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J11610-001

Tikhonova A.N.¹, Ageeva N.M.², Lisovets U.A.¹, Biryukov A.P.¹
THE USE OF GRAPE DIETARY FIBER IN PRODUCTION OF DRY
WHITE TABLE WINES

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Abstract. Presented the results of investigations of the grape must, which was made from the grape variety Sauvignon Blanc, and wine, produced as a result of fermentation of the grape must. Studied the effect of dietary fiber produced from grape marc on the dynamics of fermentation of grape must. Discovered the influence of grinding extent, the mode and method of drying of the dietary fiber on the quality of table wine. Analysis of obtained data indicates a significant influence of the properties of dietary fiber on the chemical composition of the wine, especially glycerol and organic acids, on the transfer of extractives and phenolic compounds. It was found that the use of grape dietary fiber at the stage of alcoholic fermentation of grape must facilitates the intensification of the fermentation process and the production of high quality wines. Grinding extent of dietary fiber (3 and 5 mm) produced by infrared (IR) drying is superior in the quality to other samples.

Key words: grape marc, dietary fiber, fermentation, color intensity, phenolic compounds, organic acid, glycerol

Introduction. Wineries widely use oak wood products (shavings, staves, wood splint and woodchips) to improve the quality of grape wines, their extract content and fullness of taste. Adding these products is carried out at various stages of technology – from the fermentation of grape must to wine aging. Such technological techniques provide the improvement of taste and aroma of the wine due to biochemical reactions with oak wood components – tannins, catechins, aromatic aldehydes [1, 2].

The disadvantages of such technologies include the fact that very often the wine is enriched with phenolic compounds, resulting the appearance of golden shades in the color, and as for the aroma and flavor the oak tones prevail over the grape and wine tones. In this connection, at least partial replacement of oak wood and its derivatives by grape dietary fiber is reasonable. It allows improving the organoleptic characteristics of the wine and maintaining the prevailing of wine and varietal tones. This is particularly important in the technology of dry white table wines, where the presence of light straw color even flesh color and pronounced varietal aroma is welcomed.

The purpose of the research: to establish the influence of dietary fiber produced from grape marc on the dynamics of fermentation of grape must and the quality of table wine.

The objects and the methods of the research. The object of the research was grape must produced from grape variety Sauvignon Blanc, and the wine, produced as a result of fermentation of the grape must.



The color intensity of the samples was determined spectrophotometrically by V.G. Gerzhikova procedure [3]. Mass concentration of phenolic compounds was determined colorimetrically using the Folin-Ciocalteu reagent [3], pH value – potentiometrically at pH-meter pH-151. Mass concentration of titrated and volatile acids, the extract and percentage of ethyl alcohol was monitored by conventional methods of GOST, and as for glycerol – by gas-liquid chromatography (Crystal 5000, Russia).

Results and discussion. For fermentation were used reactivated active dry yeast strains *Saccharomyces cerevisiae* Killer Bayanus, race IOS 18-2007 (France, Institute of Oenology) in an amount of 2 g/dm³ and 1 g/dm³ of grape dietary fiber, made according to the technology developed by us [4]. Pre reactivated active dry yeast was mixed with dietary fiber to immobilize the cells on the surface of dietary fiber. Fermentation was carried out at a temperature 18 °C. The solids content was determined daily by refractometric method.

Production of dietary fiber was made in the following manner. Fresh grape marc of white grape variety, produced by separating from the stems and seeds, was extracted three times during 30-60 minutes. Distilled water was used as an extractant at 20° C and a water duty 1:1 by weight; pressed raw materials were divided into two parts. To understand whether the drying modes and methods influence the dietary fiber properties, drying of the first part was carried out in desiccator at 65° C, the second – by means of IR drying. It is known [5] that the drying at temperature of 65° C allows to preserve the biologically valuable components. Advantages of IR drying are the best physico-chemical indicators of dietary fiber [6]. Produced dietary fiber was used in different grinding extent (tab. 1). Grape must which fermented on "free" yeast without the addition of dietary fiber was used as a control sample.

Table 1 shows the characteristic of experimental samples – type of drying and particle size of dietary fiber used as immobilizing centers.

Table 1

The characteristic of experimental samples

Number of the sample	Type of drying	Grinding extent of dietary fiber
1	desiccator	1 mm
2	desiccator	3 mm
3	desiccator	5 mm
4	desiccator	non-grinded
5	check sample	check sample
6	IR	1 mm
7	IR	3 mm
8	IR	5 mm
9	IR	non-grinded

Results of the study of solids' dynamics during the fermentation of grape must in the presence of dietary fiber are shown in fig. 1 and 2. As for check sample it was a sample, which fermented on "free" yeast cells (without using dietary fiber). It was



found that the yeast cell immobilization onto the surface of the dietary fiber facilitates the intensification of the process of alcoholic fermentation. The best results were obtained using the dietary fiber with a particle size 3 and 5 mm: the duration of fermentation was decreased, achieved complete fermentation of sugars, wine samples were prepared what characterized by qualitative organoleptic advantages.

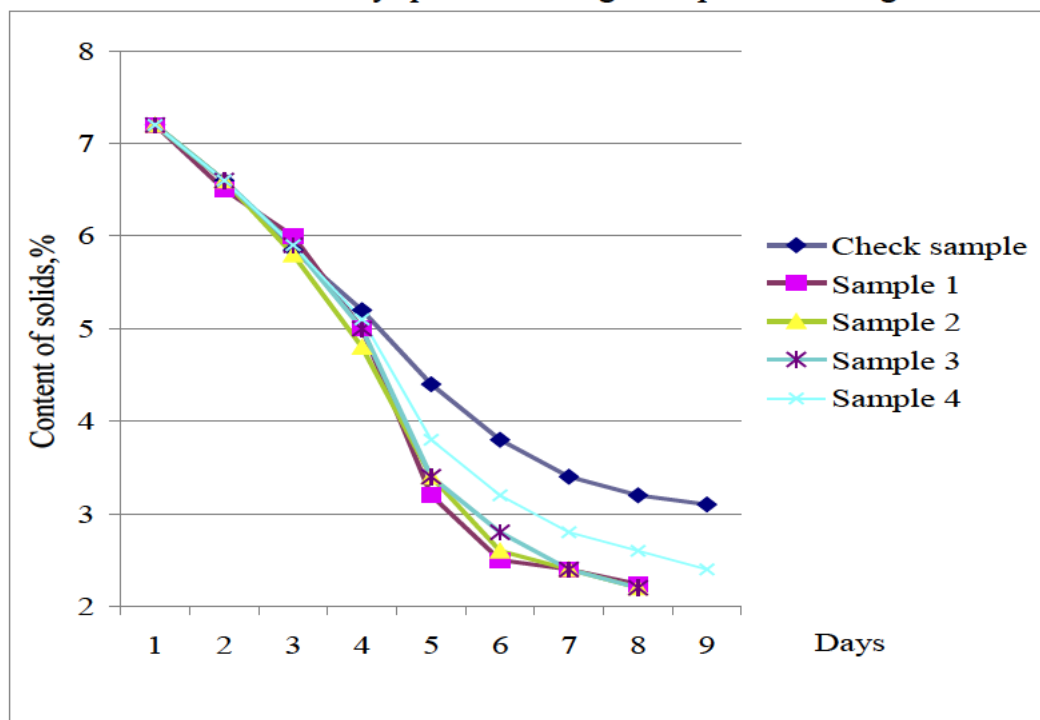


Fig. 1 Dynamics of solids in the grape must during the fermentation using the grape dietary fiber, drying desiccator

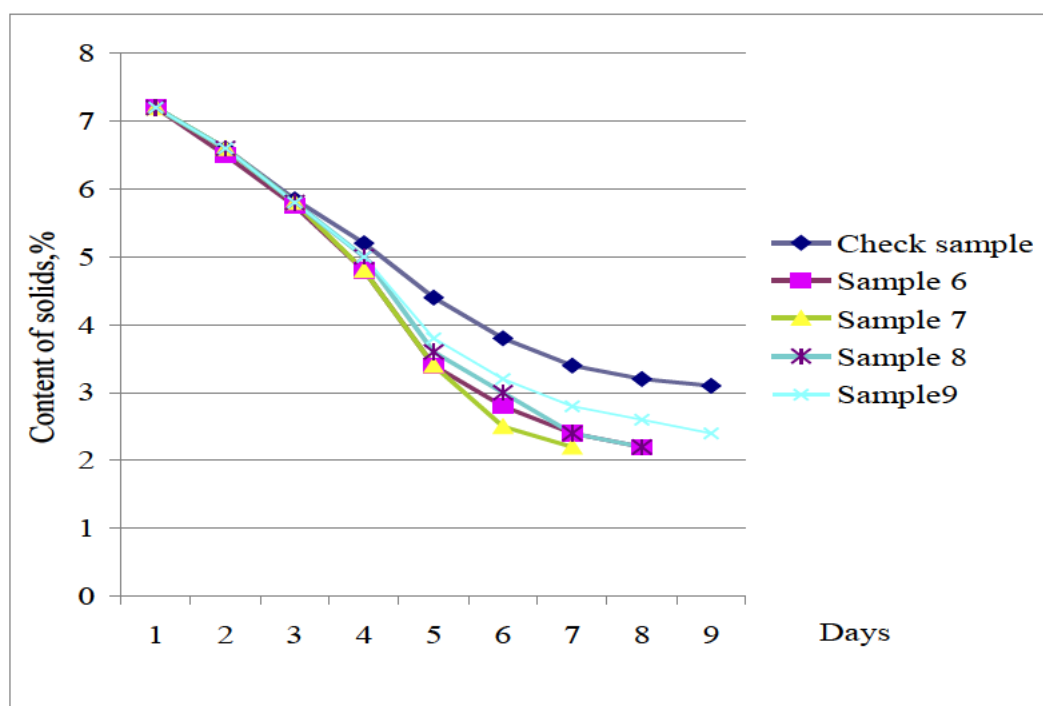


Fig. 2 Dynamics of solids in the grape must during the fermentation using the grape dietary fiber, IR drying



It should be noted that in the sample # 7 where the dietary fiber was produced by IR drying, the duration of fermentation reduced to two days.

To understand how the dietary fiber affects the color of produced wine, we identified overall color intensity (the amount of optical densities at wavelengths of 420 and 520 nm). Low rates of color intensity (fig. 3) characterize less colored wines without golden and amber shades what is encouraged in production of white table wines.

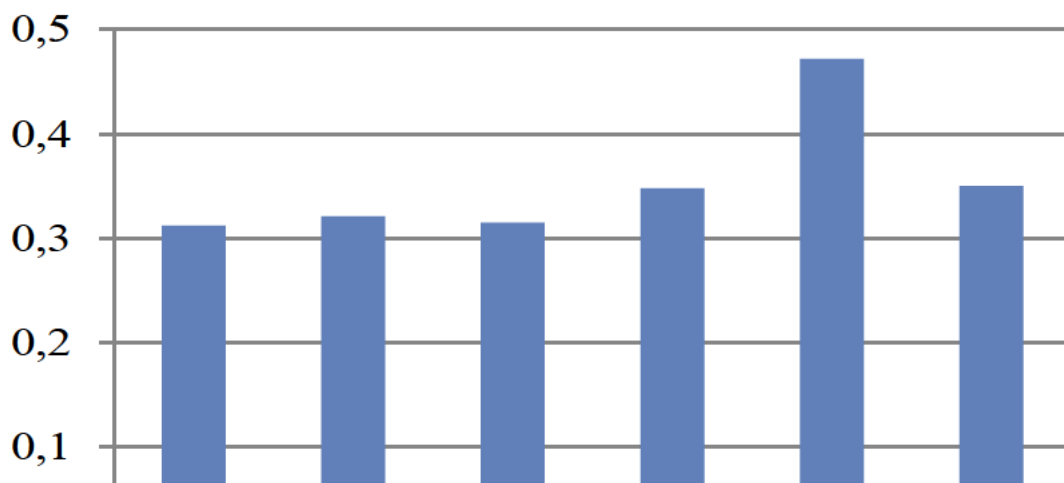


Fig. 3 The intensity of produced wine's color

Using dietary fiber in all samples led to lower color intensity in comparison with check sample. Samples # 1, 2, 3, 7, 8, 9 had light straw color, in the samples # 4 and 6 attended more yellow-golden hue and the check sample had a straw color.

On the wine's extract value affects both the degree of grape ripeness and the compounds accumulated during fermentation, including glycerol and other non-volatile polyhydric alcohols, nitrogen and mineral compounds, acids and its salts and other extractives. Based on the mass concentration characteristics of the extract (fig. 4a), it can be claimed that wine is enriched with biologically valuable components of dietary fiber during the fermentation. And their transition depends on the grinding extent of dietary fiber and type of drying.

Using dietary fiber during fermentation leads to lower mass concentration characteristics of phenolic compounds which are responsible for the color that correlates with the above mentioned findings of samples' color intensity. Moreover, the wines with addition of dietary fiber which was produced by IR drying have significantly smaller values of extractives, including phenolic compounds (fig. 4b) that is significant in the production of dry white wines, as in its production it is important not to activate the oxidation processes of phenolic compounds [7, 8]. At the same time the grinding extent of dietary fiber also affects the content of phenolic compounds, to wit, the greater grinding extent the smaller concentration of phenolic compounds is in experimental wine samples.

