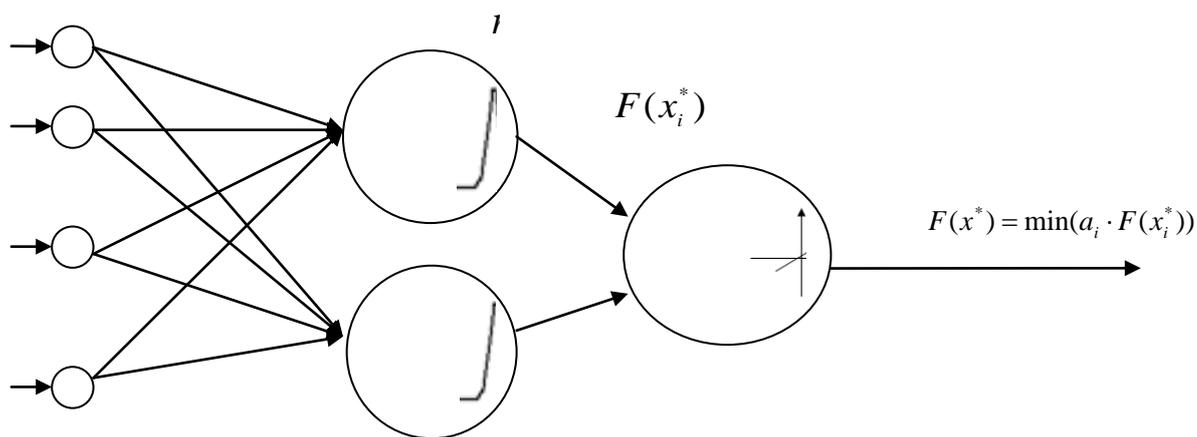


Fig. 4. Structure of a neural network of the used approximation

Output of the radial neuron:

$$F(x_i^*) = \sum_{i=1}^N \rho(\|x_i^* - c_i\|),$$

where N - the number of neurons in the hidden layer; c_i - the center vector for neuron i ; ρ - Gaussian; $\| \|$ - the Euclidean distance.

Outputs of the radial neuron are multiplied by weights vectors of the linear neuron. Weights vectors of the linear neuron are set on an interval $[-1, 1]$ such that maximum $F(x_i^*)$ corresponded the minimum weight. As training function is the minimum then the output of the linear neuron:

$$F(x^*) = \min(a_i \cdot F(x_i^*)),$$

where a_i - are the weights of the linear output neuron.

The received output value allows to estimate a current condition of the object, having carried it to one of the following classes: $F(x^*)=1$ - serviceable; $0 < F(x^*) < 1$ - operative; $-1 \leq F(x^*) \leq 0$ - corrupt.

If the BLDC actuator is operative, it is possible to forecast it's technical condition. Forecasting is carried out in two stages. In the first stage it predicts the following values of the function. In the second stage the outputs of the first phase are approximated and are determined by the state of the BLDC actuator next time.

Experimental results

The proposed method of diagnosing has been evaluated on the BLDC actuator having the principal structure as depicted in Fig.5. The used BLDC drive in the experimental setup in laboratory of Institute of Control Theory and System Engineering (RST) at TU-Dortmund. Further details to the experimental system can be found e.g. by [5].

Rotary motion of the BLDC motor is transferred through the coupling of the reducing gear connected to an actuation mechanism. Current measurement is carried

out within a low level BLDC control, therefore using a spectrum current it is possible to determine only the technical condition for BLDC with the full load which is directly connected with it. Reducing gear is a constant passive load and there is no variable influence on a frequency spectrum of the current consumed by the motor.

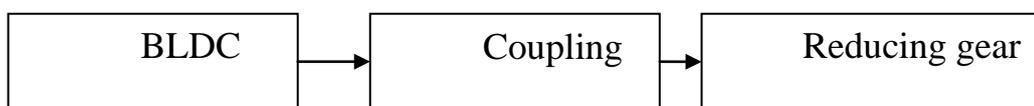


Fig. 8: Block diagram of a BLDC drive

In Tab. 1, the basic typical faults of the BLDC motor and their characteristic frequencies are summarized [6].

Time series of the consumed current of the motor are recorded at frequencies of rotation 1, 10, 15, 20, 25 and 30 Hz. Two types of equivalent measurement were performed, once with a priory faultless coupling, and once with a damaged coupling that exhibits a side crack. The collected data is converted by fast Fourier transformation to the frequency domain and scanned by the aforementioned method. Results of diagnosing at various frequencies of rotation of the BLDC motor are presented in Tab. 2

Table 1

Characteristic frequencies for a motor current

Faults	Frequencies for a current signal
Commutation faults	$2 \cdot k \cdot p \cdot f_r$ $k \cdot f_r$
Rotor faults	$2 \cdot p \cdot f_r$, $k \cdot f_r \pm 2 \cdot p \cdot f_r$
Voltage ripples	$k \cdot f_s$
Coupling faults	$k \cdot f_r$
Stator faults	$2 \cdot f_s$

where f_s - frequency of power supply for the rectifier, Hz;

f_r - rotation frequency of the motor, Hz;

$k = 1, 2, 3$ - current harmonic number;

p - number of poles.

Table 2

Value of diagnosing function at various frequencies of rotation of the motor

Fault type	Rotation frequency, Hz					
	1	10	15	20	25	30
Commutation faults	0,5	0,6324	0,9398	0,5	0,5	0,9470
Rotor faults	0,5	1	1	0,5	1	1
Voltage ripples	0,0011	0,7964	1	0,5	0,4984	0,5154
Coupling faults	-1	-1	-1	-0,1354	-1	-1
Stator faults	1	1	1	1	0,9753	0,7871

Results of the diagnosing testifies the coupling fault. From the Tab. 4 it is visible, that to the same faults on various frequencies of rotation there are corresponding various values of diagnosis function. For an establishment of the reasons of these divergences it is necessary to carry out the analysis of amplitudes on characteristic frequencies of diagnosing.

Conclusions. The neuro-fuzzy method of diagnosing BLDC motor on a current spectrum is described. The analysis of initial data has shown, that the spectrum of the current which has been removed on low frequencies of rotation (1 Hz), has a large noise contribution which hinder to analyses properly the characteristical fault frequencies. In the current spectrum which has been obtained on frequencies 10, 20, 25 and 30 Hz there is an impose of harmonics of a power line and rotation that can give an uncertain information about a currently technical condition of the motor. The most informative spectrum is obtained on the frequency of rotation of 15 Hz at which there are marginal imposing harmonics. The described neuro-fuzzy method of diagnosing allows to determine the technical drive condition, using the current spectrum of the steady-state drive, from which the normalized characteristical values are determined. The latest ones constitute an adequate input for the applied neuro-fuzzy method.

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Fenko O.G., Lysenko D.I.

PROBLEMS OF SAFETY OF SOFTWARE*Poltava National Technical University named after Yuri Kondratyuk*

*Abstract*In-process analysed the international documents and norms from protection of the information. The resulted examples of typical threats for information resources the analysis of model of modern technology harmful programs and maintenance of protection is lead by the example of API-functions and DLL-functions operational system (OS).

Key words: information safety, modern harmful technologies software

Introduction. Safety of information technologies (IT) shows by itself conception of issues of the day of computerization of the state. Her decision is determined, in the first turn, by the presence of legislative acts and normatively-technical documents on providing of safety of IT.

The estimation of safety of information technologies and foods of IT is based on the criteria of safety of the computer systems resulted in basic documents. Basic documents in area of estimation of safety of IT are:

1. Federal criteria information technologies
2. TCSEC

There is a row of international standards that try to decide this problem, however up to the last time they could not apply on that, to become a managing document to the action or even to lay the foundation of safe information technologies of the future. In different countries, including in Ukraine, worked out documents that show by itself only some inheritance to the foreign standards of ten year remoteness. In the conditions of general informatization and computerization of major spheres of state machine to the country new decisions are simply needed in this area. In recent year in the world a problem that is related to providing of safe activity of people in general became sharp sharply. In the conditions of political and economic instability in the world now constantly there are the different negative phenomena from local wars to international terrorism.

Providing of safety appeared straight related to informative safety in the consequence of deployment of information technologies practically in all areas of human activity.

As computer systems now are straight integrated in the informative structures of modern society, facilities of defence must take into account the modern forms of presentation of information. It means that the systems of defence must provide safety at the level of informative resources, but not separate documents, files or reports.

This task needs to be decided in a global scale, without regard to that parties that participate can be in different parts of planet, function on different vehicle platforms and for different WASP.

Experience of exploitation of the existent systems showed that today from the systems of defence new functions are required quite, namely, possibility of providing of safety in the conditions of any their co-operating with similar facilities, including

at appearance into their programs that carry out destructive actions - computer viruses, automated facilities of fracture, aggressive agents. It seems on the face of it, that this problem is settled by facilities of differentiation of access, however it not quite so, that confirmed by the known cases of distribution of computer viruses in the "protected" systems. Integration of priv in the process of automation of her treatment is a mandatory member. In an order to be claimed by the modern market of the informative systems, facilities of safety not must substantially worsen descriptions of existent applications and formed technologies of treatment of information, but vice versa, must become inalienable part of these facilities and technologies. The Countries-participants of European Union have the concerted system of priv in certain sense, but at the same time she is ramified, because, as marked higher, although there is Directive in relation to Defence of personality with the observance of the mode of the personal data and free motion of such data, that regulates certain questions in principle, but here almost every country of EU has the laws, positions, instructions, in relation to the settlement of questions of safety of information. Such system has the advantages, and defects. A defect consists in that exchange information between countries becomes complicated through certain mismatch in the normative acts of countries, about what it was marked higher. The same problem exists in the relations of EU and Ukraine, as an informative legislation in general does not coincide with determinations of concepts in the legislation of European Union.

For Ukraine of question of informative war actual, as never and software can inflict irreparable harm to not only informative space but also safety of Ukraine that is why defence of software product, his "rightness" is very important. In today time became obvious, that activity on a priv and providing of informative safety is one of major tasks of providing of sovereignty and defensive capacity of Ukraine. Informative space becomes territory of informative wars (for example connect with events on east and in Crimea), that give an opportunity of creation of facilities of harmful effect on informative spheres, violation of the normal functioning of the informative and telecommunication systems, and also receipt of unauthorized division to them. A basic problem at defence and estimation of vulnerable places in the operating systems is access that will be realized at the level of user control. In dependences on tasks, that needs to be decided by means of the computer system, the type of access that will be entered in the informative system control is elected. An error in the question of division of rights between users can result in the source of valuable information or her complete loss. Technology of management of informative safety of the state the system forms such system of informative safety that will allow assuredly providing defence and safety; if there will be the real threat to national safety of Ukraine. Technology of management informative safety is based on general approach, intended for development, introduction, functioning, monitoring, revision, support and perfection of informative safety.

Aspiring of our country to high to the level of informatization generates the problem of informative safety. This problem of actual is for the whole world that goes on the way of integration. It should be noted problem of free software the

Obligatory requirement verification and certification of the accepted foods by means of the specialized programs that it costs to buy in, must become. At first a source code is analysed static, then dynamically in an operating condition with the exhaustive search of entry parameters in different working terms (variation of volume of main and virtual memory and others like that). At the exposure of vulnerable and errors in code, the programs are passed to developer on work. After it the program acts on the repeated testing. In wide sense under reliability of software understand his ability to function without the display of any negative consequences for the concrete computer system and her user. One of such negative consequences there is violation of integrity and confidentiality of information in the programmatic complexes of the computer systems or grant software functionally of useless results of treatment of information. The aggregate of internal and external informative threats is created by pre-conditions for by violation safe functioning of the system of informative safety.

Conclusions. Marking the high level of activity and personal interest of international concord in the strategic decision of problems of development of informative space, considered determination of informative safety, that is complex and experience of leading countries in this sphere that can become an example for Ukraine in forming of her own strategy in an informative environment.

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J21510-016

Serikuly Zh., Zaurbekov M.N., Kumisbekov S.A.
DROP STRUCTURE GAS-LIQUID LAYER IN THE VOLUME OF
REGULAR MOBILE PACKING

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Key words: modeling, aggregation process, dispersions.

Introduction. At the industrial enterprises for carrying out mass transfer processes (absorption, distillation, extraction) and contact cooling of gas and liquid got widespread packed columns along with disk-shaped devices. Regular and irregular packing are used in it as the contact devices. Irregular packing (Raschig rings, Pall, Berl saddles, packing of HY-PAK, CASCADE-RINGS and «Inzhekhim») [1,2] have an increased flow friction. They have a comparatively small efficiency and are not able to operate with dirty gases and liquids.

Regular packing INTALOX, Sulzer, Koch, «Inzhekhim», Norton, «Vakupak» «Glitch -Grid», Mellapak, MellapakPlus, Mellagrid and netted packing BX and CY contain regular channels, owing to which they have some minimal flow friction and a high efficiency. However, they are subject to overgrowing by hard deposits.

The work [3,4] shows the study results of hydrodynamic characteristics of apparatuses with a regular movable packing of cylindrical, lamellar and ball shapes, for obtaining the dependences for calculating the coefficients of hydraulic resistance, the number of retained fluid.

The aim of the research work is to study the hydrodynamic and kinetic characteristics of movable devices with a regular lamellar, cylindrical and ball shapes with dispersed details containing the liquid phase and to obtain the calculated dependences for the determination of mass transfer coefficients in the gas phase and the diameters of the drops.

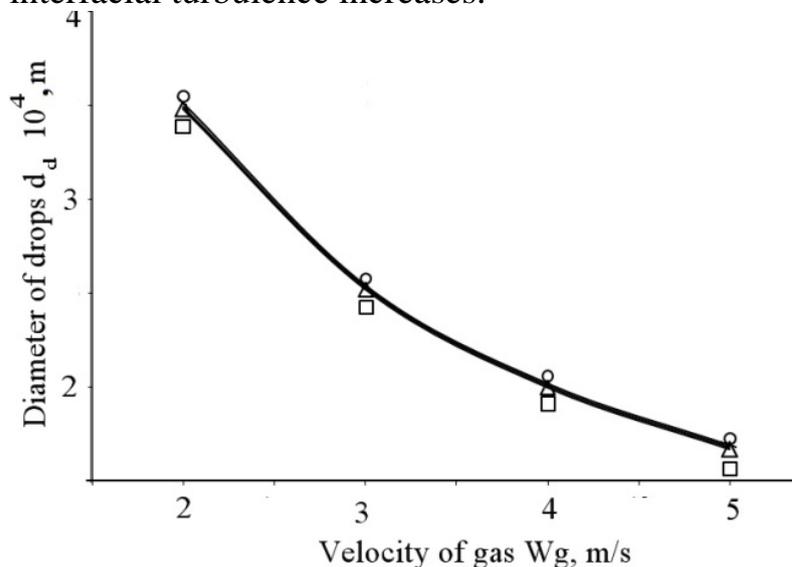
In this regard, the task of the work includes an experimental research of mass transfer coefficients in the gas phase and droplet diameters in the movable devices with a regular packing of lamellar, cylindrical and ball shapes and obtaining the calculated dependences of examined parameters.

Materials and Methods. Studying of mass exchange characteristics of devices with the regional wire packing was carried out on the experimental installation including a column in diameter of 1,0 m and a height of the working space of 1,0 m [4]. Movements of gas and liquid streams were carried out in a counterblow mode. Installation was equipped with a gas blower providing the gas flow rate in the working space of the device $W_g = 1-5\text{m/s}$, the pump allowing to create the irrigation density of $L = 10-75\text{ m}^3/\text{m}^2\cdot\text{h}$, devices for measuring the gas velocity, liquid flow rate, hydraulic resistance, psychrometers to measure the moisture content in the gas flow, thermometers and measured capacities.

Experimental values of diameters of drops were determined by statistical processing of photos.

Research diameters of drops was carried out for lamellar, tubular and spherical packing elements.

Results. The graphs of dependence of diameters of drops $d_d=f(W_g)$ from W_g are presented in figure 1, respectively. Analysis of these curves shows that, structure of a gas-liquid layer undergoes a change, the average diameter of drops decreases (figure 1), and, hence, the interfacial turbulence increases.



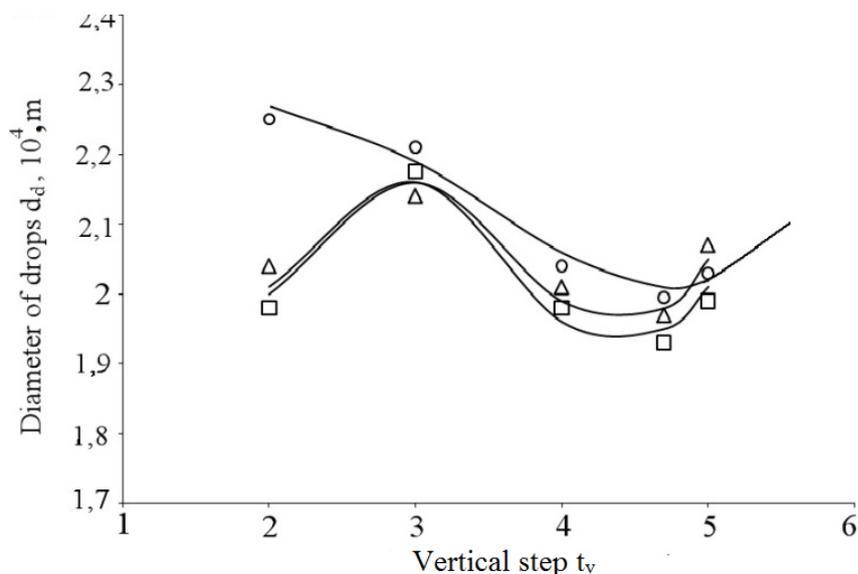
- - is a ball at $L=25 \text{ m}^3/\text{m}^2\cdot\text{h}$; $t_v/d_b=4,7$; $t_r/d_b=2$;
- - is a cylinder at $L=25 \text{ m}^3/\text{m}^2\cdot\text{h}$; $t_v/d_c=2$; $t_r/d_c=2$;
- Δ - is a lamina at $L=25 \text{ m}^3/\text{m}^2\cdot\text{h}$; $t_v/b=2$; $t_r/b=2$;

Figure 1. Dependence of diameter of drops of a liquid d_r , 10^{-4} m from the gas velocity W_g

Values of mass transfer coefficients in the gas phase increase if density of an irrigation L increase. This is due to the fact that the surface of contact between phases is determined significantly by the surface of liquid drops, the number and diameter of which increases with increasing density L . In turn, growth of the drops quantity is caused by increasing the speed of liquid movement on a packing and intensity of inflow of fresh liquid in a contact zone. It is known [5,6], the increase in density of an irrigation at absorption of well soluble gases influences significantly on efficiency and causes additional expenses on pumping of liquid at increased values.

Adhering to the general recommendations, the choice of optimal density of irrigation can be performed on the basis of experience data directly in the study of the absorption process of a gaseous component by the accepted absorber and data on hydrodynamics.

In addition to regime parameters (the velocity of gas W_g and the density of an irrigation L), relative position of packing elements (step deployment of elements of a packing in the vertical t_v/b and radial directions t_r/b) has a significant influence on the mass transfer process.



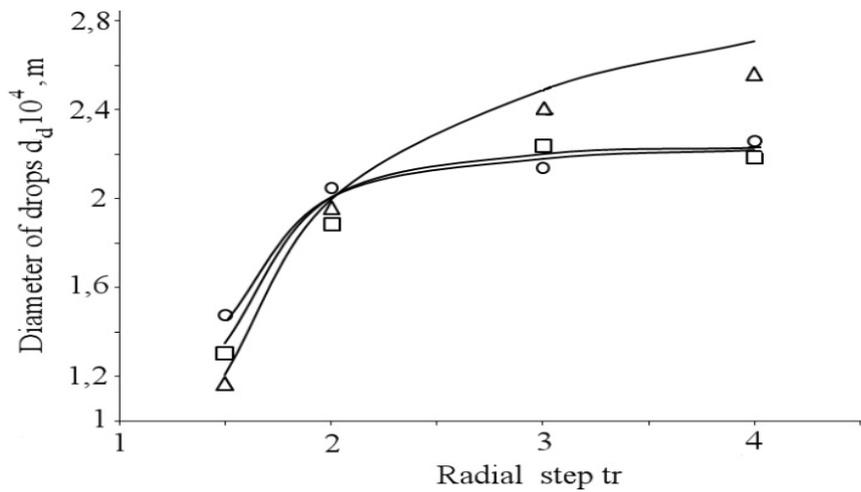
- - is a ball at $L = 25 \text{ m}^3/\text{m}^2 \cdot \text{h}$; $t_r/d_b = 2$; $Wg = 4 \text{ m/s}$;
- - is a cylinder at $L = 25 \text{ m}^3/\text{m}^2 \cdot \text{h}$; $t_r/d_c = 2$; $Wg = 4 \text{ m/s}$;
- △ - is a lamina at $L = 25 \text{ m}^3/\text{m}^2 \cdot \text{h}$; $t_r/b = 2$; $Wg = 4 \text{ m/s}$.

Figure 2. Dependence of the diameter of liquid drops $d_d \cdot 10^4 \text{ m}$ from the vertical step t_v

Influence of steps of an arrangement of a packing elements on structural changes of disperse liquid phase illustrates visually the schedule of dependence of $d_d = f(t_v)$ (figure 2).

As it is seen in figure 2, the minimum values of d_d are observed in the curves $d_d = f(t_v)$ in the range of the vertical steps t_v from 2 to 6, corresponding to values of $t_v = 2$ and 4 for the tube bundle and plates, as well as $t_v/d_b = 4,7$ for the balls. It was noted above that approach of in-phase modes corresponds to these steps. These modes are characterized by the creation of powerful vortices that crush jets into smaller drops. The in-phase mode is broken at other values of steps, the capacity of vortices decreases and diameter of crushable drops grows.

In a series of studies of droplet diameters, it has been found that there are two plots of the curve changes at change of radial steps t_r (figure 3). To $t_r < 2$ the diameters of drops are much lower than for $t_r \geq 2$. The obtained results are confirmation of the above-described mechanism of vortex formation, according to which the frequency of vortex shedding to the critical step $t_r = 2$ is defined by the value of gap between packing elements in the radial direction, while exceeding the critical step leads to the fact that the vortex shedding frequency is determined by the size of streamlined elements of a packing. Therefore more powerful vortices with the high relative frequency of their failure at $t_r > 2$ significantly contribute to the formation of small droplets than in the case where the vortices are formed behind the packing elements.



- - is a ball at $L = 25 \text{ m}^3/\text{m}^2 \cdot \text{h}$; $t_v/d_b = 4,7$; $Wg = 4 \text{ m/s}$;
- - is a cylinder at $L = 25 \text{ m}^3/\text{m}^2 \cdot \text{h}$; $t_v/d_c = 2$; $Wg = 4 \text{ m/s}$;
- △ - is a lamina at $L = 25 \text{ m}^3/\text{m}^2 \cdot \text{h}$; $t_v/b = 2$; $Wg = 4 \text{ m/s}$.

Figure 3. Dependence of diameter of drops of liquid $d_d \cdot 10^4 \text{ m}$ on the radial step t_r .

Mechanism of decomposition of liquid drops in the layer of a regular mobile packing is complex [7] as crushing occurs there both because of deformation of drops, and under the impact of moving with a high speed drops on the packing and with each other. Depending on the kinetic energy of colliding particles and liquid particles of packing elements, both decay of drops, and sticking to the packing, and also the coalescence of the liquid particles can occur. Such constant and multiple change of acts of crushing and merging tends to equalization of the size of drops. Therefore estimating dependence of the average integral value of diameter of drops from basic parameters of the layer is of interest for the calculated equations.

The crushing mechanism of drops in an entire stream is explained [7] based on the theory of locally isotropic turbulence. Applying the balance equation of the forces, operating on a drop, for calculating the diameter of drops of liquid, the following equation is obtained:

$$d_d = B_k \cdot \xi_L^{1/3} \frac{\rho_l^{1/6} \cdot \sigma^{1/3} \cdot d_{jl}^{2/3} \cdot U_g}{\rho_g^{1/2} \cdot U_{jl}^{5/3}}, \tag{1}$$

here ξ_L is the resistance coefficient of an irrigated packing; ρ_g is the gas density, and ρ_l is the liquid density in kg/m^3 ; σ is the surface tension in N/m ; d_{jl} is the diameter (m) and U_{jl} is the velocity (m/s) of a liquid stream; B_k is a correcting coefficient.

$B_k = 0,07$ for a lamellar packing; $B_k = 0,067$ for a tubular bunch with round pipes; $B_k = 0,072$ for a ball packing.

Discussions. The study identified that as the velocity of the gas mass transfer coefficient in the gas phase are growing, and the diameters of drops falling. The diameters of drops grow with increasing the irrigation density. The increase in steps of an arrangement of the packing elements in the vertical direction leads to modes of simultaneous vortex formation (in-phase modes) which are achieved at $t_v / b = 2$ and 4

for a lamellar and tubular packing, respectively and at $t_v/b=4,7$ for a spherical one. If steps of an arrangement of elements of a packing are changed in the radial direction, two domains are identified, differing with sources of vortex formation. For $t_r/b < 2$, a source of vortex formation is the gap between packings, and for $t_r/b \geq 2$ it is the width of streamline packing bodies. The diameter of drops is determined based on the theory of locally isotropic turbulence and the balance equation of the forces operating on a drop.

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**DYNAMICS OF ANTHOCYANS AND ASCORBIC ACID IN EXPOSURE
ON DROP AND STORAGE SPIRITED STRAWBERRY JUICE FROM
DIFFERENT VARIETIES**

¹National university of life and environmental sciences of Ukraine, Kiev

²National university of horticulture, Uman

³Taras Shevchenko National University of Kyiv, Kiev

⁴University of Applied Sciences Weihenstephan-Triesdorf, Weidenbach,
Germany

The article the influence of technological operation exposure on drop on changes anthocyanins and ascorbic acid of strawberry juice and their changes during long-term storage are present

Key words: berry, strawberry, heat treatment, anthocyanins, ascorbic acid, storage, quality.

Introduction. An important task of processing industry is the production of high-quality, biologically valuable and competitive products. Ukraine has a very big potential for growing and processing of this culture, currently the world production in 2014-2015 years there were over 4,4 bln. tons. European and American countries produce 75 % of the world strawberry (37 % and 38 %) and in Asia - only 16 % [2, 10].

Strawberry is a culture that is sensitive to the optimum weather conditions and providing mineral nutrients. Under optimal conditions, it is able to form a complex berries biologically active substances [1, 11].