Analysis of the obtained data (tab. 2 and 3) indicates a significant influence of dietary fiber properties on the chemical composition of wines, especially glycerol and organic acids. It should be noted that there is a correlation between the mass concentration of the extract and glycerol. This indicates that the use of dietary fiber



assists fermentation process with glycerol-pyruvic way forming a large amount of glycerol [9].

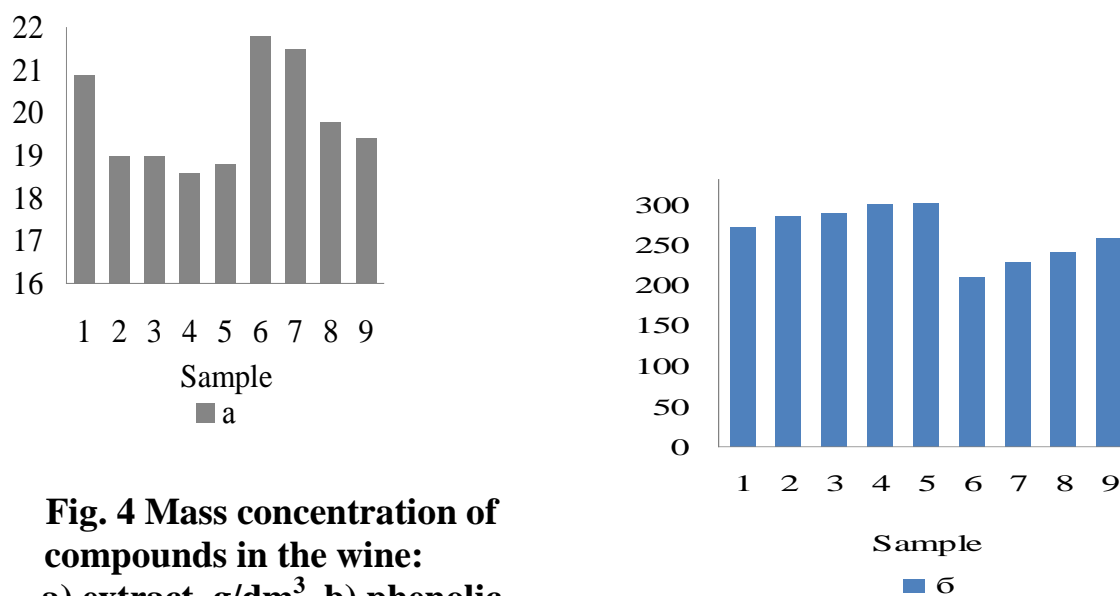


Fig. 4 Mass concentration of compounds in the wine:
a) extract, g/dm³, b) phenolic compounds, mg/dm³

Table 2

The chemical composition of the samples

The number of the sample	Percentage of ethyl alcohol, % vol.	Mass concentration of acids, g/dm ³		pH	Glycerol, g/dm ³
		titrated	volatile		
1	9,78	6,9	0,43	2,91	6,08
2	9,52	7,2	0,31	2,88	5,78
3	9,85	7,4	0,33	2,87	5,25
4	9,25	7,2	0,36	2,76	4,88
5	9,25	8,4	0,56	3,09	4,12
6	8,56	6,2	0,28	3,08	6,70
7	8,56	6,0	0,33	3,11	6,55
8	8,48	5,9	0,32	3,11	6,60
9	8,16	5,7	0,34	3,10	6,82

Table 3

The mass concentration of organic acids in the samples

#	Organic acids, g/dm ³				
	wine	malic	citric	siccine	lactic
1	4,32	1,61	0,27	0,79	2,21
2	4,50	1,66	0,28	0,76	2,18
3	4,66	1,91	0,29	0,73	2,09
4	4,56	1,96	0,34	0,70	1,92
5	4,77	1,98	0,47	0,87	1,80
6	2,43	1,13	0,36	0,74	1,54



7	2,28	1,23	0,36	0,68	1,54
8	1,82	1,28	0,38	0,58	1,37
9	1,96	1,47	0,30	0,56	1,28

Comparing the concentration of organic acids it can be noted that a minimal amount of volatile acids, including acetic acid, was accumulated in the experimental samples. This indicated a high conversion of acetaldehyde, acetic acid into ethyl alcohol under the action of the enzymes [7]. These obtained data allows suggesting that the use of dietary fiber leads to the activation of enzymatic reactions in the fermentation of grape must.

In experimental samples, especially # 1, 2, 6-8, it was noted a visible decrease in the concentration of malic acid, which may also be associated with the activation of enzymes in the tricarboxylic acid cycle (Krebs cycle) [10].

Conclusions. The use of grape dietary fiber on the stage of alcoholic fermentation of grape must assists in the intensification of the fermentation process and the production of high quality wines. Using grape dietary fiber affects the chemical composition of wines, particularly glycerol and organic acids, the transition of extractives, the content of phenolic compounds. The grinding extent of dietary fiber (3 and 5 mm) produced by IR drying is superior in quality to other samples.

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J11610-002

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**THE INSTALATION FOR REMOVING WATER AND FULE
FRACTIONS FROM REJECTED ENGINE OILS USING THE
THERMOVACUUM EVAPORATING EFFECT
AND EFFECT OF RANQUE – HILSCHA**

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The installation for thermovacuum distillation used motor oil (UMO) for the purpose of removal from them fuel and waters fractions (WFF) is described. Rationality of clearing of UMO from liquid and firm pollution in circulation-film evaporators and filters of volume type is shown. Efficiency of using the recycled lubricant oils is considered on marine see fleet. It has been proposed a way of removing WFF from used engine oil (UEO) using consecutive two-phase drop-film distillation which in the first phase occurs in expanding linear stream and then in cyclone thermo-vacuum evaporators of the module, respectively.

Keywords: engines, used engine oil, regeneration units, test oil, see vessel, research of questions connected with pollution of the sea from seagoing ships, regeneration of the fulfilled engine oils in ship conditions, regeneration of the fulfilled engine oils in laboratory conditions.

It has been known for sure that in the conditions of engines operating on oil/gas exploratory and production platforms, support ships, marine and inland water transport ships, mining and cargo fleet of the fish processing industry of the country and also during transportation and storage of engine lube oils (ELO), they are contaminated with fuel, water and refrigerant coolants. In the result of ELO contaminating with liquid contaminants, from 50 to 70% of oils are rejected.

Effectiveness analysis of the existing REO recovery units shows that within the range from 0.3 to 3.0 tons per hour there are no small-size units and complexes on treating and recovery of commercial properties of oils. It was determined that during low-tonnage recovery the most effective methods are those where physical ways of recovery prevail that's why at the plants of oil and gas industry, in marine and river shipping companies it's reasonable to use small-size and mobile units and for big land-based plants – multifunctional mobile and stationary recovery units, realizing unifying concept on collection and treatment of used lubricants (UL).

That's why the purpose for creation of the developed unit is implementation of the proposed way of recovery, gain in performance and intensity of distillation process of liquid pollutants from oil, lowering the mass and dimensions of the unit, providing the stability of WFF removal from REO in operational conditions of both ships and MOGF. Especially important is the possibility of lowering the heat temperature of the recovered oil to prevent its thermal cracking by means of vacuum creation in vaporizer chamber and also using heat utilization from cooling systems of main engines (ME) and auxiliary diesel generators (ADG) of the power plant (PP) for REO heating. This enables seriously bring down the expenses for REO recovery.



The target goal is achieved by the following: for cleaning lubricating oil from liquid pollutants, after heating and filtration is used a thermal-vacuum sequential two-stage drop and film distillation in volume linear and cyclone thermal-vacuum vaporizer (CTVV) accordingly. On the stage of drop and film evaporation almost all water and the most part of light oil fractions is removed from oil, upon this the presence of dispersed water in oil increase the effectiveness of drop and film evaporation by means of secondary oil drop spray and local flame turbulence by means of cavitation from microexplosion of overheated water drops, stabilization of drop evaporation stage is provided by special shape of chamber and high REO speed. Simultaneously with distillation, in drop evaporation chamber from the sprayed and almost dehydrated oil and also water and oil vapor is forming a two-phase narrow liquid-vapor flame with high linear speed which is tangentially brought directly from drop evaporation chamber to the internal fixed surface in the top part of the cyclone. Shape and size of the cyclone are chosen such as to provide the oil film movement at the initial stage with high linear and angular speed in spiral downward and unseparated film flow over the whole cyclone surface; exclude oil film splashing by flame and arrange the vapor phase movement in the cyclone with high angular speed in double spiral: external whirl – downward in a cocurrent film movement and internal whirl - upward with counter-rotation. Tangential atomized oil admission in the top of cyclone, its high linear speed and cyclone shape ensure forming a thin film layer on its surface that moves on the internal surface of cyclone with high linear and angular speed.

High angular speed of film on the phase of film evaporation ensures full separation of steam and liquid phases of the flame after the phase of drop evaporation and the effective film stabilization in centrifugal force field in static and dynamic linear and angular movements (inclination tilts) of evaporator. Film forming from water-free (on the first phase) oil, the place of flame admission and film oil withdrawal from flame zone due to cyclone shape exclude post spraying of oil and droplet oil entrainment with steam phase. High linear speed movement of thin oil film on the internal fixed surface of cyclone and oil viscosity due to inertial forces interaction, friction forces between cyclone surface and oil, internal friction forces in oil and centrifugal forces, make the motion of oil film wavy in the form of successive microvortexes that roll over the cyclone surface in the form of inclined cords. The shape of cyclone and the place of flame admission ensure the oil film movement in spiral downward. Such movement of oil film is characterized by the intensive heat and mass exchange. Tangential oil admission to the cyclone, the shape of cyclone and high linear speed of flame are forming the movement of the steam phase within the cyclone in the form of two whirls according to Ranque-Hilsch effect, herein the temperature of the external whirl is higher than the temperature of the internal whirl. External steam whirl moves cocurrent the film movement downward through the external spiral; internal steam whirl moves through the reverse spiral upward with simultaneous cooling which promotes in future the acceleration of condensation of water and fuel vapors that vaporize from oil. The method of regeneration using the developed module is unique by the reason that for cleaning UEO from WFF, after removing mechanical impurities (heating and filtration) thermo-vacuum evaporation



is used with sequential two-phase WFF distillation: first – drop-film distillation in positive-displacement linear cylinder (with a little taper) evaporator after nozzle-ejector and then – in cyclone thermal-vacuum vaporizer (CTVV) respectively, where, owing to design features, application of Ranque-Hilsch effect is realized.

The module is working as follows. Contaminated oil through the coarse filter 12 and the heat exchanger 17 is supplied by the oil pump 10 to the main oil heater 11. From the main oil heater 11 through the fine filter 13, the oil with parameters $P_{oil}=1 - 2.5$ MPa and temperature $t_{oil}=130 - 170^{\circ}\text{C}$ is supplied to the nozzle 2. From the nozzle 2 the linear flame without twist of the oil spray having the shape of narrow hollow cone through the suction chamber 3 with a speed of $V = 25 - 40$ m/sec is supplied to the drop evaporation chamber 1. Underpressure in the suction chamber 3 is used for making the oil spray flame and condenser 14 evacuation. The absolute pressure in the drop evaporation chamber and in the cyclone 4 is maintained within the range $0.01 - 0.03$ MPa at $t = 100 - 160^{\circ}\text{C}$. In the evacuated drop evaporation chamber 1, overheated water drops dispersed in oil are immediately evaporated; “microexplosions”, breaking the oil particles sprayed by the nozzle 2 to tens smaller particles, in hundred times increasing the oil evaporating surface and internal turbulization and cross section of the flame are simultaneously increasing.

Drop evaporation chamber 1 is a stepped cylinder or cone with a small cone corner, for example $5-10$ deg. and coaxial with a nozzle. This cylinder or cone is diverging along the flame movement. The cross section of drop evaporation chamber 1 is designed so that the speeds of movement of steam and liquid fractions of the flame are almost equal and the chamber length and the outlet diameter are designed so that at given dynamic, linear and angular movements of the module, the flame axis movement at the outlet, during the oil flow from to the nozzle cut to the chamber 1 outlet is less than the clearance δ_B between the exterior diameter of flame at the inlet in cyclone 4 from the chamber 1 and the inlet diameter of the cyclone 8.

Steam and liquid flame of the sprayed oil is tangentially supplied directly from the drop evaporation chamber 1 to the upper part of the fixed inside surface of the cyclone 12; the flame movement changes from linear to rotating one along the interior surface of the cyclone. On the wall of the cyclone 12, by means of centrifugal forces which repeatedly exceed the force of gravity, the separation of steam and liquid phases of the sprayed flame is carried out, and the oil film forms.

The cyclone geometrical characteristics at the design phase are chosen such that the oil film may have unseparated flow in spiral downward at static inclinations of cyclone ± 40 and ± 30 deg. from the vertical in oscillating motion with roll period of 5 seconds and to exclude secondary spray of oil from the film, e.g. under the influence of flame.

Due to aggregate effect of inertial forces of floating oil in the film, internal friction forces in oil and centrifugal forces, oil film undulates through the wall of cyclone in alternating whirls, that through the wall of cyclone in spiral downward, providing the high intensity of weight-and-heat exchange in the film and high rate of fuel fractions evaporation from the film. Intensive heat-and-weight exchange in the film and the effect of heat steam phase on the oil film surface in vacuum provides high rate of fuel fractions evaporation from the film and multiple exceeds the rate of



fuel fractions evaporation on the phase of film evaporation as compared to laminar film movement in rotary-film evaporators. The diagram of the film forming on the walls of cyclone is shown in Fig. 2. Water and fuel vapors, evaporated in drop evaporation chamber 1 and separated in cyclone 4 owing to the shape of cyclone and inertial forces move inside the cyclone in two whirls: external whirl – downward in a cocurrent film movement and internal whirl - upward to the steam receiver 7 in spiral with counter-rotation. Due to Ranque-Hilsch effect, the external whirl temperature is higher than the internal steam whirl, and it provides the stimulation of the oil film evaporation.

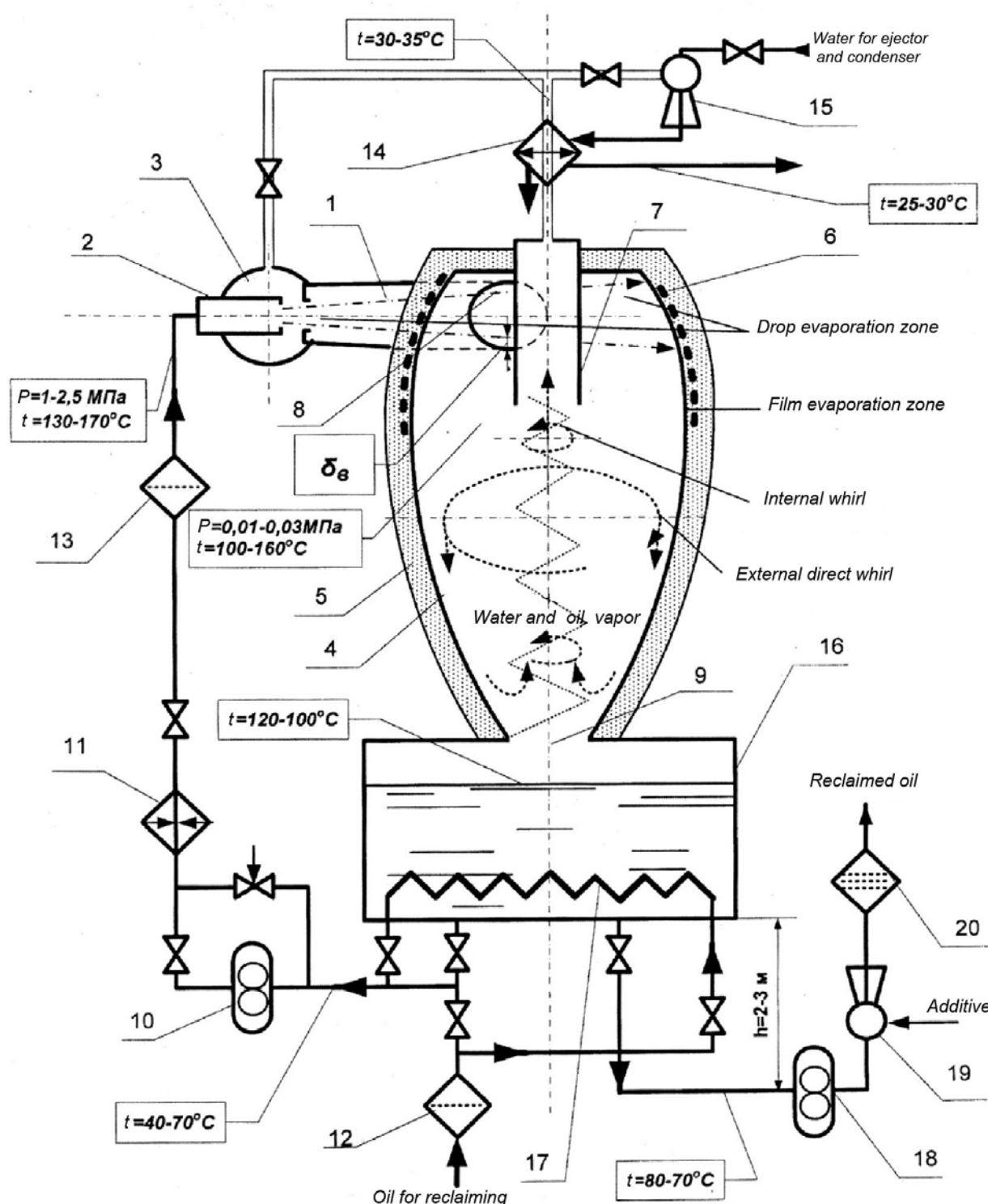




Figure 1. Schematic diagram of module for reclaiming of rejected engine oils.

Legend: 1- drop evaporation chamber; 2 - nozzle; 3 – suction chamber; 4 – cyclone; 5 – cyclone heat insulation; 6 - heater; 7 – steam receiver; 8 – cyclone inlet whole; 9 – cyclone outlet hole; 10 – supply oil pump; 11 – main oil heater; 12 – coarse filter; 13 – fine filter; 14 - condenser; 15 – water ejector; 16 – oil tank; 17 – heat exchanger; 18 – extraction oil pump; 19 – additive dispersant batcher; 20 – fine filter.

From the steam receiver 7 water and oil vapors are supplied to the condenser 14 and then removed for disposal. Additionally to the suction chamber 3 for evacuation condenser 14, cyclone 4 and drop evaporation chamber 1, the water ejector 15 is used. Discharge water from the ejector is used for cooling the condenser 14. The oil film in cyclone after the oil fractions evaporation gravitates through the outlet hole 9 of the cyclone 4 to the oil tank 16, mounted below the cyclone.

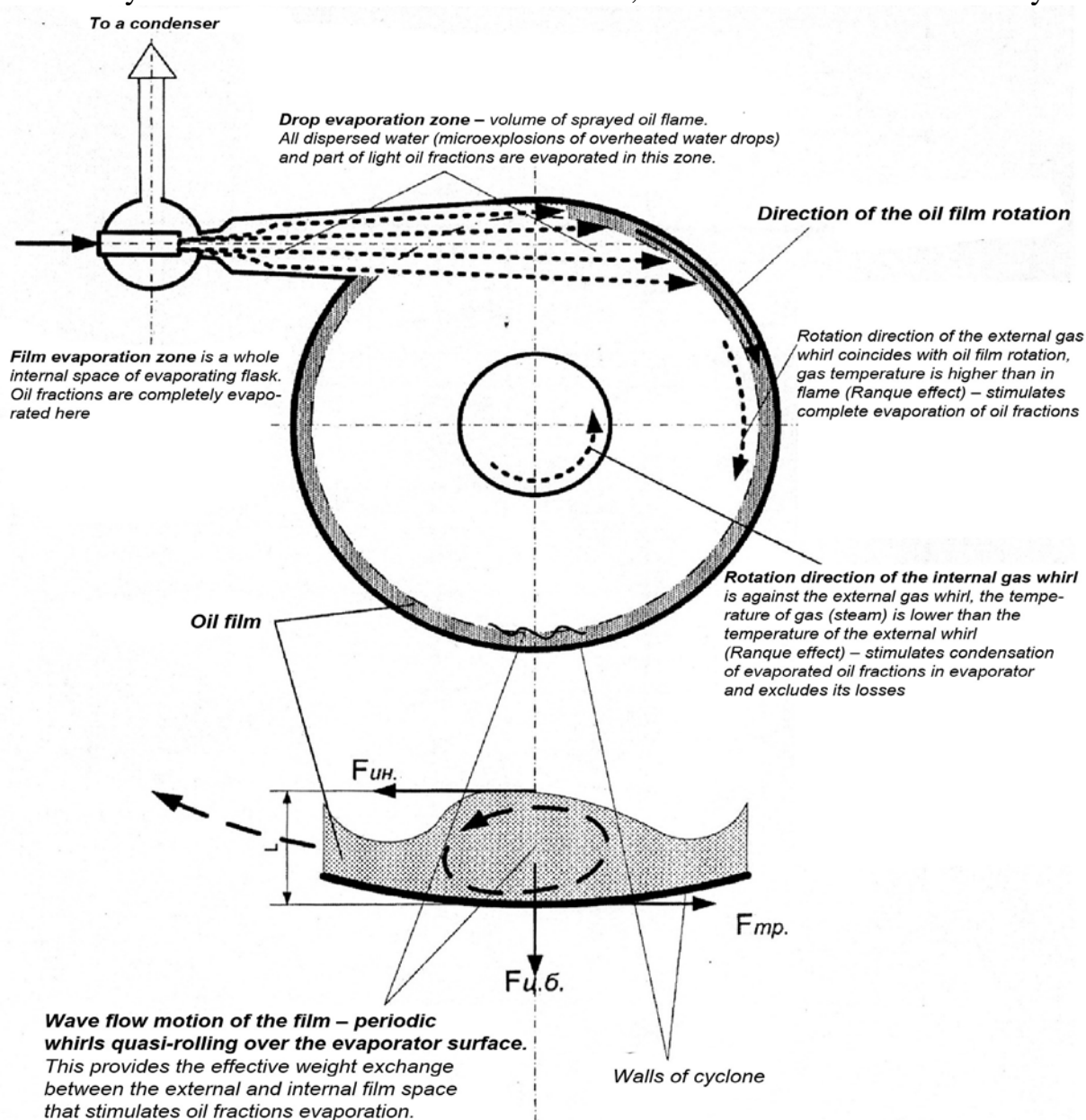


Figure 2. Diagram of the film forming on the walls of cyclone



In the oil tank the purified oil is cooled by the oil supplying for reclaiming through the heat exchanger 17, cutting the costs of the module operation. The purified oil is transferred by the pump 18 from the oil tank through the additive dispersant batcher 19 and the fine filter 20 to the pure oil tank. As there is no need to measure additive, the pure oil pump may be excluded from the scheme, but in this case pure oil tank must be located below the level of the oil tank at the height that is higher than the height of vacuum in the cyclone, or evacuated with the cyclone. For compensation of oil flame cooling in drop evaporation chamber 1 and the oil film in the upper part of the cyclone 4 from vigorous evaporation, the heater 6 is installed.

The above method of treating UEO from WFF was checked in operation on specially manufactured mobile module. To summarize the results of tests it should be noted that with so small dimensions of the module (0.7 x 0.85 x 0.9) m, weight 30 kg and power consumption – 2.1 kW, its output comes to 0.23 m³/h. The following values of the recoverable indications of engine oils having M-10 – M-24 viscosity types were obtained: increase of flashpoint from 145o C to 200o C and viscosity from $\nu_{100} = 8.97$ to $\nu_{100} = 11 - 22$ mm²/sec. Upon that the module can be used both in periodic circulation mode and in continuous circulation, at UEO heating before the module entrance up to 80 – 90o C during heat utilization from cooling systems of ME and ADG of PP.

High technical features of the module that were achieved are stipulated by the unique method of removal water and fuel fractions when using sequential two-stage drop and film distillation. Specific feature is lower temperature of UEO heating, by means of making deep vacuum from implementation of Ranque-Hilsch effect in vaporizer chamber. This aids high productivity and increased rate of WOF distillation, excluding oil thermal cracking in high-temperature zones, as it happens in other modules for UEO reclaiming. Tests of the pilot unit showed that at high mobility and small dimensions, when diesel installations of power units (DIPU) on the oil and gas exploratory and producing platforms are operating on the shelf of Arctic and North seas, this unit will operate with necessary quality factors of recovered oil and without performance loss during heat recovery of cooling systems in internal combustion engines (ICE), vehicles and machinery, both ICE and PP on support ships of the hydrocarbon production plants. Reclaiming of rejected oil products has to become one of the trends of oil and gas clusters in the Far-East region to lower the human anthropological effect on nature and improvement of energy-and-resources saving technologies.

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**J11610-003**

Ivanchikov S.O., Nikonova Z.A., Nyebesnyuk O.Y., Nikonova A.O.
INFLUENCE OF ON REHABILITATION LASER ANNEALING
BEHAVIOR OF IMPURITIES IMPLANTED IN SILICON

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Abstract. The effect of pulsed thermal annealing behavior and electrical activity in the implanted silicon impurities B, P and As. The properties of high-silicon layers produced by ion implantation followed by thermal annealing, depend strongly on the degree of recovery of the crystal lattice perfection and the distribution of impurity atoms. In addition to the recrystallization annealing of the lattice contributes to the electrical activation of implanted impurity ions, which the more intense the higher the degree of matching the size of the covalent radius of impurity atoms and silicon. Otherwise, it is necessary to expend extra energy. The final result depends on the mass annealing implanted ion, the substrate orientation, temperature, doping, energy and dose.

Key words: laser annealing, thermal annealing, silicon, impurities, temperature, alloying, atom.

Introduction.

Known [1,2], that pulsed laser annealing (LA) adequately and effectively minimizes and deactivates the radiation defects, thus providing the required level of electrical activity of the implanted impurity. Thus, the utilization rate of the impurity, i.e. the ratio of surface dopant concentration to dose after the LA higher than after thermal annealing (TA). This is observed in particular, during the annealing ruby laser, and Nd: glass laser in continuous mode. Moreover, in the second case, the crystal temperature does not exceed 800 °C. However, at low doses utilization in both cases, the LA and TO is close to unity, and only at high doses of ions of phosphorus (P), then it does not provide a high value [3].

Methods of research and experiment, especially.