Flavonoids - is one of the most different and widespread group of phenolic compounds. They are an important part of the human diet due to their high antioxidant activity (potential ability to reduce oxidative stress that results from tissue damage) and antitumor activity. This group of substances include compounds with C6-C3-C6 carbon skeleton structure - a flavonony, flavones, isoflavones, anthocyanins, leucoantotsiany and others. Total flavonoid content in strawberries varies from 1,2 to 4,1 %. The concentration of catechins depends on the variety, cultivation area, cultivation techniques and formed in concentrations of 50 to 250 mg /100 g. Content leucoantotsianiv - from 60 to 300 mg / 100g, while noted that most of them accumulates in the unripe berries. In general, the composition and the total number of phenolic substances change during the ripening of fruit, as in qualitative and quantitative terms, and is the varieties' basis [4, 7, 11].

Raw materials fruit has a certain technological reserve of nutrients that can remove to juice. For this wine using various technological methods, including heat treatment pulp [14].

In strawberries pigment accumulates phenolic resveratrol, which has a wide range of physiological effects, is involved in redox processes, immune reactions, causes inflammatory, sensitizing, antitumor, radioprotective effect, has a high antioxidant activity. At the same time, resveratrol is quite well tolerated by the human body, its daily consumption of 400 mg is safe, and the recommended dose is 50 mg

per day [5, 9, 14].

Currently phenolic compounds with high biological activity. They are active metabolites of plants, including participating in the growth, reproduction, resistance to pathogens causing pigmentation of leaves, stems, flowers, fruit. In humans also exhibit a number of properties: P-vitamin (the normal state support capillaries, increasing their strength and permeability), antioxidant, antitumor, radioprotective, etc. Phenolic compounds not have toxic properties. It is interesting to note that the juices are less expressed antioxidant properties than wine, although the content of phenolic compounds in them more [3, 6].

Established that wine phenolic substances removed from the human body peroxynitrite, whose presence causes cardiovascular disease, including atherosclerosis. The use of moderate amounts of red wine and juice, helps to eliminate from the body of piroksinitryt. The effectiveness of red wines is 10 times higher than pink, and 18 times - than whites. Illumination of wines bentonite, gelatin, polivinilipirolidonom helps to remove phenolic compounds of wine, and efficiency decreases output piroksinitryt 185 times [8, 11].

The purpose of our research was to identify quantitative changes anthocyanin content and ascorbic acid for treating pulp impact during production and storage of strawberry spirited juices.

Place of the, objects and methods of research. Research performed in the laboratory of food technologies innovative gardening of the Institute Horticulture NAAS, department of storage technology, processing and product standardization after B. V Lesik National university of life and environmental sciences of Ukraine and at the department of technology of storage and processing of fruits and vegetables Uman National University of Horticulture.

Berries are three sorts (Yasna, Tenira Coral and 100) were taken in full ripeness crushed, added SO₂ concentrations of 50-75 mg/kg. Pulp heat treatment was carried out at intervals: 40, 50, 60, 75° C. A control was spirited juices, prepared in the traditional way without additional processing pulp. The resulting samples are laying on the storage and investigated by biochemical and organoleptic characteristics by conventional methods in winemaking [12, 13].

Results and discussion. Applying heat treatment process taking pulp strawberry significantly affects the concentration of anthocyanins and ascorbic acid in strawberry juice (figure. 1, 2). The highest concentration is intensely colored juices spirited varieties of berries Koralova 100 (over 63 mg/l), lowest – Yasna (21,1). Increase of anthocyanin (A) in spirited juices detected by heating to 40° C - на 2,25%, 50 – на 11%, 60 – 11,4, 75° C – 13,6 %. Increasing the concentration of A in spirited juices, probably due to the inactivation of enzymes and destruction of cell membranes, and a high temperature processing not helped raise the concentration of A, but it causes more intense oxidation.

The dispersion analysis treating pulp strawberry impact on the concentration of A in spirited juices showed them the greatest influence on the formation of this indicator than the varietal characteristics of culture (6%).

Research changes the content of ascorbic acid (AA) in strawberry juice spirited for treating pulp revealed another pattern (fig. 2).

Control juices (without treatment) containing different concentrations AA. The highest - in the juices from berries Koralova100 (15,1 mg/l), the lowest - with a variety Yasna (7,2 1 mg/l).

Applying treating to pulp to 40 °C leads to increased concentrations AA on 15,6 %, 50 – 40,7, 60 – 39, 75° C – 33 %. Analysis of the data revealed that the most optimal is the use of treating to 50° C pulp, because at a higher temperature observed reduction of AA on 4-6 %.

The dispersion analysis treating pulp strawberry impact on the concentration of ascorbic acid in spirited juices shows the figure is more on the varietal characteristics used varieties.

Organoleptic evaluation of samples revealed that the use of treating pulp affect the organoleptic characteristics spirited juices in general (table 1). Samples of prepared pulp with heating to 50 °C and 60 characterized by a rich flavor and aroma. Heating pulp to 75 °C had negative consequences, such as the emergence of boiled tones in the aroma and significant decrease in the yield of juice.

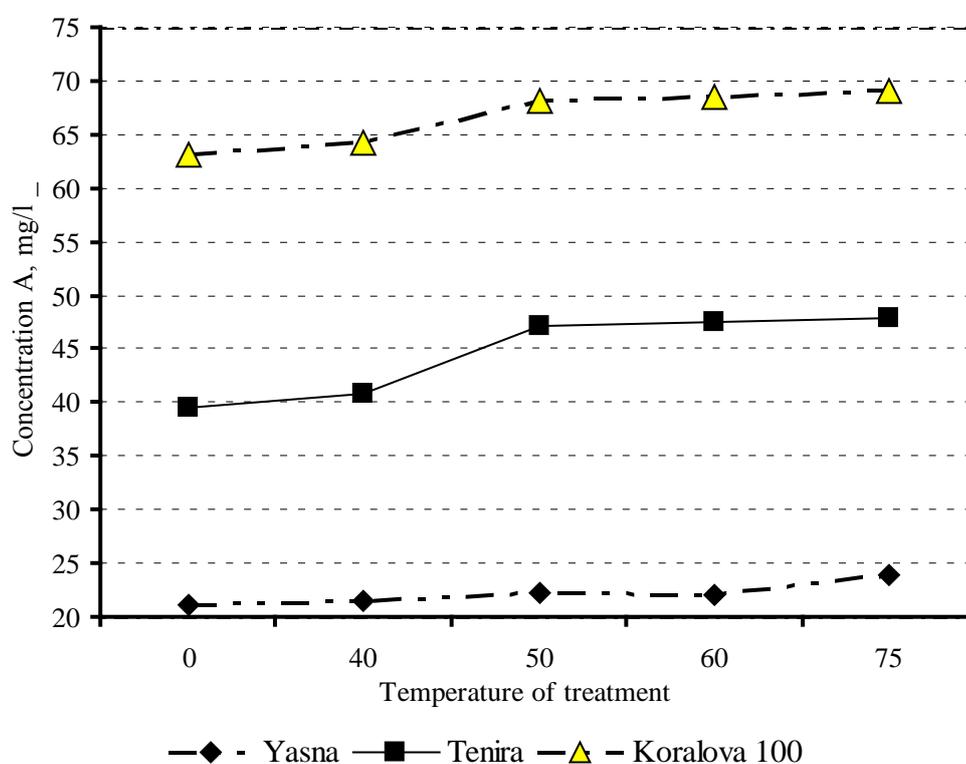


Figure. 1. The concentration of anthocyanins in strawberry spirited juices by treating pulp.

To study the stability of the components studied biochemical composition and quality of the samples spirited juices laid for long-term storage (Fig. 3). Reducing the concentration of anthocyanins in spirited juices found 10-11% after 3 months of storage for further storage - significant changes were detected.

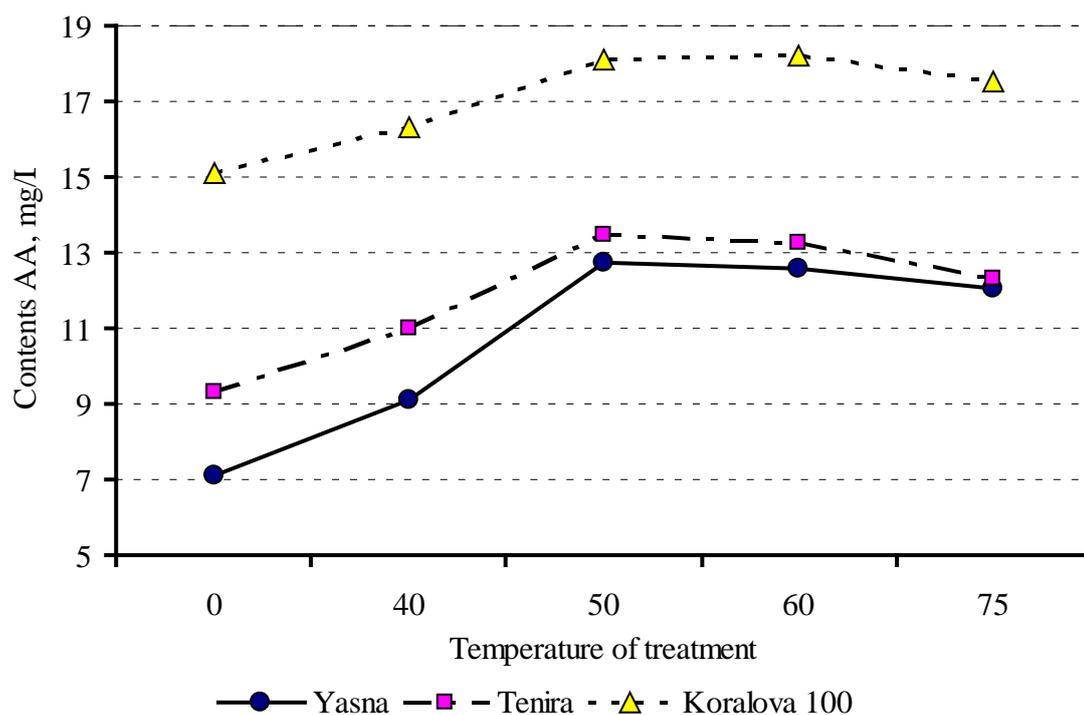


Fig. 2. Effect treating of pulp on the concentration AA in spirited juices strawberry.

Table 1

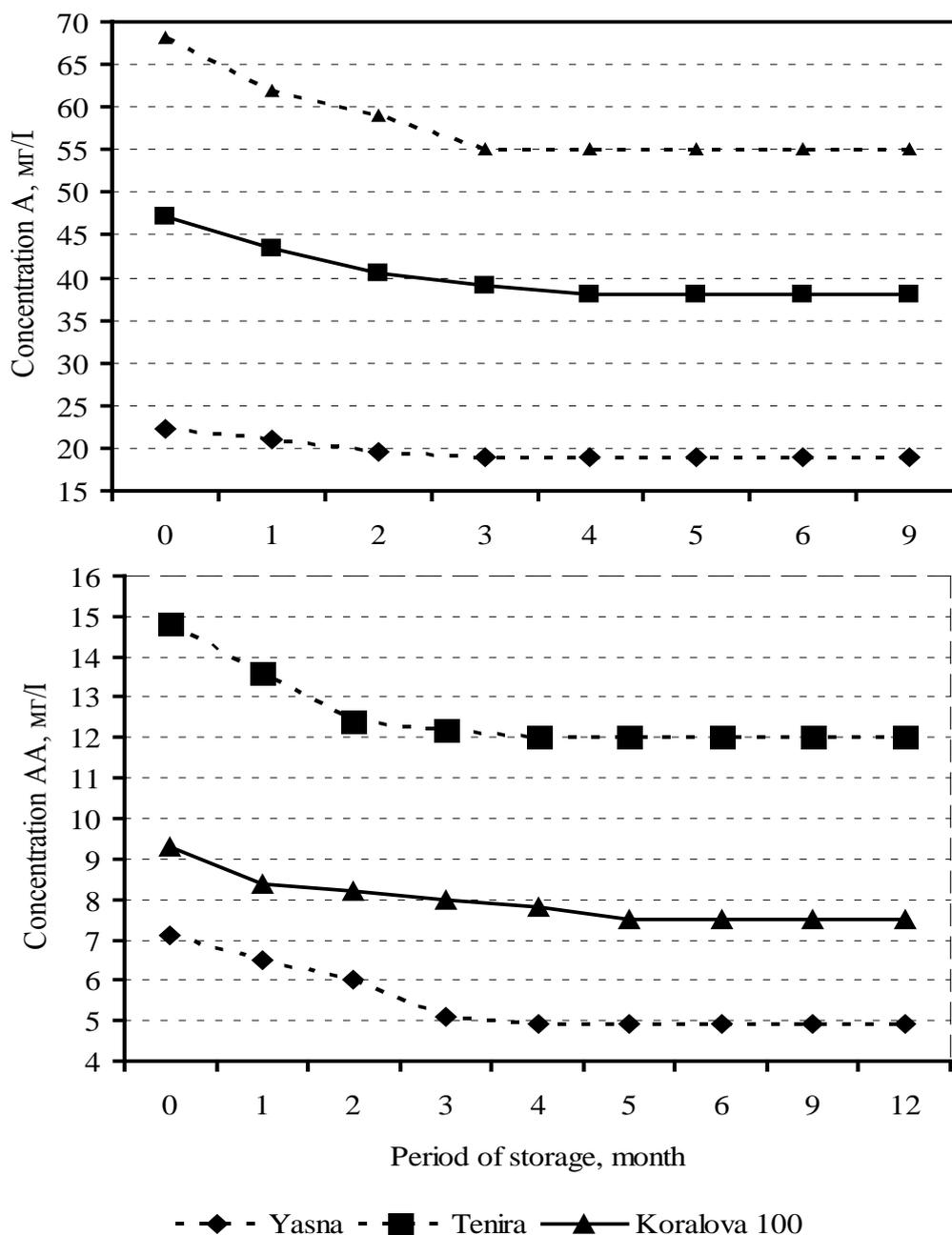
Tasting score specimens spirited strawberry juice, points

Sort	Heating pulp, °C				
	0	40	50	60	75
Korolova 100	8,18	8,2	8,30	8,40	8,34
Yasna	8,0	8,4	8,48	8,43	8,36
Tenira	8,13	8,3	8,42	8,42	8,32
Середнє	8,10	8,30	8,40	8,42	8,34

3. Dynamics of A and AA for long-term storage spirited strawberry juice

Noted that the prolonged storage of juices spirited with strawberry varieties Tenira, observed browning and reduce transparency, loss of dark brown sludge and worsening of flavor (strawberry tones appearance boiled jam). Thus spirited juice from the berries grade Tenira not recommended to store more than 6 months.