The experiment was conducted at high power laser exposure, which is about 50 mW, t. To. At a power of about 20mW detect surface changes are minor. Annealing temperature 500-700 °C, the laser power LGN-215 to modify and control the meter IMO-2. The samples were examined by electron electron microscope JEM-120.

Features of influence of heat treatment on the concentration of the impulse, electrical activity and the distribution of implanted impurities were determined by the impurity profiles (Fig. 1), obtained by the authors as a result of LA ruby.

The authors noted a general pattern - the expansion of the doped region as a result of the LA. In addition, the test samples were portion with approximately constant impurity concentration to a depth of 200 nm for boron (B), and P, and 120 nm - arsenic (As). Redistribution of impurity removal, and was accompanied by the transfer of the implanted atoms in the substrate replacement. Losses resulting from the impurity atoms LA has been detected, the integrated quantity of before and after the LA coincide up to 6%.

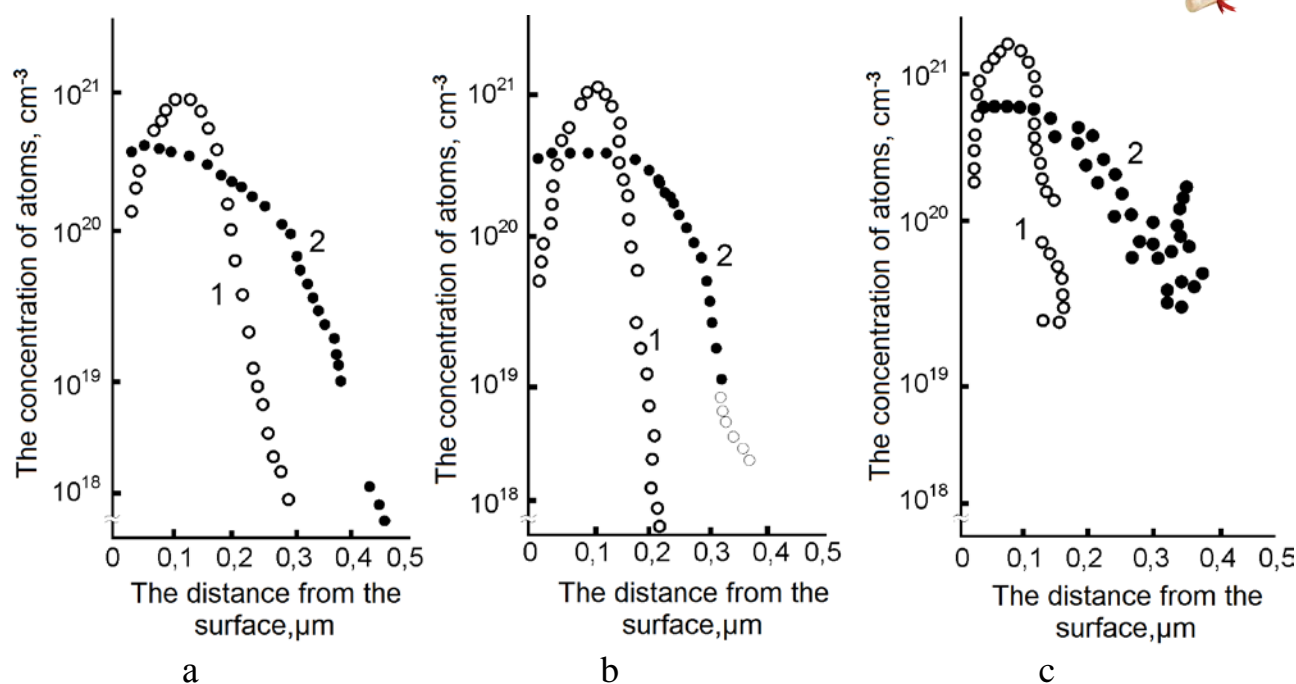


Figure 1 - Distribution of concentration of atoms of B (a) P (b) and As (c) after implantation and LA ruby laser.

Fig. 2 shows the experimental dose dependence of the distribution of the tin atoms (Sb), implanted with an energy of 100 keV.

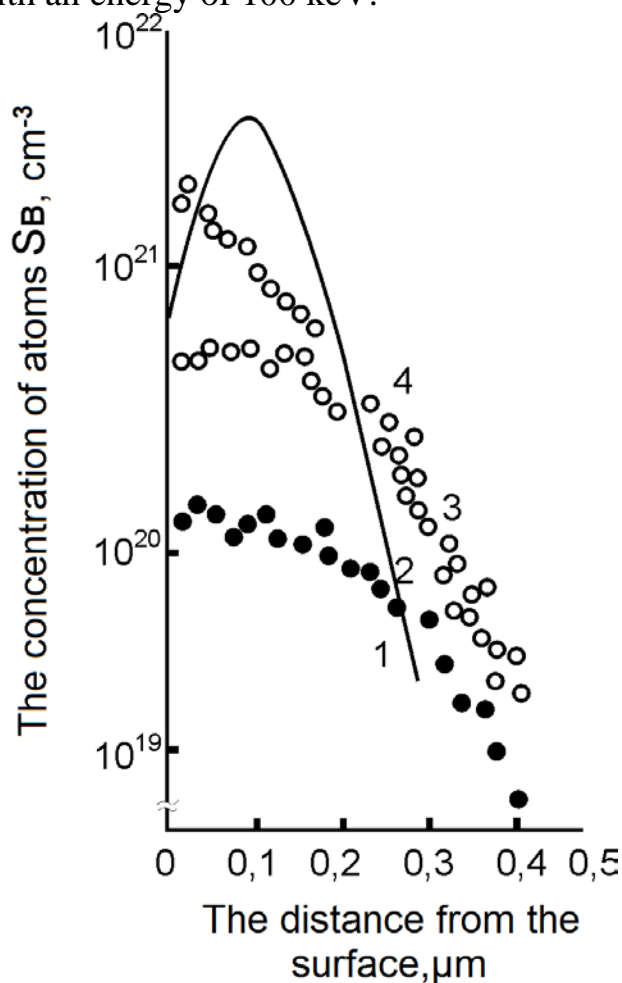


Figure 2 - The dose dependence of the concentration distribution of the atoms. The ion energy 100 keV.



In this case, the maximum concentration of the Sb atoms is greater than the solubility limit of Sb in Si. At low dose implementation to 99% of the atoms is in the substitution site is a constant concentration of approximately 70 nm from the surface. The remaining violations were found. At a high dose of an exponential decrease in concentration with increasing depth, and in the surface layer thickness of 30 nm remained significant violations. Loss of Sb atoms at high doses is 35% of the implanted level.

Known [4, 5], the coefficient distribution limiting solubility of Sb in Si lower than for B, P and As. This fact determines the characteristics of the layers LA undoped ions Sb.

Results and discussion.

In experimental studies established (Fig. 3), depending on the transition of the surface layers in the molten state silicon and impurity profiles vary.

At an energy density of 0.64 J/cm^2 profile atoms in virtually indistinguishable from the original, the residual defects as dislocation loop are stored and only 30% of the atoms are activated. When the energy of $\geq 1,1 \text{ J/cm}^2$ occurs plot constant concentration, concentration profile extends, and with a further increase in the beam energy is achieved almost complete electrical activation.

Our results agree well with the calculated values, allows for the diffusion of atoms B in the liquid silicon at a temperature above the melting point.

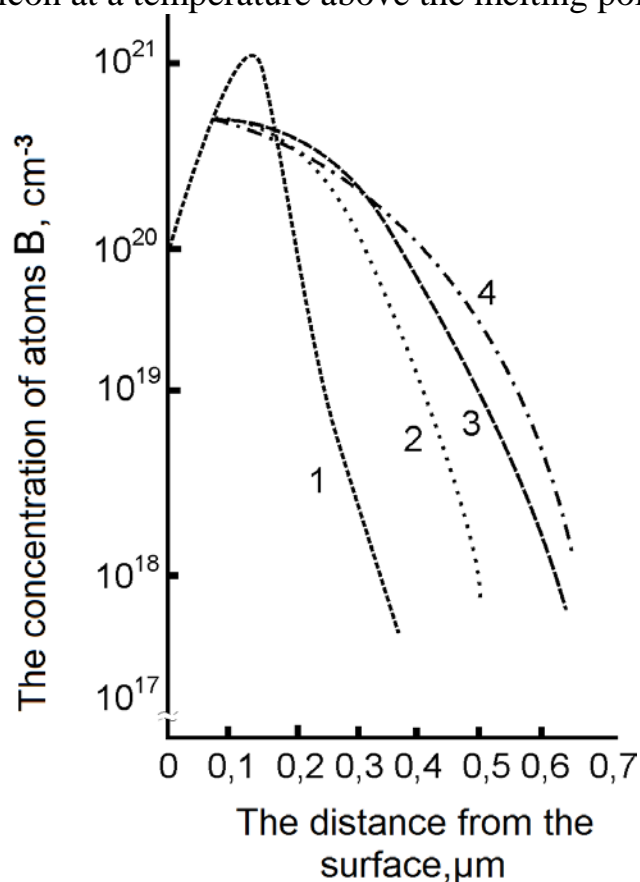


Figure 3 - Distribution of atoms in depending on the laser energy per pulse.

The high coefficient of diffusion of atoms As, about $10^{15} \text{ cm}^2/\text{s}$, from high layer is also characteristic of the annealing laser pulse Nd: YAG ($\lambda = 1,06 \text{ μm}$). It was



found that the impurity profile depends on the radiation power per unit area (Fig. 4). When power 38 mW/cm^2 , there is some redistribution of impurities, however, while maintaining a sufficiently large number of structural defects. Defects is significantly reduced with the increase in power up to 76 mW/cm^2 , and the As atoms penetrate to a depth of 500 nm at an initial value of the projection path of 50 nm.

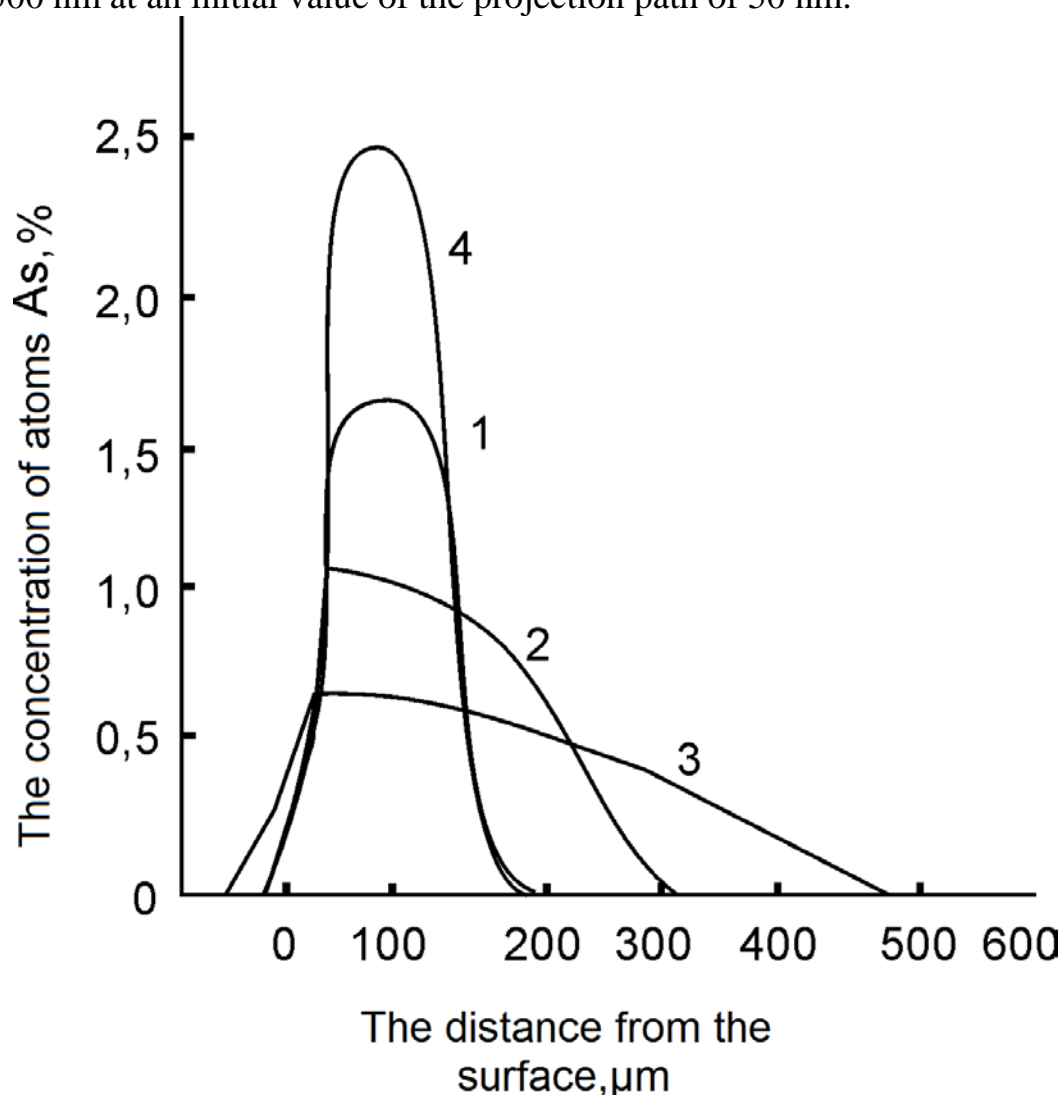


Figure 4 - Distribution of As atoms after annealing laser Nd: YAG as a function of pulse power.

LA results are sensitive to the conditions of implantation and the properties of the treated high-alloy layer.

For studies were taken LA layers formed by implantation of As ions with a dose of 10^{15} , 10^{16} , and $5 \cdot 10^{16} \text{ cm}^{-2}$ in the Si (110) - orientation. The energy of 60 keV projection provided ion path length of 35 nm, and the ranges of doses occurred amorphization silicon.

With two large doses of LA observed incorporation into the lattice more than 95 atom% As. At a lower dose of the impurity profile is practically unchanged as a result LA, whereas said large doses lead to a significant increase in the area of high layers (Fig. 5, sections 2 and 3). In this case, a corresponding influence the structure of the implanted layer.

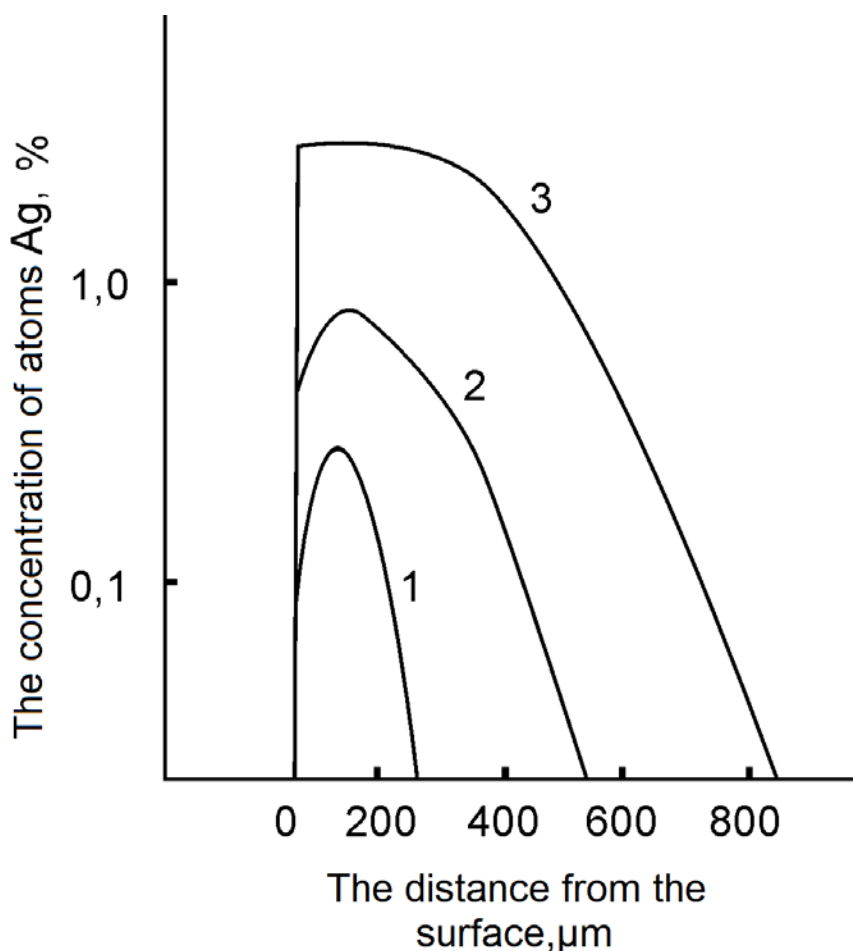


Figure 5 - Dose according to the distribution of As atoms in the layers after the LA mode: laser Nd: YAG.

It is found that the higher the dose of implantation, the greater the thickness of the amorphous layer produced and the greater the degree of amorphization and absorption. Therefore, the melting point of the layer occurs before and during the action of radiation pulses melt extends to a greater depth. The consequence of these processes is to expand high-alloyed layer.

In pulsed LA perfection resulting structure is determined by the depth of penetration relative to the original layer violation. It should be noted that in the case of the amorphous layer is strong absorption of ruby laser radiation at the surface. At an energy of 0.7 J/cm^2 , the melt zone encompasses the entire damaged layer thickness, for example, 180 nm, obtained by introducing a dose of $5 \cdot 10^5 \text{ J/cm}^2$ of ions of P, whereas the deeper or heavily disturbed amorphous layers are seeded to promote recrystallization and formation of the polycrystalline layer with a thickness of 150 nm to 100 nm grain diameter. When the energy of 1.5 J/cm^2 whole amorphised layer is melted, crystallization occurred but at cluster layer and thus formed dislocation and stacking faults.

Based on the foregoing, it can be concluded that the LA mode selection must be made taking into account at least the projected layer structure subjected to ion implantation.

Conclusion.

1. It is found that the impurity profile in ion implantation depends on sufficiently hard radiation power per unit area



2. Results LAT sensitive to the conditions of implantation and the properties of the treated high-alloy layer.

3. It was found that with increasing energy up to 1.5 J/cm^2 is melted all amorphised layer and crystallization occurred in a cluster layer to form dislocations and stacking faults.

4. It was found that the choice of mode LA should be made at least taking into account the predicted structure of the layer subjected to ion implantation.

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DIRECTIONS OF AUDIT AND DEFENCE OF THE INFORMSYSTEMS

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Introduction.

Today Ukraine ran not only into the problem of informative war, and with digital (cyber war). There is a common purpose in these determinations, but different decisions of tasks - it was shown by the tragic events of the last years. Global penetration of information technologies in our life, the gradual passing to the electronic methods of doing business is put before the participants of market by tasks on providing of informative safety. General informatization is accompanied by the increase of number of computer crimes and, as a result, material losses. Therefore informative safety became an obligatory condition.

Researchers usually distinguish three basic types of threats of safety are the threats of opening, integrity and refuse in service (DoS). The threat of opening consists that information becomes known that, who it does not cost it would be to know it. Sometimes instead of word "opening" terms "theft" or "source" are used. The threat of integrity is contained by any intentional change of data that is kept in the computer system or, that passed from one system in other. It is usually considered that state structures yield in a greater degree the threat of opening, and to the threat of integrity - business or commercial. Will mark that for year's independence in Ukraine bases are only stopped up for forming of the system of providing of informative safety. In electronic space to the information transfer the next receptions of achievement of terrorist aims are used:

1. Causing of loss to the separate physical elements of space, destruction of networks of power supply, aiming of obstacles, use of the special programs that stimulate destruction of vehicle tools, biological and chemical tools of destruction of element base et cetera.

2. Theft or elimination of informative, programmatic and technical resources of space, that have public meaningfulness, by overcoming of the systems of defence, introduction of viruses, programmatic book-marks and others like that.

Model of Take - Grant that will realize the discretionary policy of differentiation of rights (safety). The aggregate of norms and rules that regulate process treatments of information, implementation of that provides protecting from the determined enormous amount of threats and folds the necessary condition of safety of the system, understands under the policy of safety. In case of the use of discretionary policy of safety there is a necessity of determination of rules of distribution of permissions and analysis of their influence on safety IS. In the model of Take - Grant as basic elements are used count of accesses and rule of their transformations.

A term of "root kit" (from the eng of root kit is a "set for taking title of administrator") is not that other, as a program or set of the programs for the hidden taking under control of the broken system. In the context of concealment of viral code in the system Windows under root kit it is accepted to bear such code in a mind, that,



being embedded in the system, capable to intercept system functions. Rewrite instructions to the Macaw-function are executed in code of root kit for providing of inviolability of implementation of function. Such intercept comes true purposefully taking into account the version of OS and it the set updating. Counteract to this method of intercept of functions to MACAW it is organized by the calculation of check sum (CRC) of library to MACAW at memory and comparison of it with the known check sum of "clean" library. The difference of the indicated check sums gives an opportunity to assert about violation of original code of library. The code of "clean" library of API-function undertakes from the handwritten created process that avoided the attack of root kit. Such process is created without the use of calls of functions of Win API by the use of NativeAPI of calls. It is undifficult to guess, that such intercept and modification of API - functions allow root kit easy and it is simple to mask being in the broken system.

User - mode category root kits is based on the intercept of functions of libraries of the mode of user, kernel - mode - on setting in the system. Distinguish the next basic methods of concealment:

1) Modification of table import. Presumably, exactly this methodology of concealment applies on the rank of classic. Technology of such disguise consists in the following: root kit finds in memory the table of import of the program that is executed, and corrects the addresses interest of its functions on the addresses of the interceptors. In the moment of call of API - function program reads her address from the table of import and transfers control to this address. The search of table of import in memory is simple, as for this purpose already the known is specialized API - function, that allow to work with character of the program in memory. 2) Modifications of machine code of the application program. As follows from the name, essence of method consists in modification of machine code that answers in the application program for the call of that or other API - function. Realization of methodology is difficult enough, conditioned it by a rich variety as if programming and versions of compilers, besides and realization of calls of API - function can be different. 3) Modifications of programmatic code of API - function. Methodology consists in that root kit must find in memory the absolute code of interest him API - function and to modify him. Thus interference with the absolute code of functions that is intercepted, minimum. At the beginning of function usually allocate 2-3 computer instructions that transfer control basic to the function-interceptor. The basic condition of such methodology is maintenance of initial machine code is for every function modified to them. 4) Intercepts of functions of LoadLibrary and GetProcAddress. Executed by modification table of import: if to intercept the function of GetProcAddress, then at the washed down addresses can be produced to the program the real not addresses of interest her functions, but addresses of the interceptors. At the call of GetProcAddress it gets an address and executes the call of function. 5) Intercept of functions is in the mode of kernel (kernel mode). Co-operating with a kernel comes true through ntdll.dll, most functions of that are mediators at an address to the kernel through breaking of INT 2Eh. An eventual address to the functions of kernel is based on the structure of ServiceDescriptorTable (or briefly SDT), located in ntoskrnl.exe. SDT is a table that contains the



points access of services kernel of NT. It is simplified possible to say, that for the intercept of functions it is necessary to write a driver that will do modification of table of SDT. Before modification to the driver it is necessary to save the addresses of functions that is intercepted, and write down in the table of SDT of address of the process.

Conclusions.

Marking the high level of activity and personal interest of international concord in the strategic decision of problems of development of informative space; considering 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 it own strategy in an informative sphere, it is possible to do corresponding conclusions. Creation of the real international consensus through this question between the states - partners are by an objective necessity, as cyber crime grows both on national, and at an international level. Ukraine already today feels influence of cyber crime, and objectively interested in forming of corresponding policy and construction of the own system of cyber save, first of all by creation of Strategy, as from the leading documents of public policy of Ukraine, that determine activity of organs of power in an informative sphere doctrine certain questions of safety; laws that is related to the newest information technologies.

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J11610-005

Nabiyev M.A., Yermagambet B.T., Nurgaliyev N.U.,
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PROCESS CALCULATION OF LAYERED GASIFICATION OF SARYADYR COAL DEPOSIT (LAYER "NADEZHNYI")

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Abstract. Simulation of gasification of Saryadyr coal (layer "Nadezhnyi") was conducted for steam and air blow in this research. The optimal technological parameters of the test under specified conditions were determined to obtain energy and synthesis gas. The influence of water vapor and air on gas composition was revealed.

Key words: coal, gasification process, gas, simulation, steam and air blow, optimal parameters.

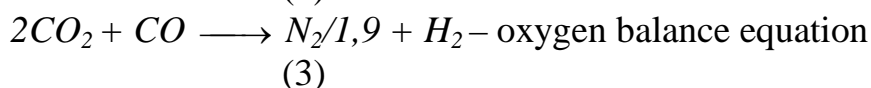
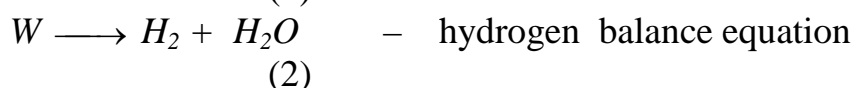
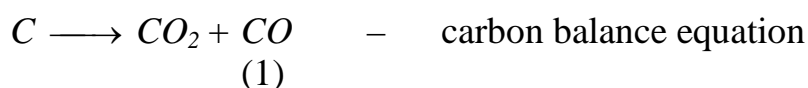
Introduction.

Gasification process of solid fuels is one of the most promising areas of coal processing. It allows producing synthesis gas for production of liquid motor fuels, process gases for chemical industry and metallurgy, gas energy source for production of electricity and heat, etc. At the same time it is highly relevant to determine the optimal technological conditions of the process which can be implemented only on the basis of computational models of gasification [1].

Input data and methods.

In order to implement mathematical modeling of layered gasification, method of Professor N.N. Dobrokhotoy was selected, which is used in calculations of gasification of bituminous and brown coal. [2] The main result of calculation is to determine the composition and quantity of generator gas, based on coal composition, i.e. without carrying out of experiments.