The dispersion analysis treating pulp strawberry influence on organoleptic spirited juices showed that they are more dependent on application receiving treating than the varietal characteristics (less than 8%)



Conclusions. For produce high quality fruit berry wines and alcohol-containing beverages with a high content of bioactive compounds and a rich taste and aroma, it is advisable to apply heat treatment to 50° C. For long-term storage of recommended varieties with more stable complex anthocyanin (Zasna and Korolova 100), and the juice obtained from berries grade Tenira keep no more than 6 months. The results expedient to consider in the production of new domestic natural alcohol-competitive products of high quality and biological value.

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Voytsekhyvska O.

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DETERMINE THE EFFECT OF COMPOSITION OF THE SUBSTRATE TO BIOGAS OUTPUT

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Abstract: It was found that due to the growing energy crisis, the limited resources of natural gas, biogas, raw materials for the production of which in Ukraine with excess, can become a real alternative to the "blue fuel". It was determined that the yield of methane from the substrate depends on the content of proteins, fats and carbohydrates. In addition, one of the most important factors for the stability of methane fermentation is the ratio of carbon and nitrogen in the substrate. The effect of the type of substrate on the biogas yield. It was found that the feeding of cattle feed containing a large amount of cellulose, biogas yield decreases. When the fermentation of chicken manure an increase in the yield of biogas, which is due to the low content of methane poorly lit

Keywords: biogas, methane, substrate, chicken manure, pus SEC, the ratio of carbon to nitrogen

Introduction. Energy supply of mankind is increasingly dependent on natural gas because of the ease of use and environmental friendliness. However, the proven natural gas reserves will be enough only 60 years old. Though Ukraine ranked third in Europe in terms of natural gas production, provide themselves with their own gas by only 20%. The rest is exported. But in Ukraine is enough raw material to produce an analog of natural gas – biogas, produced from biological raw material (manure, waste agricultural production and processing of agricultural products, biomass, etc.) in the biogas plants. However, the efficiency of biogas production is largely dependent on the composition of the substrate [1].

Literature review. Each type of microbial anaerobic decomposition of different specific needs for macro- and microelements and vitamins. Concentration and availability of these components affect the rate of growth and activity of various populations. Depending on the type of microorganism there is a minimum and maximum concentration, which is difficult due to the definition of the manifold crops and partially pronounced adaptive capacity. To receive the substrates from methane possibly more, should provide an optimal supply of nutrients to the microorganisms. As a result, as methane may be produced from the substrates used, determined by the content of protein, fat and carbohydrates. These factors equally affect the specific nutrient requirements [2].

Of all the wastes pig manure on the level of the crude oil has a uniquely high. Since fat is due to the high energy content and easy solubility has a very high yield of gas, it can be assumed that the pig manure is best suited for the production of biogas than chicken manure and cattle manure. Unfortunately, this advantage is mitigated somewhat low in organic solids and high water content.

The cattle manure through the ration contains more crude fiber, which is well decomposed only after a long fermentation. Less use different pig manure and

chicken manure in protein and carbohydrates. Both of these materials are well biodegradable. The high content of proteins is often associated with high-protein food. However, increased protein content in the feed may cause an increased content of hydrogen sulphide in the biogas. Nitrogen, which contains carbohydrates, although the methane bacteria and is not necessary for the production of gas, but essential for the formation of their own cellular substance (protein).

For the stability of the process must be balanced ratio of macro- and micronutrients.

With the most important trace elements for the symbiosis of bacteria is carbon and nitrogen. Carbon is the basis of constructive biogas. Nitrogen is needed for the formation of enzymes that carry out metabolism in bacteria. Therefore, one of the most important factors for the stability of methane fermentation is the ratio of carbon and nitrogen in the substrate. If this ratio is too large (many small C and N), as a result of insufficient metabolic available carbon can not be fully processed, thus decreasing yield biogas. If a lot of little N and C, due to an excess of nitrogen can form a large amount of ammonia, which even in small concentrations, inhibits the growth of bacteria and may even lead to the complete destruction of the entire population of microorganisms. Therefore, to ensure the stability of C / N ratio is in the range from 10 to 30 [2]. In this range fall into the manure of cattle, horses, pigs, fresh grass. [3]

Input data and methods. Research of influence of the type of substrate on the yield and the thermal value of the biogas was carried out on different substrates (manure of cattle manure, chicken manure, and mixtures thereof), on cattle manure, resulting in the consumption of cows different feed, which is based in one case were kontskorma and hay, in the other case – straw. Methane fermentation was carried out with a batch of substrate. The load factor of 29 m³ digester is 0,75. The study was conducted at the temperature of the fermentation substrate 40°S with stirring.

Results. Discussion and Analysis. Investigation of the effect of feeding cattle biogas output is shown in Fig. 1. Biogas output during the exponential phase and a phase of slowing growth (11 days) when fed with hay and concentrated feed was 7179 cm³/day. When base feed was straw biogas yield was 4125 cm³/day. From the foregoing, it follows that in the presence of large amounts of manure, undigested cellulose, the yield of biogas is reduced by 1,7 times.

When using as substrate chicken manure, in comparison with cattle slurry, biogas yield increases dramatically (Fig. 2). Thus, the output of biogas from chicken manure fermentation for 13 days is 91 845 cm³ or 3827 cm³/day, while for the 32 days of fermentation slurry 117112 cm³ or 3660 cm³/day. The period of the two most productive phases and phase – exponential slowdown is 9 days, during which the output of biogas from chicken manure is 8356 cm³/day of manure – 4881 cm³/day.

However, the fermentation of chicken manure, unlike slurry, an increased yield of hydrogen sulfide, as evidenced by the characteristic smell, while the yield of methane is less noticeable. For the first 10 days of biogas does not burn, the next few days there is burning, but it is very poor, with interruptions, often burning aborted.

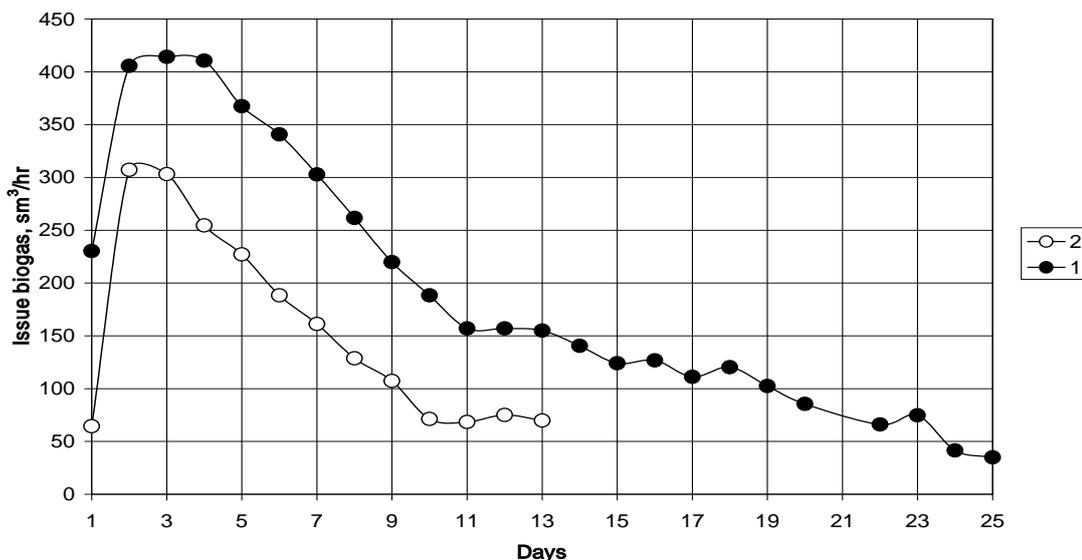


Fig. 1. The yield of biogas in the methane fermentation of cattle slurry moisture content of 93% at 40°C: 1 – after feeding cattle hay and concentrates; 2 – after feeding cattle roughage (straw)

When used as a substrate a mixture of manure and chicken manure biogas yield in comparison with the fermentation of pure slurry increases, but the methane content in biogas this low. For example, at a temperature of 50°C and fermentation 55°C complete combustion of the biogas is only observed on the 7th day of work digester at 45°C and 35°C – on day 4.

Burning biogas formed during the fermentation of manure, in most experiments was observed for the first fermentation, only a few cases recorded his lack of combustion in the first 1-2 days.

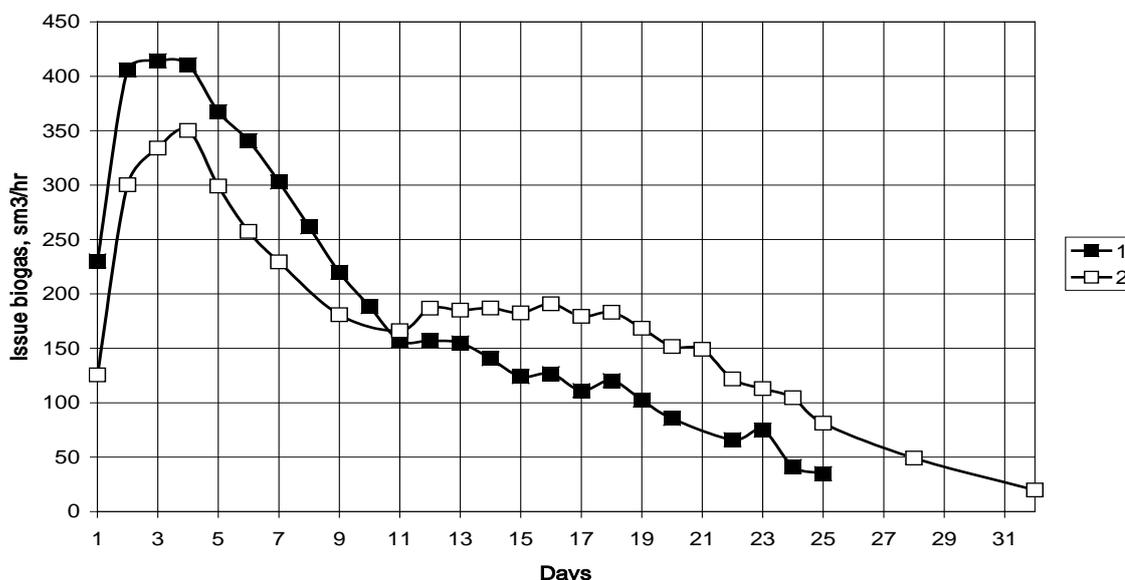


Fig. 2. The yield of biogas in the methane fermentation of different substrates without stirring: 1 – cattle manure humidity 93% at 40°C; 2 – chicken manure humidity 73% at 40°C

Summary and Conclusions.

When feeding of cattle feed containing a large amount of cellulose, the yield of biogas is reduced by 1,7 times.

Use as an additive to the substrate or substrate chicken manure causes a significant increase in the yield of biogas, which is, however, poorly lit due to a low content of methane and high concentrations of carbon dioxide and hydrogen sulfide.

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STUDY OF THE IMPACT TEMPERATURE DIGESTER BIOGAS OUTPUT

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Abstract: It was found that the biogas, which was a byproduct of biological treatment of waste, due to the energy crisis from arising can be a real substitute for fossil fuels. The effect of temperature on the efficiency of methane fermentation biogas generation. The groups of methanogenic bacteria for temperature control. The research on the effect of temperature on the yield of biogas digester. It is found that increasing the temperature of the methane fermentation leads to a higher yield of biogas, but it also increases the cost of heating the substrate

Keywords: biogas, methanogens, mode of fermentation, methane, lag phase, temperature, bacteria

Introduction. Mankind has long used live organisms for food. In the twentieth century at the intersection of biological, chemical and engineering sciences there biotechnology science that studies the use of living organisms and biological processes in the production. Since then, biotechnological processes have proliferated in medicine, food, light and-mining industry, waste management and agriculture. It is by living organisms to perform some basic cleaning processes of environmental pollution with the production of organic fertilizers. These processes can be carried out both aerobic and anaerobic organisms. The basic process of cleaning pollution in our time – aerobic, which, however, has some major drawbacks: require large areas of land are not always neutralized pathogens and helminth eggs and stuff. Therefore we began refining waste under anaerobic conditions in special reactors. In this byproduct of this process was combustible gas, which is either discharged into the environment, or partially used to maintain the process.

Recently, however, there was a global energy problem of humanity, which is the depletion of fossil fuels. Thus, the proven oil reserves left on the 45 years of production, the gas from the gas and oil fields – 60 years. The level of uranium production is no longer sufficient to provide fuel for all operating nuclear power plants. World coal reserves are some more: they will last more than 200 years of production, but it is burning associated with significant pollution.