The calculation is done separately for both stages in this method: a) stage of dry decomposition (in upper part of generator) and b) gasification process (lower part of generator). Thus, based on practical data, components of generator gas were set from carbon C, oxygen O₂ and hydrogen H₂ contained in fuel. Then, quantity of CO, H₂, CO₂ and H₂O are calculated in gas produced in lower part of gasifier. This latter process is characterized by the following equation [2]:



$$(CO \cdot H_2O)/(CO_2 \cdot H_2) = K_p \quad - \quad \text{equation of equilibrium constant} \quad (4)$$

Calculation of Saryadyr coal gasification process (layer "Nadezhnyi") was carried out in the mode of blowing of steam-air mixture with flow rates which



(according to this method) shall be taken: steam - 0.2; 0.3; 0.4 kg / kg and air - 1.06; 1.11; 1.16 m³ / kg (per 1 kg of coal). In this regard, the number of performed calculations was $3^2 = 9$ times, i.e. combinations were carried out among all parameters of these intervals. The choice of such amounts of calculation was due to determination of the optimal technological regimes of process conduction to obtaining energetic and synthesis gas. Selection of these H₂ / CO ratios is caused by the fact that they are usually used in the synthesis of liquid fuels and chemicals depending on the synthesis conditions [3]. Table 1 shows the characteristics of Saryadyr coal.

Table 1

Characteristics of Saryadyr coal (layer "Nadezhnyi")

Fuel	Coal composition (operating mass), %								heating value, (kcal / kg)	
									the highest	the lowest
	W _t ^r	A ^r	V ^{daf}	C ^r	O ^r	H ^r	N ^r	S ^r	Q _y ^e	Q _y ^h
Saryadyr	2,94	46,47	27,68	40,71	6,56	2,66	0,39	0,27	3932	3771

Results. Discussion and Analysis.

Results of these calculations are presented in Table 2 and in Figures 1 and 2. The calorific value of gas Q_g and gasification efficiency η (%) was defined as:

$$Q_g = (3016 \cdot CO + 2576 \cdot H_2 + 8558 \cdot CH_4 + 5620 \cdot H_2S) \cdot 0,01 \text{ kcal / m}^3$$

Q_g – gas calorific value; 3016, 2576, 8558, 5620 – gas calorific value (kcal / m³) of CO, H₂, CH₄, H₂S respectively; CO, H₂, CH₄, H₂S – component content in gas, vol.%.

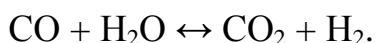
$$\eta = \frac{V_g \cdot Q_g}{M \cdot Q_y} \cdot 100 \%$$

Q_g and Q_y – calorific values of gas and coal respectively (kcal/kg); V_g – volume of produced gas (m³); M – mass of consumed coal (kg).

Analysis of the results shows that increasing of steam flow rate (in the range of 0.2-0.4 kg / kg) leads to:

- Increasing of CO₂ и H₂ concentration, target ratio of H₂/CO (0.65 to 1.03), heating value Q_r , gasification efficiency η_r , total gas yield;
- Yield decreasing of CO, CH₄, N₂, C₂H₄, total yield of main gas components V_r .

Influence of steam can be explained by water gas reaction:



Increase of air flow results in a similar influence on gas composition, except that the H₂ yield decreases and concentration of nitrogen N₂ increases.

To obtain energetic gas with the highest indicators for calorific value and gasification efficiency, consumption of injected steam and air should be the lowest but sufficient for good combustion of coal, i.e. with minimal remnants of slag. The mode №3 (Table 2) corresponds to these conditions of the specified ranges of values of steam-air blow, with maximum output of combustible components V_r (48.35 % for



dry gas) and the lowest ratio of H_2 / CO (0.649). Table 3 shows material balance of coal gasification for mode 3, corresponding to the optimal mode of the process conduction for energetic gas obtaining. The slight discrepancy between income and expenditure items related to the error of calculation, which is $\approx 0,12\%$.

The mode №7 with the maximum ratio of H_2 / CO (1.029) is the most suitable for production of synthesis gas with the highest values of air consumption (1.16 m^3/kg) and steam (0.4 kg/kg), and the lowest yield of combustible components V_r (42.29% for dry gas) (Table 2).

Table 2

**Options of conduction of coal gasification process of Saryadyr deposit
(layer "Nadezhnyi")**

Mode	1	2	3	4	5	6	7	8	9
Vapor consumption (kg/kg)	0,2	0,2	0,2	0,3	0,3	0,3	0,4	0,4	0,4
Air consumption (m^3/kg)	1,16	1,11	1,06	1,16	1,11	1,06	1,16	1,11	1,06
Gasification temperature ($^{\circ}C$)	900	900	900	900	900	900	900	900	900
Yield of wet gas (m^3/kg)	2,04	2,00	1,96	2,16	2,12	2,08	2,29	2,24	2,20
Yield of dry gas (m^3/kg)	1,89	1,85	1,82	1,94	1,90	1,87	1,97	1,94	1,91
Sum V_r ($CO + H_2 + CH_4$), vol. %	40,93 44,25	42,99 46,36	44,95 48,35	38,57 43,12	40,48 45,11	42,27 46,98	36,48 42,29	38,22 44,21	39,87 45,99
Ratio of H_2/CO	0,654	0,651	0,649	0,847	0,845	0,843	1,029	1,027	1,026
Gas composition (%):	wet / dry								
CO_2	5,88 6,35	5,26 5,67	4,68 5,03	7,82 8,75	7,37 8,21	6,94 7,71	9,06 10,50	8,71 10,07	8,39 9,67
CH_4	2,56 2,76	2,61 2,82	2,67 2,87	2,41 2,69	2,46 2,74	2,51 2,79	2,28 2,64	2,32 2,69	2,36 2,73
CO	23,20 25,09	24,46 26,37	25,64 27,58	19,58 21,89	20,61 22,97	21,57 23,97	16,86 19,54	17,71 20,48	18,51 21,35
H_2S	0,07 0,08	0,08 0,08	0,08 0,08	0,07 0,08	0,07 0,08	0,07 0,08	0,07 0,08	0,07 0,08	0,07 0,08
H_2	15,17 16,40	15,92 17,17	16,64 17,90	16,58 18,54	17,41 19,40	18,19 20,22	17,34 20,11	18,19 21,04	19,00 21,91
N_2	45,24 48,92	44,04 47,49	42,90 46,13	42,64 47,67	41,45 46,21	40,33 44,83	40,32 46,75	39,16 45,27	38,06 43,88
H_2O	7,52 -	7,26 -	7,01 -	10,55 -	10,29 -	10,03 -	13,75 -	13,51 -	13,27 -
C_2H_4	0,37 0,39	0,37 0,40	0,38 0,41	0,34 0,38	0,35 0,39	0,36 0,40	0,33 0,38	0,33 0,38	0,34 0,39
Total	100	100	100	100,0	100,0	100,0	100,0	100,0	100,0
heating value Q_r ,	1420,2	1483,4	1542,7	1372,7	1431,5	1486,7	1337,8	1393,6	1445,9



kcal /m ³									
η _r (coefficient of efficiency), %	71,04	72,81	74,41	70,47	72,21	73,79	70,02	71,75	73,32

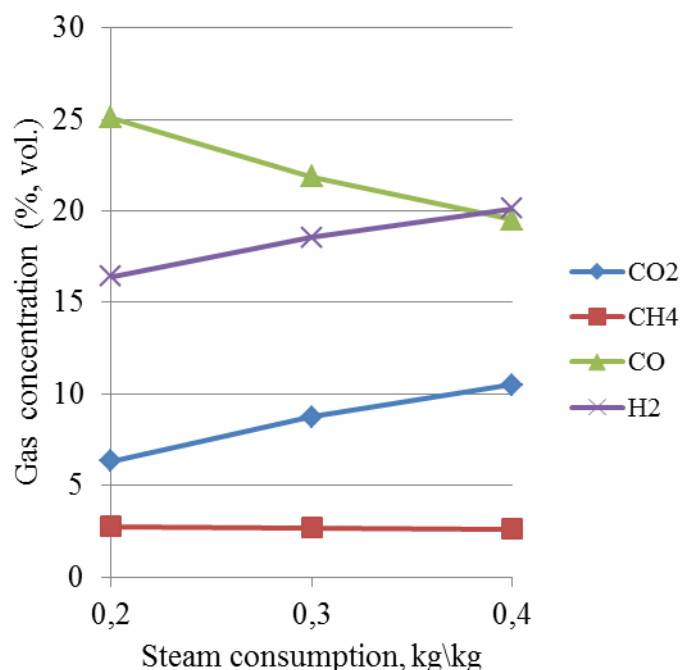


Fig. 1 Influence of steam consumption (per 1 kg of coal) on yield of dry gas components from Saryadyr coal with air consumption in amount of 1.16 m³/kg

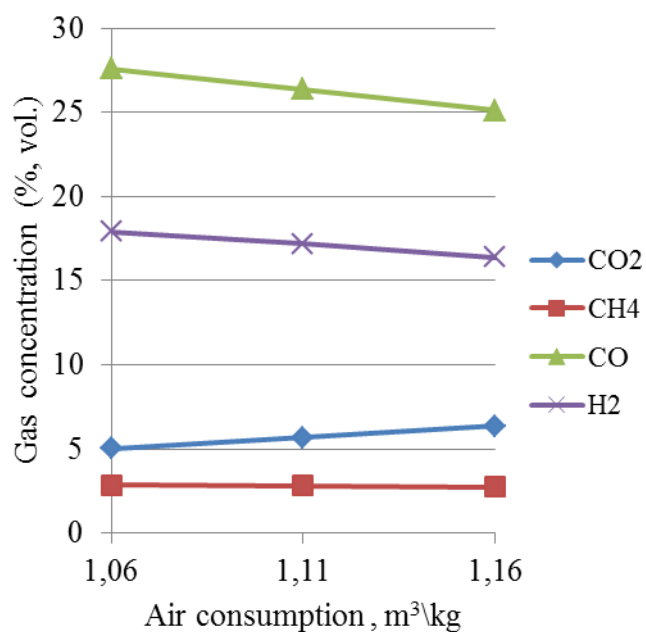


Fig. 2 Influence of air consumption (per 1 kg of coal) on yield of dry gas components from Saryadyr coal with steam consumption in amount of 0.2 kg/kg



Table 3

The material balance of coal gasification

Items of input and consumption	kg
<i>Input</i>	
1. Coal	100,0
2. Water vapor	20,0
3. Air	135,1
Total consumption	255,1
<i>Consumption</i>	
1. Syngas	204,4
2. carbon carry-over in fuel	1,6
3. Ash ($A^r = 46,5 \%$)	46,5
4. Undecomposed vapor (10 % of H_2O)	2,3
Balance discrepancy	0,3
Total consumption	255,1

Conclusions.

Mathematical calculation of layered coal gasification of Saryadyr deposit (layer "Nadezhnyi") was conducted. The optimal flow rates of steam and air were determined on the basis of calculation for production of power and synthesis gas under given initial conditions. The influence of water vapor and air on gas composition was revealed.

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Polishchuk A.V., Kozak N.I., Tarasenko S.E., Polishchuk V.N.
SPRAYERS FOR WASHING BIODIESEL. REVIEW AND ANALYSIS

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Abstract: The necessity of purifying the biodiesel from an alkali catalyst which can be carried out by neutralization followed by precipitation and spray washing water drops plates salts of citric acid. The analysis of the possibility of using inkjet, deflector, rotary and centrifugal spray nozzles for washing biodiesel. It was found that spray water over a bed of biodiesel reactor is most advisable to apply the full cone spray centrifugal. Using a sprayer to cover the entire area of biodiesel reactor is impractical due to the cost of the assembly. It is recommended to place a few sprays radially to ensure a certain overlap of spray cones

Keywords: atomizer pressure, citric acid, neutralization, spray pattern

Introduction. Produced by traditional technology, biodiesel contains alkali catalyst, which negatively affects the engine itself. [1] To release the biodiesel from the catalyst carried neutralization with an aqueous solution of citric acid [2], resulting in formation of salts of potassium, small plates which are deposited for a long time [3]. To release biodiesel from potassium salts held its aerosol washing. For this purpose the system nozzles placed above the layer of biodiesel through which the water to form a spray of droplets and their movement through the bed methyl ester. Thus waterdrops capture small plates potassium citrate and render them from biodiesel layer [4].

However, biodiesel production has appeared relatively recently, so the industry does not produce special sprays for these purposes. You have to use sprays, manufactured for other purposes such as fire fighting or mechanization of plant protection products. However, there is a wide variety of types of nozzles that are well suited for the purpose for which they were designed, and may not be suitable for aerosol cleaning biodiesel.

Therefore, **the aim of our research** is to analyze the types and selection of suitable spray for use in spray washing biodiesel.

Results. Discussion and Analysis. There are many types of sprayers: jet, centrifugal, pneumatic, mechanical, electromagnetic, combined. All the indicators of quality of spraying is largely dependent on the type of parameters and operating modes of spray.

Ink (hydraulic), nebulizers most simple constructive design and consists of a cylindrical tube with which under pressure follows the liquid jet, which then disintegrates into droplets and forming spray pattern [5]. The sputtering technique common FLAT slotted nozzles (Fig. 1) which provide a broad spectrum of spray droplet dispersion with an opening angle of the spray from 40° 110° to [6].