So now actively search for new alternative energy sources. One such energy sources may act combustible gas produced in the anaerobic waste treatment.

As a result, biotechnological processes waste, other than cleaning the environment, produce an energy source – biogas. In a world built more biogas plants using agricultural waste and the purpose of which – biogas, which is used for power generation and as fuel for vehicles, including agricultural land.

Literature review. A very important factor in effective percolation of the fermentation process is the temperature of the substrate. Methane fermentation begins at 6°C [1]. Reducing the temperature of the environment can lead to the oppression of microorganisms, however, these changes are reversible, signs of recovery occurs

through 2-3 hours of incubation at optimum temperature [2]. Simultaneously with increasing the temperature rapidly increases gas evolution. Thus, at a temperature of 30°C biogas selection occurs 12 times faster than at 10°C. However, increasing the temperature decreases the methane content in biogas. This is due to the fact that at high temperatures the dissolved carbon dioxide in the substrate rapidly proceeds in the gaseous phase (in the biogas), thereby reducing the relative abundance of methane [1].

Depending on the temperature of benefits are three groups of methanogens: thermophiles, mesophiles and psychrophiles. Temperature zones of these groups of bacteria are shown in Table. 1.

Table 1

Temperature zones of life methanogens [2]

Temperature zones	Psychrophiles	Mesophiles	Thermophiles
Optimal	10-15°C	35-37°	50-60°C
Upper growth retardation	25-30°C	43-45°C	75°C
Lower growth retardation	0-5°C	15-20°	45°C

The psychrophilic mode there is no need to heat the substrate, but the performance degradation and the amount of gas produced is negligible. Therefore, profitable operation of biogas plants in psychrophilic mode is usually impossible. Most biogas plants operate in the mesophilic regime, since in this case are relatively large volumes of produced gas and a good stability of the process, and the cost of heating the substrate are relatively minor.

If the substrate by hygienisation necessary to destroy harmful microorganisms, or used as a substrate by-products or waste having a high temperature of their own (for example, process water), it is recommended to use a thermophilic digestion mode. In this case, due to the high operating temperature is reached large decomposition rate of the substrate. But keep in mind that for heating during the fermentation process requires more energy. Fermentation in this temperature range also is more sensitive to malfunctions, uneven supply of the substrate or the mode of operation of the reactor, since under thermophilic conditions, there is less of various kinds of methanogenic microorganisms.

Practice has shown that the transitions between the temperature ranges are smooth and harm microorganisms, primarily, rapid changes in temperature, and vice versa, methanogenic bacteria can in the case of slow temperature changes to adapt it to various levels. Therefore, for the process stability is important, not the absolute temperature, so as to a much greater degree of constancy of the temperature level [3]. Allowable temperature changes in the fermentation process can be in the following ranges:

- psychrophilic mode: $\pm 2^{\circ}\text{C/hr.}$;
- mesophilic mode: $\pm 1^{\circ}\text{C/hr.}$;
- thermophilic mode: $\pm 0,5^{\circ}\text{C/hr.}$ [4].

It should also focus on the effect of self-heating, which is sometimes observed in practice. This effect appears when using substrates that contain mostly carbohydrates and non-liquid materials, as well as well-insulated tank. Self-heating due to the fact that specific groups of microorganisms during the decomposition of carbohydrates

produce heat. This can lead to the fact that the initial operating mode mesophilic substrate temperature may reach a thermophilic mode to increase to the range 43-48°C. With vigorous regulation of the temperature change can occur with short-term, minor decline in the product gas. But if you do not provide the necessary intervention in the process (for example, reduce the amount of feed), microorganisms will not be able to adapt to changes in temperature and in the worst case of gas will be reduced to zero [3].

Input data and methods. The extent of the influence of temperature on the efficiency of the digester biogas production was investigated during batch digester for example methane fermentation of cattle slurry moisture 93,4% in thermophilic and mesophilic conditions at temperatures of 55, 50, 45 and 40°C.

Methane fermentation was carried out with a batch of substrate. The load factor of 29 m³ digester is 0,75.

Results. Discussion and Analysis. The results are given in Fig. 1, which shows that an increase in temperature of the digester biogas yield increases. Thus, the average biogas yield at 55°C is 7103 cm³/day at 50°C – 5226 cm³/day, with 45°C – 4893 cm³/day, with 40°C – 2041 cm³/day.

In the experiments the duration of the lag phase was minimal and amounted to less than a day (except for fermentation at a temperature 55°C when due to the change of the substrate temperature and the duration of the lag phase was 4 days). For all temperatures sum of the exponential phase and the phase delay of growth was in the range 14-15 days. During this time, biogas is: at 55°C – 11254 cm³/day, 50°C – 8980 cm³/day, 45°C – 8059 cm³/day, 40°C – 3611 cm³/day. At the same time, during the stationary phase and a death phase whose duration of the experiments was 20-25 days, biogas yield was: at 55°C – 4797 cm³/day, 50°C – 4179 cm³/day, 45°C – 2632 cm³/day, 40°C – 1108 cm³/day. That is, the ratio of the output of biogas in the first 14-15 days and then during operation of the reactor is 2,1-3,3, which means that if the main aim is to obtain a waste fermentation biogas, rational process time is 14-15 days.

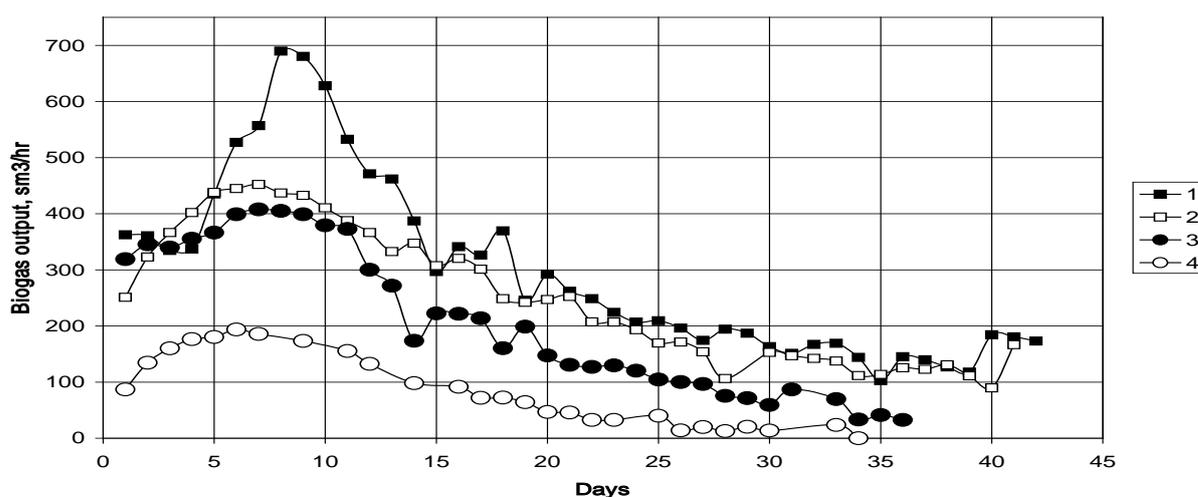


Fig. 1. The yield biogas methane fermentation of cattle slurry humidity of 93% under different temperature conditions: 1 – t = 55°C; 2 – t = 50°C; 3 – t = 45°C; 4 – t = 40°C

Summary and Conclusions

The research on the effect of temperature on the yield of biogas digester. It was found that the most productive on the generation of biogas is methane fermentation logarithmic phase (3-5 days) and the phase of the slowdown. The total period of these phases is 7 to 15 days. The total time of the stationary phase, which gradually turns into a phase of decline, can be 25-20 days, but this time the biogas production is greatly reduced. Therefore, at the end of the slowdown phase is recommended replacing the substrate and the beginning of a new cycle of digestion. When fermentation slurry with increasing temperature during this period is reduced from 14-15 days at 40°C to 11 days at 55°C. Increasing the temperature of the methane fermentation leads to a higher yield of biogas, but it also increases the cost of heating the substrate.

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ANALYSIS OF MODELS OF HUMAN FLOW MOVEMENT AT EVACUATION FROM BUILDINGS

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Abstract. The article discusses the issue of modeling of human behavior at evacuation from buildings. The article explores the basic models of human flow movement, their advantages and disadvantages.

Key words: modeling, human behavior, model, human flow, evacuation.

Modeling of human behavior at evacuation from buildings and dynamic models of fire risk factors propagation are used in fire resistance grading. Developers determine models grading boundaries based on their representations of real world phenomena, known by the current date.

Mathematical description allows specify the most important properties of a real phenomenon which hereinafter will be considered in the model. It is a difficult task, because the phenomenon must be depicted as an adequate theory which can represent a real phenomenon through a mathematical model to any desired degree of precision. At the same time the key elements of the model are specially developed mathematical apparatus, as well as computerization means and software with sufficient computational capacity.

The Emergency Ministry of the Russian Federation approved a special procedure, which determines conformity with fire norms. At this date there are a few models of human flow movement.

One of such models is **the actual evacuation time model**. Estimated time of human evacuation from a building t_p is defined as calculation of the time of movement of one or several human flows through emergency exits from the most remote locations.

All the way of human flow movement is divided into parts. Parts are passages, doorways, corridors, ladders with length l_i and width δ_i . Passages between workplaces, equipment and row of seats are initial parts.

For calculation of the time of human evacuation from buildings we define real length and width of the parts. Length of the way on landings, as well as on ramps, is measured by length of bays. Doorway length of the way is equal to zero. Opening, located in the wall, which thickness is more than 0,7 m, as well as the vestibule, should be considered independent parts of a horizontal way with length l_i .

Estimated time of human evacuation t_p is calculated as the sum of the time of human flow movement on separate parts of the way t_i according to the formula (1):

$$t_p = t_1 + t_2 + t_3 + \dots + t_i \quad (1)$$

t_1 – the time of human flow movement on the first (initial) part, min.,

$t_1, t_2, t_3, \dots, t_i$ – the time of human flow movement on each of following after the first part, min.

The individually-flow movement model defines estimated time of evacuation

as the time for which the last man leaves a building.

At first we should study evacuation routes. All evacuation routes consist of evacuation parts with length equal a and width b . For designing buildings length and width of each part of the evacuation route are identical to the plan's values, and for constructed buildings they are identical to real values. Length of the landing evacuation route is measured by length of landing. Length of the evacuation route in doorway is equal to zero. Evacuation parts can be horizontal and inclined (ladder downwards, ladder upwards and ramp).

The individually-flow movement model describes a man as an ellipse. The thickness of the body is equal to 0.25 m and the width of the shoulders is equal to 0.5 m. Each man is assigned to coordinate x_i , which describes the distance from the center of the ellipse to the border of the evacuation part. Two or more people will be side by side if the difference of their coordinates is less than 0.25 m.

Such body dimensions help us to determine the maximum number of people that are side by side, as well as the maximum number of people located at a particular evacuation part. During the initial period the coordinates of each man x_i are set in accordance with the scheme of people arrangement in the buildings (workplaces, seats for spectators, berths and etc.). Such data may be unknown, for example, in case of stores and exhibition halls. In this case, we could place people on an even basis in the entire area of the building, but we should also take into account the equipment, located in the building. We determine the coordinates of each man at time t alternately using formulas. It is very important to calculate the local density of the flow, a man's coordinate at the next evacuation site, the number of people moving from one evacuation part to another, the traffic flow at the exit from the evacuation part. All calculations will be repeated for each time point until people are evacuated from the building.

The simulation-stochastic mathematical model describes an evacuation as the following situation: all people at the same time go in one direction and form a common human flow. Common human flows are typically formed in evacuation parts which have passages. Human flows are usually formed in passages between the equipment. In addition to the above these parts will be initial parts for the following evacuation routes. All people are located on an even basis in the evacuation parts. Then these human flows coalesce on the general evacuation route. They form a common evacuation flow, parts of which have different densities. In further these densities become more equable – the evacuation flow disbands. Account must be taken of his head part which spreads – people tend to go freely. During the current period of time a part of people goes from the initial to the following evacuation parts and changes the state of the human flow of people and its movement.

Despite the fact that all models calculate the evacuation of human flow, they have their own advantages and disadvantages. For example, **the actual evacuation time model** does not take into account such simulation cases as the re-formation and spreading of human flow, formation and elimination of clusters, emotional state of people, heterogeneous composition of human flow. On the other hand, this model is the easiest way to calculate the actual time of the evacuation. **The individually-flow movement model** and **the simulation-stochastic mathematical model** are more

comprehensive and precise, but they are very difficult to implement. These models are more demanding of computing power and bulk storage of input data that consequently leads to high cost of calculation. It follows that in case of exact calculations for typical small data objects these models may not be appropriate. For these tasks it is necessary to develop the most optimized model which will be sufficiently accurate and not demanding to the size of input data and computing power.

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J21510-021**Ilina E.A., Chekanova E.D., Dyorina N.V.****THE ISSUES OF SET-THEORETIC ANALYSIS RESULT VISUALIZATION***Nosov Magnitogorsk State Technical University,
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Annotation. This article considers the most popular software used by researchers to present the results of set-theoretic analysis. The authors have revealed their advantages in some areas and shortcomings that do not allow minimizing the researcher's work.

Keywords: system theory, system analysis, set-theoretic analysis, visualization issues.

Introduction. System theory and system analysis allow studying the laws of construction, operation and development of systems with different physical nature and methods of their research, including the ones based on the use of computers. The set-theoretic analysis let handle the system and to carry out their structuring. This treatment allows you to optimize and adjust the system quickly and effectively, thus efficiently manage it.

The results of the set-theoretic analysis are performed in the form of diagrams, visualizing the structure of the system and the interaction between the elements.

At this point the researcher uses a variety of software products to present the results of set-theoretic analysis. Often, they are the products of Microsoft, such as Visio, Word, Excel. Let us examine them in detail.

Visualization by means of Microsoft Visio

This software is designed for building diagrams, organizational charts, flowcharts and plans. And the presentation of the analysis results in the form of a scheme does not take a lot of time and effort. The program is easy to use and has a large selection of ready-made "figures" for their use in constructing elements.

Thus, MS Visio allows presenting the results of the set-theoretic analysis in the form of a diagram, but this is not enough to perform a complete "picture" in the given paradigm. This requires a more detailed description of current properties and qualities both elements and interactions. It is necessary to use other software in order to describe them.

Visualization by means of Microsoft Excel

Unlike MS Visio, MS Excel software is used for tabulation. A table is a tool that allows you to describe all the necessary information about the elements in detail and to group them by category.

To visualize the results of the set-theoretic analysis this software has a large selection of tools. So to describe the data elements and their interactions, Excel allows using the table. This form makes it possible to provide structured data. It is possible to insert shapes for data presentation in the form of a circuit. However, the construction of the scheme in MS Excel would require more time and effort than the construction of the same system representations in MS Visio. If MS Visio elements "communicate" with each other and the position of the arrow represents the interaction between the elements depends on the position of the elements, the

situation in MS Excel interactions is static and when varying the position of an element that has a certain connection, you need to change its location.

MS Excel program allows you to perform how the scheme of the system and its description, but neither scheme, nor description are not connected, so there is a possibility of divergence in the views of data, with the more and more complex the system, the greater the chance of missing a typo. There is also a necessity to monitor compliance of the two representations in making any changes and improvements to the system.

Visualization by means of Microsoft Word

MS Word is software for creating, viewing and editing text documents, which has the same tools to build circuits as MS Excel. The system description in MS Word can be presented as a text. There is also an opportunity to provide a description in the form of tables, but their preparation takes large amounts of time than when working in MS Excel. MS Word has the same features to build circuits as MS Excel and consequently has the same problems and shortcomings, conceding MS Visio. However, this software is the best of the surveyed ones for the report on the done work; it enables to insert diagrams and pictures made in MS Visio and handle the tables copied from MS Excel.

Conclusion

After considering the advantages and disadvantages of the presented software products that are most often used by researchers to present the results of set-theoretic analysis the authors did not reveal a single software product that automates the process of results' visualization. Each software product is strong in its area and none of them allows you to automate the process of the analysis visualization. The programs that allow full implementation of visualization, do not include any automation, i.e. there is a need for data entry by a researcher twice, in the description of the system and the creation of its scheme. The ability to create a scheme based on the description, for example, presented in a tabular form would eliminate the appearance of differences in both views at minimum cost for the researcher.

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**FORMULATION OF THE PROBLEM OF MIXTURES FOR
OPTIMIZING FERROALLOY INPUT QUANTITY DURING BOF
PRODUCTION OF STEEL INTO LADDLE**

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Abstract. In this work short characteristics and general formulation of the problem of mixtures are given, also problem formulation for optimization of ferroalloy input amounts during steel tapping from the BOF is investigated.

Keywords: optimization problem, linear programming, the problem of mixtures, one-criterion optimization.

Introduction. An optimization problem – it is the task of choosing the best solution from the set of several feasible solutions. One of the typical problems of linear programming is the mixtures problem: using a given range of components with certain specific characteristics and values an optimal mixture must be made, the mixture must satisfy certain conditions with minimal expenses. Such problems are widely applied in various industries, including metallurgy.

Setting the problem. The general formulation of the problem of mixtures is as follows: there are n components, these components combined in various proportions form various mixtures. Each component consists of m substances. Let a_{ij} be the quantity of the i -th substance ($i = 1, \dots, m$) from the composition of one unit of the j -th component ($j = 1, \dots, n$) and a_i – the quantity of the i -th substance in a unit of a mixture. An array of numbers c_j ($j = 1, \dots, n$) is set. These numbers characterize the j -th component's value per unit. Numbers b_i ($i = 1, \dots, m$) tell the minimum necessary quantity of the i -th substance in a mixture. It is required to determine a mixture composition of minimum cost.

If the numbers x_j ($j = 1, \dots, n$) characterize the quantity of j -th component in a mixture then the problem can be put this way: minimize overall cost function (1)

$$\min \sum_{j=1}^n c_j x_j, \quad (1)$$

the next minimum quantity of each substance is required (2):

$$\sum_{j=1}^n a_{ij} x_j \geq b_i \quad (i = 1, \dots, m) \quad (2)$$

The problem of mixtures formulation for optimization of ferroalloy inputs amounts during the BOF production of steel will be more complicated because it is necessary to consider the loss of ferroalloys as well as the chemical composition of slag which is needed to protect the metal surface from cooling and oxidation. Such problem formulation demands additional researches of steel deoxidation and alloying

processes, that is why a only one of many feasible variants is shown below.

The following function minimizes company’s expenses on ferroalloys (3):

$$\min \sum_{j=1}^n c_j m_j, \tag{3}$$

where n – is the quantity of different types of ferroalloys, c_j – is the cost of the j -th ferroalloy type per tonn, m_j – is the weight of the j -th ferroalloy.

There are two groups of constraints in the problem, one of them includes double inequalities which provide that percentage of chemical elements in ferroalloys meets the requirements of certain steel grade (4):

$$\sum_{j=1}^n a_{ij} m_j \geq d_i m_c \quad (i = 1, \dots, m) \tag{4}$$

where m – is the quantity of different chemical elements composing the ferroalloy, d_i – is the minimum mass proportion of the i -th chemical element for the given steel grade, m_c – is the steel mass, a_{ij} – mass proportion of the i -th chemical element ($i = 1, \dots, m$), which is a part of j -th ferroalloy; m_j – j -th ferroalloy mass; h_i – maximum mass proportion of i -th chemical element for the given steel grade.

Percentages of all chemical elements included in one unit of ferroalloy are given in a tab.1 below.

Table 1

Percentages of chemical elements included in one unit of ferroalloy

Ferroalloy name	Chemical composition, %						
	Si	C	Mn	Al	Cr	P	S
Ferrosilicon	74-80	–	≤ 0,4	≤ 2,5	≤ 0,4	≥ 0,05	≥ 0,03
Ferromanganese	≤ 2,0	≤ 0,5	≤ 85,0	–	–	≥ 0,30	≥ 0,03
Ferrochrome	≤ 1,5	≤ 0,06	–	–	≤ 65,0	≥ 0,03	≥ 0,03
Ferromolybdenum	≤ 2,0	≤ 0,20	–	–	–	≥ 0,20	≥ 0,20
Ferrotitanium	0,5	0,2	–	< 5	–	≥ 0,05	≥ 0,05

Let’s take the steel of the 20A grade as an example. All chemical elements percentage boundaries for a given steel grade are shown in a tab.2 below.

Table 2

Percentage boundaries of chemical elements for the 20A grade steel

	Si	C	Mn	Cr	P	S
d	0,17	0,17	0,35	–	–	–

h	0,37	0,24	0,65	0,25	0,035	0,035
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The limitation of silicon proportion for 370 tons of steel is as follows (5):

$$0,0017 \cdot 370 \leq \sum_{j=1}^n a_{ij} m_j \leq 0,0037 \cdot 370, \quad (5)$$

where a_{ij} is taken from the tab.1 by column "Si".

The second group of constraints shows the balance of chemical elements percentages before and after alloying and deoxidation processes (6):

$$S_{s_i} \leq S_{t_i} + S_{f_i} - S_{sl_i} - S_{w_i}, \quad (6)$$

where S_{s_i} – proportion of the i -th chemical element in steel; S_{t_i} – proportion of the i -th chemical element for steel tapping from BOF into ladle; S_{f_i} – proportion of the i -th chemical element in ferroalloy; S_{sl_i} – proportion of the i -th chemical element in slag; S_{w_i} – proportion of the i -th chemical element in waste.

These are only some of the features of formulating a problem of mixtures. In further researches more factors will be taken into consideration.

Conclusion. Thereby in this article the mixture problem general formulating was simplified to a variant of one-criterion optimization problem. During the research it will be widened to a multicriteria optimization problem and additional factors affecting the usage of ferroalloys will be taken into consideration.

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EFFECT OF POSTHARVEST HANDLING OF MUSHROOMS OYSTER PLEUROTUS ON THE INTENSITY OF PHYSIOLOGICAL PROCESSES

Results of study of influence of postharvest handling the mushrooms of Oyster Pleurotus by carbon dioxide on intensity of physiological processes in them were presented.

Key words: mushrooms, Oyster Pleurotus, postharvest handling, carbon dioxide, physiological processes.

Introduction. Statistical data of Food and Agriculture Organization of the United Nations indicated that supply population of our planet's food is a cause concern. The main problem is the lack of protein and its imbalance in the diet of people. In last decade indicated a rapid increase of production and consumption of cultivated edible mushrooms in fresh and processed form. Scientists projected that in the future much of human needs in proteins will be supply by industrial production of edible mushrooms [1, 2]. It should be noted that Ukraine due to favorable geographical location and climatic conditions, has the opportunity in the future to become a major supplier of fresh and processed mushrooms to Europe. Today in our country the leading place among cultivated mushrooms had Oyster Pleurotus.

In the processes of storing mushrooms its commercial quality lost [3, 4]. Promising is the use of technologies that provide more long-term preservation as mushrooms and due to intensity inhibition of physiological processes.

One such way is the short post-harvest handling of products by low concentrations of carbon dioxide, a so-called oxygen stress [5].

Therefore, the aim of our study was to determine the effect of postharvest handling mushrooms Oyster Pleurotus by carbon dioxide on intensive flow of physiological processes in them.

Materials and methods. In studies used mushrooms of Oyster Pleurotus of strain NK-35 and Amycel 3000 from the collection of living plants higher edible mushrooms Institute of Botany after M.G. Xolodnogo of NAS of Ukraine. These strains are widespread, highly suitable for growing all year round and for general purposes.

Postharvest handling of mushrooms by carbon dioxide carried in hermetically sealed experimental chambers KX-6Ю with volume of 6 m³. Gas filled in the required concentrations using flowmeter brand PM-2,5 ГY3. Stirring gas environment carried out by the fans.

Experimental variants of mushrooms Oyster Pleurotus handling the following regimes: 20% CO₂ during 2, 12 and 22 hours. Control experiments were these mushrooms without handled carbon dioxide. Further processed products were stored at temperature 1°C during 6 days. In the production determine intensity of physiological processes: evaporation moisture, breathing intensity and intensity of heat emission.

Results. For determine the influence of handling by carbon dioxide on the intensity physiological processes in mushrooms, they handling by carbon dioxide

with concentration 20% during 2, 12 and 22 hours and kept at optimum temperature 1°C during 6 days.

The basic percentage of natural loss during storage of mushrooms makes up the loss of water due to evaporation, because of difference of pressure of water vapor. This percentage depending on the strain of mushroom and handling regime was within 75.0- 83.8% (Table 1).

The results of studies of the dynamics of breathing intensity mushrooms (Table 2) show that after cutting the fruit body quantity highlighted of carbon dioxide begins to increase rapidly and then at the storage is reduced due to low temperature. Postharvest handling of carbon dioxide significantly affect on the amount of highlighted CO₂, especially in the first 3 days. As can be seen from the table 2, there is a tendency that with increasing duration of handling by CO₂ process of breathing is inhibited. The least intensive this process carries out at the regime handling 20% CO₂ during 22 hours.

Table 1

Evaporation moisture of fruit bodies of mushrooms Oyster Pleurotus depend on different regimes postharvest treatment by carbon dioxide, % of nature losses

Regime handling, %CO ₂ – h	Strain of mushrooms	
	HK-35	Amycel 3000
Control	81,0	78,9
20% – 2 h	82,2	80,0
20% – 12 h	83,8	81,7
20% – 22 h	76,3	75,0

Table 2

Breathing intensity of mushrooms of Oyster Pleurotus during storage at different regimes of post-harvest handling by carbon dioxide, mgCO₂/kg·h

Regime handling, %CO ₂ – h	Before storage	Duration of storage, days						
		1	2	3	4	5	6	average
Strain HK-35								
Control	6,0	11,1	12,5	7,1	4,0	3,4	2,9	6,7
20% – 2 h	6,3	9,2	11,1	6,5	3,7	3,0	2,8	6,1
20% – 12 h	6,2	8,1	10,4	5,8	3,6	3	2,6	5,7
20% – 22 h	6,5	7,4	9,9	5,6	3,1	2,4	2,3	5,3
Strain Amycel 3000								
Control	5,7	9,8	13,7	8,4	4,5	3,5	3,2	7,0
20% – 2 h	6,0	8,8	10,7	8,0	4,0	3,1	3,0	6,2
20% – 12 h	6,0	7,5	9,6	7,2	4,0	2,7	2,4	5,6
20% – 22 h	5,6	6,8	8,3	6,8	3,2	2,7	2,2	5,1

So, for mushrooms Oyster Pleurotus strain HK-35 after a day storage quantity

highlighted of CO₂ in a experimental variant was 7.4 but in the control – 11.1 mgCO₂/kg·h; two days – 9.9 and 12.5 mgCO₂/kg·h; three day – 5.6 and 7.1 mgCO₂/kg·h, respectively. Further breathing intensity control and experimental variants gradually is equalized and on the end of storage difference not significantly (2.9-2.3 mgCO₂/kg·h in research variants but 2.9 – in the control).