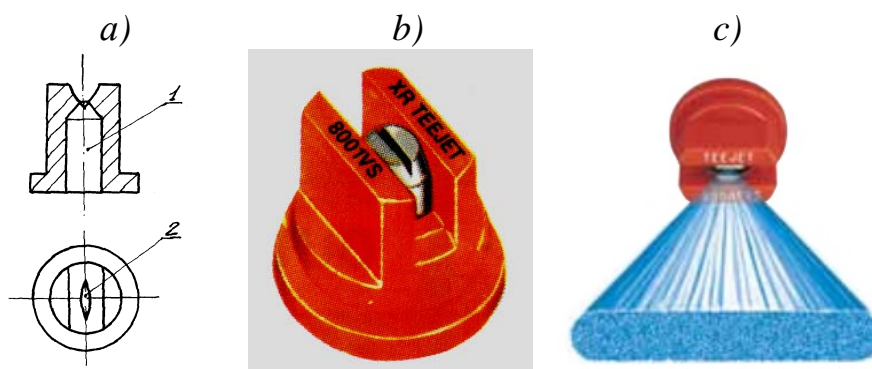


Fig. 1. Slit FLAT sprayer [6]: a) – schematic representation; 1 – input channel; 2 – the slot; b) – a general view; c) – the scheme dispersion spray cone

The group also includes hydraulic sprayers deflector (Fig. 2), where the gap is replaced by an inclined plane and is sufficiently distant from the outlet of the cylindrical tube. With their help, get roughly drip spraying the working fluid [7].

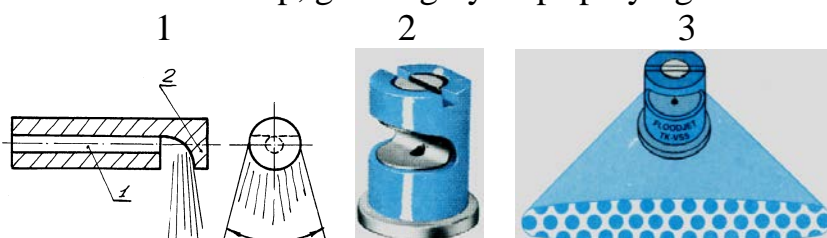


Fig. 2. The deflector sprayer [6]: 1 – a schematic view; 2 – general view; 3 – circuit dispersion spray cone

Like FLAT slit and deflection nozzles have a spray pattern in a narrow gap. Such spray is convenient to use in sprayers to protect crops from pests and diseases, but this form of the spray cone does not allow them to be used in cylindrical biodiesel reactor as to ensure complete sealing of mirrors biodiesel reactor is necessary to install a lot of guns.

Pneumatic nebulizers (Fig. 3, a), characterized in that the jet of liquid therein is broken under the action of air supplied under pressure [8]. They allow you to get a finer atomization of the working fluid in comparison with hydraulic and centrifugal, which makes it possible to reduce the rate of its consumption. Air nozzles are reliable and easy to use, but require a separate supply of liquid and air, have a very high coefficient of polydispersity – 5,5-9,0, a slight adjustment range of droplet size and poor quality of spraying at low rates of fluid [7].

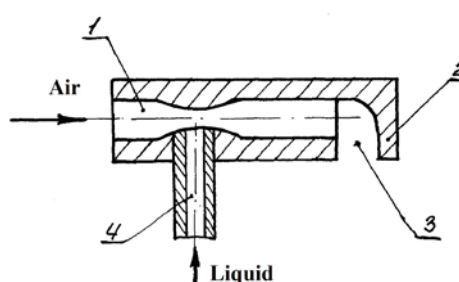
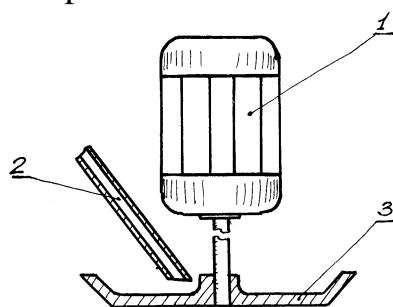


Fig. 3. Schematic representation of a pneumatic spray gun: 1 – channel for supplying air; 2 – reflective surface; 3 – slotted hole; 4 – channel for liquid injection



Using a pneumatic spray nozzles for washing biodiesel is limited to the availability of the pneumatic system of the compressor, the compressor or provide individualized for each sprayer.

The mechanical (rotary) dispensers (fig. 4) a liquid film is formed during the rotation of the rotor, it flows to the edges and becomes unstable. However, it breaks up into droplets. Among rotary nozzles most widely used disk spray elements, in which the fluid receives energy through friction of the rapidly rotating operating element (disk). The sprayers of this type of fluid dispensing and spraying it is not linked, which allows to obtain high-quality spraying when applying fluid to disk under low pressure. This is possible in two or more times to reduce the flow rate compared with hydraulic nozzles at the same dosing hole [7]. In addition, disk atomizers ensure possibility of adjusting the dispersion droplets within 40-400 microns by changing the rotational speed of disks.



**Fig. 4. Mechanical (rotary) sprayers 1 – shaft;
2 – the tube for supplying the liquid; 3 – disc**

However, spray wash biodiesel rotary nozzles are unsuitable due to their complexity and cost.

In centrifugal atomizers, the liquid moves under pressure is twisted in the swirler with a tangentially located channel (Fig. 5) (the axis of the channel perpendicular to or placed at an angle to the axis of the nozzle, but does not intersect it) and by intensive rotational motion in the chamber enters the nozzle, the output of which breaks into small droplets, thus taking the form of a hollow cone. For the formation of the fluid in the torch nozzle fed under pressure 300-1000 kPa. The range of pressure variation depends mainly on the desired spray dispersion, physical properties of the fluid and the size of the metering elements. When high pressure fluid at the inlet of the centrifugal atomizer dimensions of its nozzle and tangential channels are typically in the range 0,5-3,0 mm [5].

Centrifugal full cone nozzles TR series produces firm "Lechler", Hollow Cone - firm "Lurmark", in 1299 - the company "Hardi". The company "Spraying Systems" manufactures centrifugal spray "ConeJet" and "Disc and Core". Hollow Cone dispenser "ConeJet" molded, designed for operating pressures up to 20 bar. Spray "Disc and Core" (Fig. 6) understands that allows you to change the type of vortex generator, so that it can provide both Hollow Cone and Full cone spray pattern. It is designed for operating pressures up to 20 bar. Spray angle varies 30-60° [6].

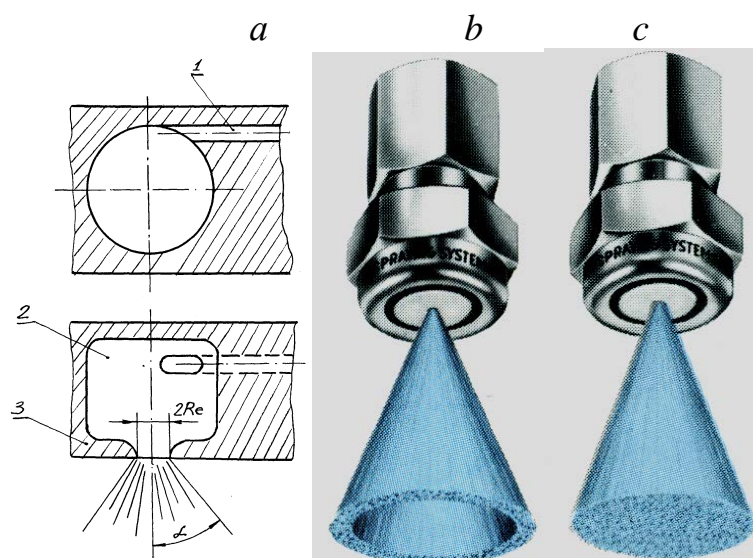


Fig. 5. Centrifugal atomizer [6]: a) - a schematic representation: 1 – tangential inlet duct; 2 – camera twist; 3 – nozzle; b) – hollow cone spray pattern; c) – full cone spray pattern

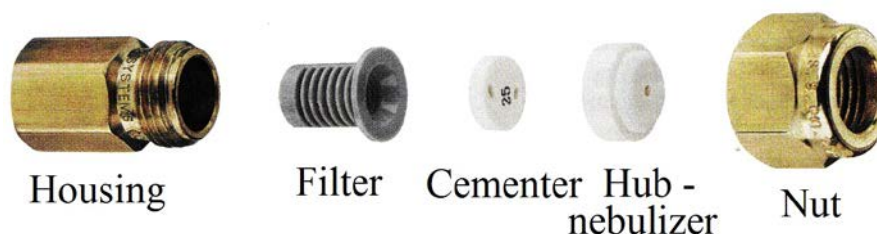


Fig. 6. Structure of the sprayer "Disc and Core"

Full cone rotary atomizer can not provide full coverage drops mirror biodiesel reactor. But the centrifugal full cone nozzles provide the most efficient overlap of atomized droplets mirror biodiesel reactor in comparison with the one discussed above types of nozzles. The use of a sprayer to cover the entire area of the biodiesel reactor problematic because existing dispensers have a small spray pattern that requires increased reactor height, and therefore a rise in price of the whole structure. It is more expedient to post several radial spray to ensure a certain overlap of spray cones, as shown in Fig. 7.

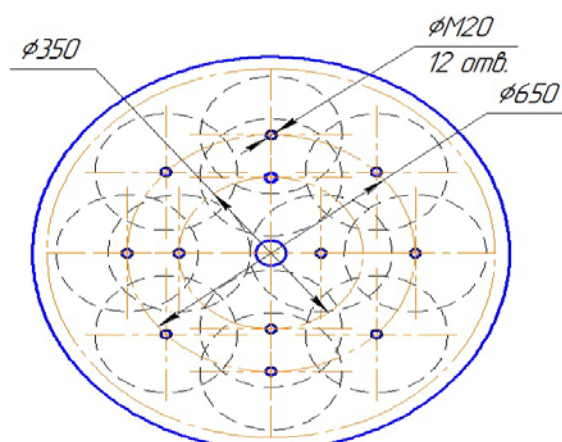


Fig. 7. Arrangement of centrifugal full cone spray to cover biodiesel reactor with the image of the flame spraying



Summary and Conclusions

1. Spray washing biodiesel is most advisable to apply the full cone spray centrifugal.

2. Use a spray gun to cover the entire area of biodiesel reactor is impractical due to the cost structure. It is recommended to place a few sprays radially to ensure a certain overlap of spray cones.

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J11610-007

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**CLASSIFICATION OF MONITORING SYSTEMS FOR MAINTENANCE
AND REPAIR OF AGRICULTURE EQUIPMENT***National University of Biological Resources and Environmental Management
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The article is dedicated to the problems of monitoring systems for maintenance and repair of agriculture equipment. The main components and information support of the monitoring system of equipment is grounded.

Key words: Agricultural equipment, monitoring, maintenance, and repair.

Challenge problem. World and domestic experience indicates that the system for maintenance and repair (MR) becomes the most promising business in the market of agricultural machinery and equipment. According to the data of the State Authority of Technical Control, about 20-25% of repaired combines do not comply with standards set in specifications and technical documentation, and each year about 30% of combine harvesters do not operate because of poor maintenance and repair. This again indicates that economically, it is useful to invest in serving infrastructure, rather than to challenge the consequences of failures caused by insufficient MR.

Review of the literature. The trend for aging of fleet and means of agricultural production makes sense for the development of the sphere of equipment MR. There are scientific works for determination of the structure and composition of the monitoring systems in the economics [2, p. 12-15] and economic potential of agricultural enterprises [7, p. 9], which offer the technology of their construction, IT operation scheme and justification models for their parameters. However, the lack of studies on the formation of the equipment MR system and its monitoring has led to the choice of the topic of the present article.

Input data and methods. The purpose of researches is to monitor the trends of development and impact factors of MR system on the reliability of agricultural equipment. The main methods of researches are the analysis and synthesis of systems and methods of equipment monitoring.

Results. Discussion and analysis. The main methods of monitoring necessary to improve the performance of the agribusiness industry of Ukraine, as observed in research [5, p. 24] are as follows: use of information analysis from public sources; benchmarking assessment of production processes; involvement of independent experts; application of methods of economic benefits; cooperation with the owners and the personnel of enterprises, performers of production processes and operators.

The performed analysis shows that the methods of forecasting the demand of agricultural producers for dealer services companies in MR for different types of agricultural equipment are not sufficient now. In developing the model, one should pay attention to the following factors: the prices for services and spare parts; the quality of works on maintenance and repair; availability of a service centre or a service repair shop; provision of equipment reliability indices; long waiting period for maintenance and repair; level of personnel competency; complexity of paperwork, and awareness of specialists about the services.



As noted in the article [3, p. 78], Ukraine need also government assistance in the creation and development of infrastructure market for engineering companies to ensure the efficiency of agricultural equipment. Creation and continuous monitoring of the information space with the database of manufacturers, suppliers, and technical service companies, as well as repair and service works are essential for the formation and development of equipment market.

Professor Naumenko O.A. identifies the following areas for the development of maintenance systems, operating in parallel [8, p. 11-13], authorized service; service which is performed by an equipment user; service that is provided by dealers or service centers; service conducted by a consortium of manufacturers or their representatives; maintenance services provided by small shops and individuals. Nevertheless, the analysis shows that along with enhanced technical service one may detect negative trends. Technical service dealer companies do not conduct technological preparation of their enterprises for complex repair and servicing works. Repair shops and repair plants, which are equipped with repair equipment, disappear gradually from the market of services; and they are not involved to ensure the efficiency of agricultural machinery and equipment.

The analysis, which at one time was conducted by Professor M.V Molodyk [6, p. 8] showed that most of the existing researches for substantiation of the optimal frequency of performance of repair and service works (RSW) used methods, which were based on the optimization of efficiency criterion.