Based on data from the breathing intensity were calculated heat emissions of mushrooms, which changes similarly (Table 3).

Table 3

Intensity of heat emission of mushrooms of Oyster Pleurotus during storage at different regimes of post-harvest handling by carbon dioxide, kJ/kg · day

Regime handling, %CO ₂ – h	Before storage	Duration of storage, days						
		1	2	3	4	5	6	average
Strain HK-35								
Control	1,5	2,8	3,2	1,8	1,0	0,9	0,7	1,7
20% – 2 h	1,6	2,4	2,8	1,7	0,9	0,8	0,7	1,6
20% – 12 h	1,6	2,1	2,7	1,5	0,9	0,8	0,7	1,5
20% – 22 h	1,7	1,9	2,5	1,4	0,8	0,6	0,6	1,4
Strain Amycel 3000								
Control	1,5	2,5	3,5	2,2	1,2	0,9	0,8	1,8
20% – 2 h	1,5	2,3	2,7	2,1	1,0	0,8	0,8	1,6
20% – 12 h	1,5	1,9	2,5	1,8	1,0	0,7	0,6	1,4
20% – 22 h	1,4	1,7	2,1	1,7	0,8	0,7	0,6	1,3

Short postharvest handling mushrooms by carbon dioxide with concentration 20 % during 2 to 22 hours has affected on the average heat emission of Oster Pleurotus during its storage. The biggest difference in heat emission values observed in mushrooms up to 3 days of storage. At the end of storage (6 days) the intensity of heat emission for nearly all regimes of handling coincides with the control.

Conclusions. Short postharvest handling of mushrooms by carbon dioxide with concentration 20% affects on the intensity of physiological processes that take place in mushrooms during storage, particularly on breasing of intensity, intensity heat emission and moisture evaporation.

The most effective the regime is handling mushrooms by carbon dioxide with concentration 20% during 22 h, which gives the best result reducing of breasing of intensity and intensity heat emission in the first three days of storage.

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ESPECIALLY THE CHEMICAL COMPOSITION AND QUALITY OF
VARIETAL APPLE JUICES**

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The article the basic biochemical and organoleptic indexes of sorts apples juices. Detected best quality of samples.

Key words: fruit, apple, grade, fermentation, juice, quality.

Introduction. The culture apple is extremely common in Ukraine at a high level. It takes up to 80% of farms in horticultural areas [3,5]. Most of the harvest is processed at sulfites puree, jam, wine and, of course, natural and concentrated juices [6, 7]. The quality of the finished product depends strongly on the chemical composition of raw materials and technological properties. Targeted use of different varieties for processing contributes to improving the quality, cost of raw materials and reduces the cost [3, 5]. The fruits of some varieties have a special taste and aroma, which is partially preserved in the processed products. Taste natural juices and drinks based on them form various organic components, primarily sugars, organic acids and polyphenols partially pectin. Exquisite flavor depends primarily on the concentration and ratio of terpenoids, esters, aldehydes and higher alcohols [1, 4, 6 8, 10]. Now on the market it formed a very wide assortment of apple, but clear recommendations for processing into juices insufficient.

The aim was to analyze the chemical composition of the widespread apple varieties grown in the conditions of forest-steppe of Ukraine and determine the suitability for the preparation of high-quality juices nonclarified high quality and biological value.

Materials and methods. Investigations were carried out at department of technology storage, processing and standardization of planting products after B.V.Lesika of National university of life and environmental sciences of Ukraine and department of technology storage and processing of products fruits and vegetable of Uman national university of horticulture.

Juice prepared by the standard technology for the processing of apples. They were ground, pressed, the juice was decanted and filtered through a fabric filter, then dispensed into the container 1 i 3 dm³ and sterilized. These juices are examined on a range of chemical and technological parameters and organoleptically by conventional methods [2, 9].

Results and discussion. Data on the chemical composition and characteristics juices prepared from fruits of different varieties of apples are given in Table. 1, 2. The largest sugar content of the juice were more varieties of Priam, Rubinove Duki, Rovyeshnik Gagarina, Florina, Liberty, Aydared (10,4-10,8%). Fruit juices of Zimove lemonne, Rubinove duki, Callvil donetskiy characterized by high acidity (9,8-14,5

g/dm³), a Aydared, Jonatan, Mekintosh – moderately (6,1-6,8). The acidity of the juice of apples Calleville snigoviy, Liberty, Priam, Florina was low (4,0-4,5 g/dm³).

The content of phenolic compounds varies depending on the variety. The highest concentration observed in the juices obtained from the fruit of apple varieties Zimove lemonne, Jonatan, Rovyeshnik Gagarina (801,2-501,1 mg/dm³), and a smaller - Calleville snigoviy, Liberty, Priam (460,3-421,2 g/dm³).

One of the important indicators of quality juice is an extract that characterizes the fullness of taste. It varies widely (18,6-24,7 g/dm³). The highest extract content in the juices of the varieties Zimove lemonne (24,7 g/dm³), Callvil donetskiy (21,9), Aydared, Jonatan (20,7), lower – Liberty (19,1), Priam (18,6), Florina (18,2 g/dm³).

Tasting assessment varietal apple juice has shown that the best aroma and taste qualities were more varieties of the fruit juice Calleville snigoviy (9,8 points), Aydared (9,56), Mekintosh (9,58), Rubinove Duki (9,64 points) (table. 2), second place - Liberty (9,35 points), Rovyeshnik Gagarina (9,31), Priam (9,36), Florina (9,21 points). Weaker aroma and excessive acidity observed in the juices of the fruit varieties Zimove lemonne (8,44 points), Callvil donetskiy (8,53). The low content of organic acids had the juice from the fruit varieties - Priam, Florina, Calleville snigoviy (4,1-4,0 g/dm³), that impairs their taste.

The results showed that the best organoleptic properties of juice from fruit varieties Aydared, Jonathan, Mekintosh, Rubinove Duki (table. 2). Since the latter accumulating large amounts of sugar, acidity of moderate, marked juices are high extracting (table. 1).

Table 1.

Biochemical composition of fruit juices of different varieties of apple

Copt	Sugar, %	Titrated acidity, g/dm ³	Extract, g/dm ³	The amount of polyphenols, g/dm ³	Pectin, g/dm ³	Sugar-acid index
Aydared	10,4	6,1	20,7	263,5	0,98	17,1
Jonathan	9,6	6,5	20,7	739,8	1,1	14,8
Zimove lomonne	8,4	14,5	24,7	801,2	1,2	5,6
Calleville Donetskiy	8,8	9,8	21,9	509,2	1,15	8,9
Calleville snigoviy	10,1	4,1	18,9	460,3	1,02	24,6
Liberty	10,4	4,5	19,1	427,1	0,89	23,1
Mekintosh	9,5	6,8	20,5	321,5	1,3	13,9
Rovyeshnik Gagarina	10,5	5,1	19,4	501,1	0,79	20,5
Priam	10,8	4,1	18,6	421,2	0,86	26,3
Florina	10,7	8,1	22,2	505,4	1,25	13,2
Florina	10,4	4,0	18,2	606,6	0,88	26
Rubinove Duki	10,5	6,4	20,4	587,8	1,23	13,4

The acidity citric of the fruit: Zimove lomonne, Calleville Donetskiiy, sometimes when cleaning excess Jonathan because juices should be used in blends with low acid juices. Correlation analysis of biochemical composition and tasting assessment showed that there is a direct link juice organoleptic evaluation sugar ($r=0,77$), sugar-acid index ($r=0,60$) and the inverse of acidity ($r=-0,73$) and phenolic substances ($r=-0,65$).

Table 2.**Organoleptic characteristics of the fruit juices of apples of different varieties**

Sort	Characteristics of juice	The optical density, D_{420}	Organoleptic evaluation, points
Aydared	Clear, with glitter, pronounced varietal aroma, taste full	0,31	9,56
Jonathan	Opal, varietal aroma is weak	0,48	9,12
Zimove lomonne	Turbid, weak aroma, taste rough	0,53	8,44
Calleville Donetskiiy	Turbid, weak aroma, taste rough	0,61	8,53
Calleville snigoviy	Clear, with glitter, pronounced varietal aroma, taste full	0,32	9,8
Liberty	Clear, with glitter, varietal aroma average, not a full taste	0,34	9,35
Mekintosh	Turbid, aroma beads, harmonious taste	0,43	9,58
Rovyesnik Gagarina	Opal, varietal aroma is weak, harmonious taste	0,46	9,31
Priam	Clear, with opal, varietal aroma average, not a full taste	0,36	9,36
Florina	Turbid, varietal aroma crisp, harmonious taste	0,57	9,64
Florina	Light Opal, varietal aroma is weak, harmonious taste	0,3	9,21
Rubinove Duki	Clear, with glitter, varietal aroma average, not a full taste	0,36	9,61

Under current rules, the rate of dry soluble substances for fruit processing is aimed at not less 9-10% (ГОСТ 27572-87). This requirement correspond apples all investigated varieties.

An important indicator of technological transparency juices. What it is higher, the less you need to further process the necessary transparency to semi (table. 2). Among the varieties studied, the figure was the highest in the juice of the fruit varieties Aydared (0,31), Calleville snigoviy (0,32), Liberty (0,34), Florina (0,3), Priam (0,36).

Conclusions. For the production of quality varietal fruit juice can be recommended varieties Aydared, Rubinove Duki, Florina, Priam. Fruit juices of apple varieties Calleville snigoviy, Priam, Florina characterized by high flavoring properties, but their low acidity. Therefore, it is advisable to add them highly acidic

juice from the fruit varieties Zimove lomonne and Calleville Donetskiy. The data is expedient to consider when planning the production of high quality and competitiveness.

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CLEANING METHOD OF BIODIESEL

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Abstract: The alkaline catalyst, which remains in the biodiesel in its manufacture by conventional techniques, may eventually cause failure of the diesel engine. This causes the purification of biodiesel from the catalyst can be carried out as a "dry" and "wet" methods. "Dry" cleaning methods are effective, but the cost of reagents is sufficiently high. Therefore it is necessary to search for other, cheaper ways to clean biodiesel, which include the "wet" method. The analysis of the "wet" cleaning methods: bubble, aerosol and bulk washing biodiesel, estimated their advantages and disadvantages. It was found that the bubble may form an emulsion washing biodiesel and salt catalyst, and aerosol and bulk washing characterized using more water and sophisticated equipment.

Keywords: biodiesel, washing, "wet" method of cleaning, "dry" method of cleaning, of purifying catalyst, drop, air bubble

Introduction. In the production of biodiesel by traditional technology to accelerate the reaction of methanolysis necessarily apply catalyst, which itself does not react, but only accelerates it. Therefore, in the manufactured biodiesel it remains completely, causing corrosion of the engine. The corrosion products entering the gap between the cylinder and the piston, causing them to abrasive wear. In the case of contact with them in the fuel system, they can plug fuel filters, or to block the work of the fuel equipment due to the inability spraying fuel through nozzles [1].

Analysis of recent research. To clean biodiesel from residual catalyst developed various ways, most important of which is the so-called "wet" and "dry" cleaning biodiesel. When dry cleaning is used adsorbent which separates impurities from biodiesel. Some systems use ion exchange resins, in other – magnesium silicate mineral, a type of which is sold under the brand name Magnesol, company Dallas Group of America Inc [2], or other inorganic adsorbents such as bleaching earth [3]. "Dry" cleaning methods are effective, but the cost magnesol and ion exchange resins is quite high, which greatly increases the cost of biodiesel produced. In addition, manufacturers of ion-exchange resins is not recommended to exceed the concentration of 500 g/t of soap in the crude biodiesel, or quality of cleaning is reduced. Also, if biodiesel is very dirty, ion-exchange resins rapidly lose their properties and are difficult to regenerate. [4]

Therefore, to reduce the cost of recommended pre-cleaning of biodiesel by other methods. **The objective of our research** is to analyze these processes, identifying their strengths and weaknesses.

The results of research. The most common method of removing water-soluble impurities is the "wet" cleaning of biodiesel, which is also called a water washing. In this process, water is used, which serves as a solvent washes out impurities, leaving pure biodiesel [2]. Water washing is divided into a bubble (foam), aerosol and bulk.

A bubble washing is gentle mixing water 1/3 and 2/3 of biodiesel (water settles to the bottom and biodiesel remains on the surface) and air bubbling through the

water layer. Air bubbles provide indirect mixing of the two fluids – they capture a small amount of water and carry it through the biodiesel, taking the soap and other impurities. When the bubble burst on the surface of the water goes down and takes away more impurities and soap on the way down. Approximately 6 hours later washing airflow overlaps and water is drained, fresh water is added and the process repeated. These water changes occur three times until it is completely transparent, and its pH is neutral. The wash water can be used repeatedly to clean the following portions of biodiesel.

Advantages of this technology is that the minimal amount of water used as compared with other technologies, and in the application of relatively cheap equipment. The process does not require constant monitoring. The disadvantages of technology include inefficient purification of biodiesel of poor quality, as well as small amounts of biodiesel, due to the fact that bubbles can mix the water and biodiesel are very vigorously, which leads to the formation of an emulsion of the two liquids. Education is a major problem emulsion washing, but it also is a form of quality assessment process.

Spray washing was developed as a way to solve the problems with the formation of the emulsion. This process uses a larger amount of water and more sophisticated equipment. However, this method also masks quality problems – can visually receive the "good washing" but does not always have an idea of what was the result. When the aerosol spray washing system is used, placed on a layer of biodiesel, with the possibility of water flow after the flow through the fuel. Aerosol flushing less mixing biodiesel than bubble and gradually removes soap. Softer stirring means less likelihood of forming an emulsion of soap, mono- and diglycerides. Many users of such a system an additional wire and bubble wash as the final step after the removal of soap – no longer as active water and oil emulsion forms, so the use of the bubble after washing spray gives a good result. Disadvantages of aerosol refers washing increased water consumption and a more complicated machinery.

When flushing volume mix equal amounts of water and biodiesel, after which they are mixed and defend, water is drained and the process is repeated many times. This method is more laborious, using more water and can not be automated as bubble [5]. Sometimes, in order to achieve full transparency may need seven or eight washing cycles. Furthermore, there is the problem of waste water disposal of hazardous impurities [2].

Typically, when a combination of washing the biodiesel washing methods: pre-wash spray with the ultimate bubble; simultaneous aerosol and bulk flushing. [5].

Findings. Purification of biodiesel from the homogeneous catalyst is carried out "dry" and "wet" method. Productivity "dry" method above, but the cost is quite high adsorbents. "Wet" method involves the use of large amounts of water, which is necessary to release the purified biodiesel, however, the cost of the purification process less. Washing of biodiesel produced bubble, spray and big ways. When the bubble may form an emulsion washing biodiesel and salt catalyst, and aerosol and bulk flushing characterized using more water and sophisticated equipment.

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POWER INTERACTION BETWEEN VISCOUS FLOW AND SOME PROFILES WITH FORWARD SHARP EDGE

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Abstract: This report deals with the contraction/expansion phenomenon in viscous flow under streamlining of bodies. Using simple hydraulic methods and early proposals [1-4] lets to decompose the problem.

Key words: viscous flow, lifting force, attack angle, contraction degree, influence radius.

Outline of the problem. It is widely accepted that the external streamlining problem may be solved with the analytic functions, ideal fluid and viscous boundary layer theories as well as the virtual mass and bound vortex models. At the same time, the bound vortex model (Kutta-Joukowski) supposes that a finite velocity exists at back sharp edge but forward edge must be smooth for passing boundary streams from the lower side of wing profile to the more convex upper side according to the Magnus' phenomenon. Fixation of the separation point at the back sharp edge by the Joukowski-Chaplygin condition lets to find the circulation value.

Analysis of recent research and publications. In case of a forward sharp edge there is blocking the bound vortex but nevertheless we shall receive a lifting force more than Newton's impulse component correlated to $\sin^2 \alpha \cos \alpha$ function of attack angle. For example, lifting force coefficient C_y and drag resistance coefficient C_x are presented as the sum in accordance with Betz and Fedyaewski works [1-4]

$$C_y = \frac{dC_y}{d\alpha} \sin \alpha + 2 \sin^2 \alpha \cos \alpha \quad 1)$$

$$C_x = K \sin^2 \alpha + 2 \sin^3 \alpha \quad 2)$$

where α = attack angle; $\frac{dC_y}{d\alpha}$ = differential of lifting force coefficient; K = constant of drag resistance coefficient considered for this approach [4].

At the present time we have only limited evidence of development of these early proposals regarding power interaction.

Impulse (newton's) component of interaction. Having received numerous experimental correlations of power interaction of non-circulation separated flow under great angles of attack we can see prevailing share of impulse (Newton's) component into drag resistance and lifting force [1-8]. So, drag resistance of struts, wires and building long-ware inclined to the wind direction depends on the $\sin^3 \alpha$ function [7,8]. Yet Eiffel's experiments with plates in air flow stated that the share of impulse component of lifting force increases under lengthening plate along the wind direction (fig.1). Perhaps, such approach of the experimental curves to the theoretical function can be explained by decreasing influence of the unequal conditions of

streamlining and local attack angles of the boundary streams.

Moreover, for finding out a "pure relationship" it was suggested to equip testing plates with the stream-forming longitudinal stabilizers and the upper stream-separating edge (fig.2). By means of equal influence of local attack angles and equal area of separation at such condition we could show the better correspondence with theoretical $\sin^2 \alpha \cos \alpha$ function. On the other hand, the lifting force of the plane long wing equipped only with the upper stream-separating edge for the constant area of separation under great angles of attack corresponds with this function too. We have shown the confirmative results also in the previous paper [2]. To analyze the components of aero-hydrodynamic forces it seems like a reasonable way to find out the pure relationships without any shares of the accompanying factors or to take them into account and to level their influence.

Calculation of profile influence. To evaluate a possibility and origin of lifting force for an endless segmentary wing profile under attack angle $0 < \alpha_0 < \beta_0$ we consider a typical scheme (fig. 3). In this case the forward sharp edge divides the running flow into two parts: upper and lower. Obviously, the upper part of flow undergoes more intensive contraction by more convex side of the profile. The maximum degree of contraction is observed near the maximum deviation of boundary streams \bar{y}_{\max} but after this we can see an expansion of flow and some zone of separation. Contraction of the lower part of flow is less intensive and the maximum comes at the back sharp edge with the deviation y_{\max} .

It is necessary to note the connection between the internal streamlining and external one is established with the influence radius. In fact, experimental data indicate that we have the immutable flow at some midship diameter distance from profile's surface. There are immutable aero-hydrodynamic parameters (pressure, velocity) out of the influence radiuses. Like the peculiar ring contraction considered before in [2.10] also the 2D flow around profile can be imaged as two 2D contraction between the influence radiuses (R_1 for lower side, R_2 for upper side) and the head surface of the profile. By this mean the external aero-hydrodynamics problem transforms into the internal problem. Then solving can be found with simple hydraulic methods.

After determination of the maximum contraction degree s_m it is possible to find the specific lifting force per unit length by integrating the difference of pressures on the lower and upper sides:

$$F_y = \frac{\rho V_0^2}{2} \int_0^{x_p} (\bar{s}^2 - s^2) dx + \frac{\rho V_0^2}{2} \int_0^{x_p} \left[\int_1^{s_m} \sin^2 \alpha d(s^2) + \sin^2 \alpha_0 \right] dx - \quad (3)$$

$$- \frac{\rho V_0^2}{2} \int_0^{x_p} \left[\int_1^{s_p} \sin^2 \alpha d(\bar{s}^2) + \sin^2 (\beta_0 - \alpha_0) \right] dx$$

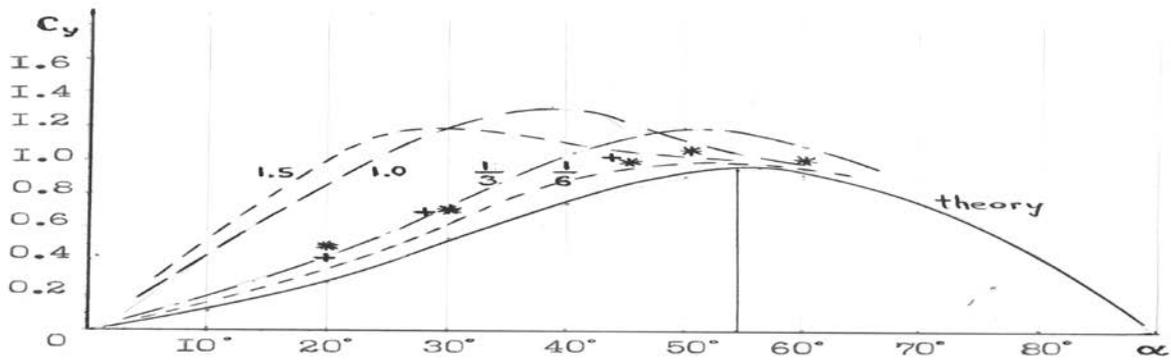


Fig.1 Approach of the lifting force coefficients to the theoretical function:
 ---- curves 1.5 ; 1 ; 1/3; 1/6; - Eiffel's experiments for different lengthening;
 *** square plate with the stream-forming equipment;
 +++ plane wing with the stream-separating edge.

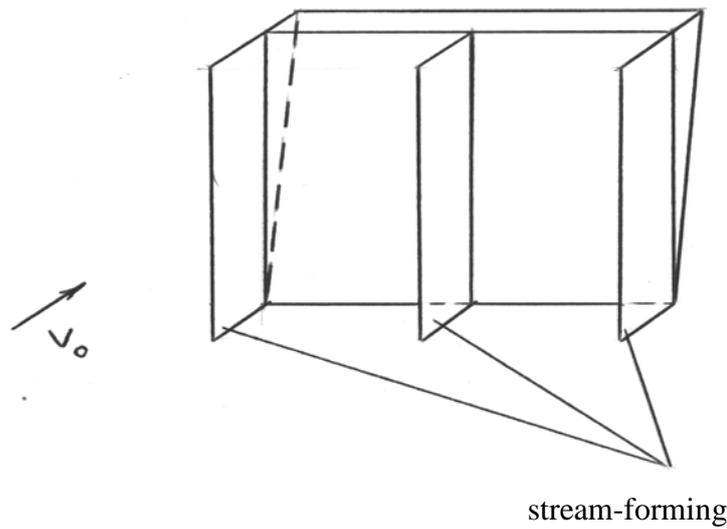


Fig 2. Square plate with the stream-forming equipment.

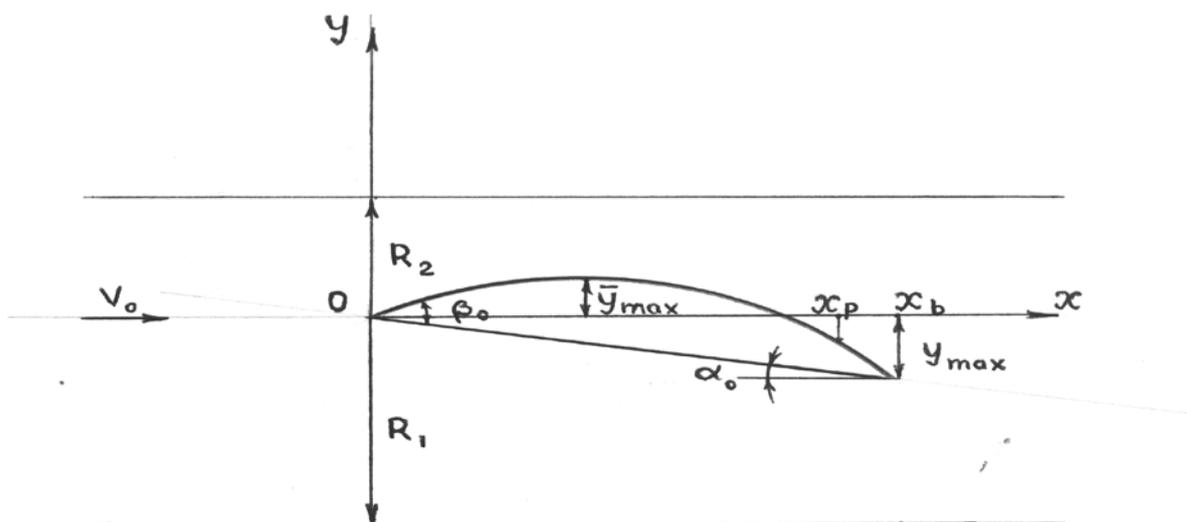


Fig.3 Scheme of profile influence.

where $s = \frac{R_1}{R_1 - y}$ = current contraction degree on the lower side;

$\bar{s} = \frac{R_2}{R_2 - \bar{y}}$ = current contraction degree on the upper side;

$s_m = \frac{R_1}{R_1 - y_{\max}} = \frac{R_2}{R_2 - \bar{y}_{\max}}$ = maximum contraction degree;

s_p = contraction degree at the separation point;

α = current attack (contraction/expansion) angle;

$\beta_0 > \alpha_0$ = contraction condition.

According to the presented model with the fixed maximum contraction degree, the influence radiuses are the constants defined by the maximum deviations of the boundary streams. The experimental data provide the reasons to suppose $s_m = 1.43$ [2]. Consequently, the influence radiuses will exceed the maximum deviations by 3.33 times:

$$R_1 = \frac{s_m}{s_m - 1} y_{\max} = 3.33 y_{\max} \quad (4)$$

$$R_2 = \frac{s_m}{s_m - 1} \bar{y}_{\max} = 3.33 \bar{y}_{\max} \quad (5)$$

A position of the separation point on the upper side may be found by analysis of the energy balance of boundary streams under the energy accumulation when $d(\bar{s}^2) > 0$ and the energy deliverance when $d(\bar{s}^2) < 0$. But this supposition needs to be accompanied with representative experimental data. At the same time, the excess energy balance of the boundary streams is confirmed by the experimental data of drag resistance coefficient for the axially symmetric bodies like submarine (see also: G. Fuhrmann "Jahrbuch der Motorluftschiff-Studiengesellschaft", Bd. 5).

According to the experimental results the drag resistance of the body with sharp conical head is essentially more than the resistance of the analogous one with the convex paraboloid head under the fully identical lengthening stern (1.13 to 1). Evidently, it is caused by the more energy of the boundary streams in the second case and a displacement of the separation point along the flow to the stern tail point.

Conclusions.

- Asymmetric contraction/expansion phenomenon under asymmetric streamlining of bodies with forward sharp edge results in generation of the profile components of lifting force and drag resistance;

- The better agreement between the experimental data and the theoretical lifting force curve for impulse Newton's component has been obtained with the auxiliary stream-forming equipment of the testing plate;

- In order to provide adequate experimental relations for influence of general attack angle, profile shape and contraction degree it is necessary to take into account

the local changes of boundary streams trajectories and their local power interactions with flow.

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