A number of organizational, economic and technical measures were formed to improve technique-technological level and engineering reliability, including the following that are worth to be investigated: increasing the competitiveness of agricultural machinery and equipment; expansion of knowledge and improvement of qualification level of specialists by means of vocational training; information support of the companies; creation of technology centers to train the professionals.

A scientific article [4, p. 52] is rather close to the previous research. The author focuses on the calculation of the organizational and technological compatibility of repair processes of different objects based on the forecast for the dynamics of changes in partial programs. In his studies [4, p. 53], the author justifies the choice of specialization of production lines and single or multi-disciplinary stations, specifying for the latest the range of brands or models of repair objects.

Based on the analysis and taking into account the article [7, p. 9], it should be noted that the role of monitoring in the management of RSW shall be realized through the following functions: ontological, heuristic, methodological, framework, descriptive, estimative, diagnostic, explanatory, instrumental, expert, practical, informative, communicative, search, and predictive.

Nowadays, the relevant areas of work to improve monitoring technologies for development trends of technology MR systems are the researches led by Professor A.I. Boyko [1, p. 15; 9, p. 99]. These include the following: creation of a model for monitoring; collection and processing of data; evaluation of the results of the monitoring study. Regarding the context, one has proven the practicability of the graph theory for analysis and synthesis of MR systems, as well as mathematical models of reliability for aging systems.



Conclusion. Based on the above researches, we formed the main directions for the improvement of the MR system: continuous monitoring of available information on the reliability of MR systems from public sources; development of models to monitor and ensure the reliability of MR systems; monitoring of the systems for organizational management of RSW; monitoring of human resources in MR.

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Polishchuk A.V., Kozak N.I., Polishchuk V.N.
RESEARCH PARAMETERS AND MODES SURROUND WASHING
BIODIESEL

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Abstract: In the production of biodiesel as potassium hydroxide catalyst is used, which causes corrosion of engine parts. Therefore biodiesel is freed from the catalyst by neutralization with a weak aqueous solution of citric acid to form a salt (potassium citrate) forming the small plates, the deposition of which takes a considerable time. One way to release biodiesel from the records of potassium citrate is its volume lavage. To this mixed equal amounts of water and biodiesel, whereupon they are mixed, the mixture is settled, the water is drained and the process repeated many times. A laboratory study of washing the biodiesel volume method for four hours at a different frequency rotational speed mixer. Installed unsatisfactory treatment of biodiesel from the catalyst at a volume washing for the specified time.

Keywords: biodiesel, citric acid, neutralization, potassium citrate, stirrer

Introduction. При производстве биодизеля по традиционной технологии применяется щелочной катализатор (как правило, гидроксид калия), который вызывает коррозию алюминиевых деталей двигателя и разъедает резиновые прокладки [1]. Поэтому биодизель освобождается от катализатора путем нейтрализации слабым водным раствором лимонной кислоты [2] с образованием солей (цитрата калия), образующих мелкие пластинки, осаждение которых занимает значительное время [3].

Literature review. To clean biodiesel from residual catalyst developed various ways, most important of which is the so-called "wet" and "dry" cleaning biodiesel. In recent years began to appear information about the development of enzyme purification method 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, or other inorganic adsorbents such as bleaching earth [4].

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

Froth is to mix washing water 1/3 and 2/3 of biodiesel and air bubbling through the water layer. Air bubbles provide indirect stirring both liquids – they occupy a small amount of water and transferred through its biodiesel selecting catalyst salt (soap), formed by the neutralization of biodiesel weak aqueous acids and other impurities. When the bubble is broken at the surface, the water descends and selects more soap and impurities. Approximately 6 hours later washing air flow is blocked and the water is drained, fresh water is added and the process repeated. These water changes occur three times, until the water is completely clear and its pH is neutral.



The disadvantages of the technology is inefficient purification of biodiesel poor quality and low volume due to the fact that bubbles can mix the water and biodiesel are very vigorously. This leads to the formation of an emulsion of the two liquids. However, when this method is used rinsing minimal amount of water compared to other technologies.

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 fuel mixes than bubble and gradually removes soap. Softer stirring is less likely to form an emulsion. However, this process uses a larger amount of water and requires a more complex equipment [5]. Theoretical Foundations of spray washing biodiesel are given in [6].

One way to release biodiesel from the records of potassium citrate is its volume lavage. To this mixed equal amounts of water and biodiesel, whereupon they are mixed, the mixture is settled, the water is drained and the process repeated many times [4].

Purpose of the research. Explore flushing volume of biodiesel and install the optimum settings and options for indicators given its quality.

Input data and methods. In a 300 ml glass flowed biodiesel after neutralization 1/3 and 2/3 water. Glass with a tripod placed in an incubator TJ-TS-01/16, which sets the temperature 40°C. Stirring was carried out using a paddle stirrer with three blades on the shaft (Fig. 1, a) and four-bladed stirrer with inclined blades (Fig. 1, b). Drive agitators carried by the agitator EUROSTAR digital is (Fig. 2).

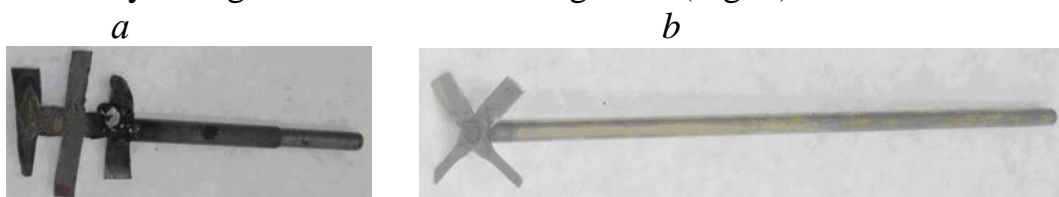


Fig. 1. Agitators: *a* - blade with three blades on the shaft; *b* - the four-inclined blades with



Fig. 2. Research surround washing biodiesel

Speed paddle was 100, 200, 300 and 400 rev/min. (at high speeds crater



formation reaches the bottom nozzle), four-bladed stirrer with inclined blades – 200, 350, 500, 650 rev/min.

Time experience takes 4 hours. Sampling of biodiesel to determine the alkalinity was carried out every hour. Also, every hour there is a replacement of contaminated water to clean.

Results. Discussion and Analysis. Dynamics of changes in the alkalinity of biodiesel is shown in Fig. 3 (for a three-blade stirrer) and Fig. 4 (for the four-bladed agitator with inclined blades).

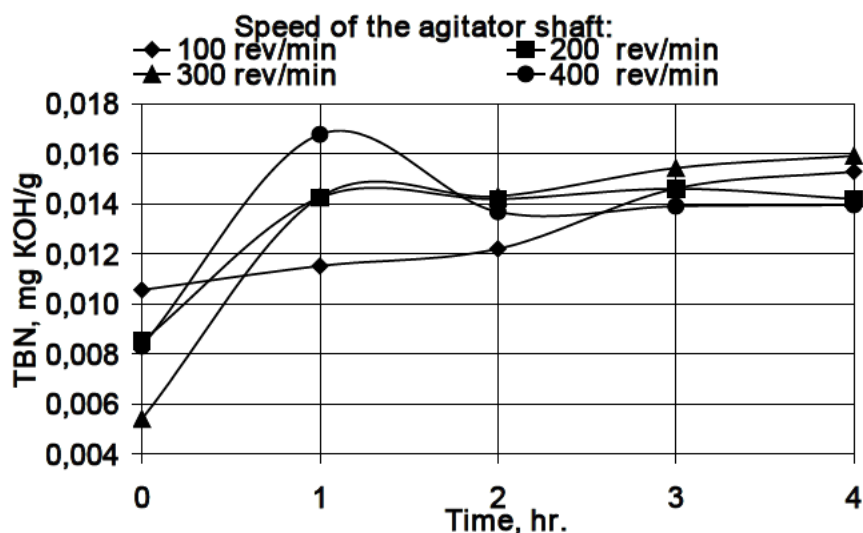


Fig. 3. Changes in alkalinity over time of biodiesel by volume washing with a paddle stirrer

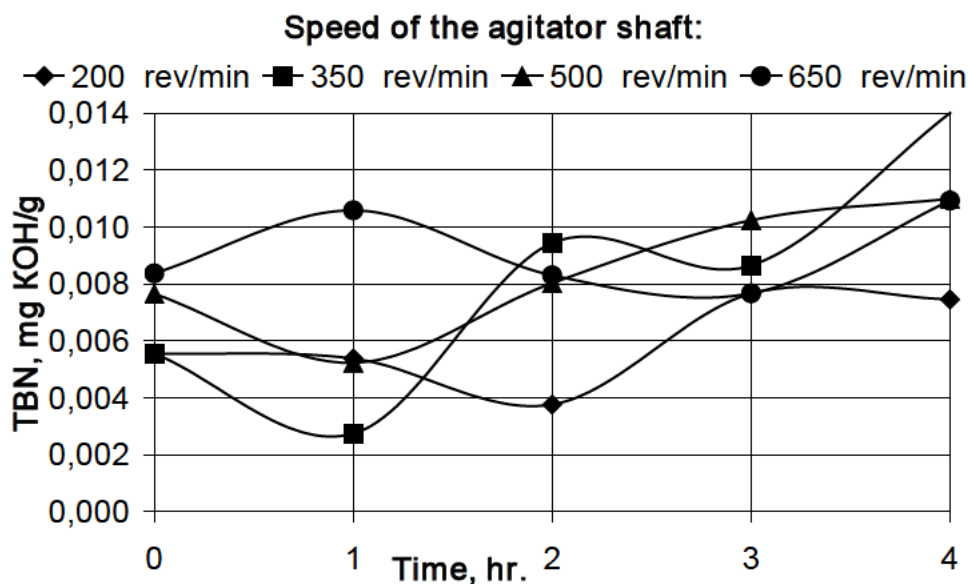


Fig. 4. Dynamics of time alkalinity biodiesel by volume washing with four-bladed agitator with inclined blades

As can be seen from Fig. 3 and Fig. 4, at a flow washing by paddle mixers biodiesel alkalinity increases with time, which can be explained breakdown plates potassium citrate smaller as a result of mechanical agitation and poor their transition from layer to layer biodiesel water. This is confirmed by the fact that with increasing speed mixer luzhnost biodiesel increases.



Thus, the volume lavage for four hours unsatisfactory frees biodiesel from catalyst residues.

Summary and Conclusions

When the volume washing with paddle mixers alkalinity of biodiesel grows over time, which can be explained broken plates potassium citrate smaller as a result of mechanical agitation and poor their transition from layer to layer biodiesel water. Volumetric washing for four hours unsatisfactory frees biodiesel from the catalyst.

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Kravchuk D.A., Vtorushin A. S., Myakinin V. A.
TENDENCIES OF DEVELOPMENT OF OPTOACOUSTIC METHODS
AND DEVICES IN BIOMEDICINE

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In work methods of diagnostic testings of biological structures by means of optoacoustic methods are considered. the review of references and the analysis of modern methods of diagnostics of blood, are considered their main merits and demerits.

Key words: optoacoustic

Introduction.

Optoacoustics – the area of scientific knowledge covering effects of excitement of a sound a laser impulse or the light bunch modulated on intensity. It is possible to call a technique with use of optoacoustic (OA) effect for a blood test "an optoacoustic tsitometriya of a stream of blood" because it allows to count and classify cages in a blood-groove, like the usual tsitometriya based on fluorescent studying of a stream of blood in which cages it is operated proceed through glass capillaries [3, 10].

Excitement of acoustic waves at impact of laser radiation on substance happens at the expense of mechanisms, square and nonlinear on amplitude of an electromagnetic field: the electro - and a magnetostriction, thermal effect, pressure of light, the concentration and deformation mechanism. Thus fluctuations are excited at a frequency of modulation of the intensity of light getting to acoustic range [3].

Review of literature.

The thermal mechanism is connected with non-uniform local heating and expansion of the environment at absorption in it laser radiation. In the wide range of values of coefficients of absorption of light and frequencies of modulation of intensity of laser radiation the thermal mechanism of excitement of a sound is the basic. Parameters of a termoopticheska of the excited acoustic signal depend on optical, heatphysical and acoustic parameters of the absorbing environment. Therefore thermooptical excitement of a sound is widely applied in problems of diagnostics of the specified parameters of gases, liquids and solid bodies.

For the first time the optoacoustic (OA) effect was observed by A. Bell in 1881 who noticed pressure pulsations in the closed volume of the gas absorbing the infrared radiation modulated on intensity. Bell suggested to use this effect for research of spectral dependence of absorption of light gases and vapors. However at that time research and application of OA of effect weren't widely adopted due to the lack of enough powerful light sources and well-tried measuring remedies of acoustic signals.

Systematic researches of fundamental questions of optoacoustics in our country were begun in 1973 by collectives under the leadership of professors L. M. Lyamshev and K. A. Naugolnykh (Acoustic institute of a name of the academician N. N.



Andreyev), professor F. V. Bunkin (Physical institute of P. N. Lebedev), professors S. A. Akhmanov and O. V. Rudenko (Lomonosov Moscow State University).

Laser optoacoustics is an initiation of acoustic fluctuations under the influence of laser radiation. Optoacoustic signals are excited in result of temperature expansion of heated volume at absorption of pulse laser radiation. Condition of instant heating: duration of laser impulses is much less, than time of distribution of an acoustic wave on the irradiated volume the Scheme of generation and detecting of OA of a signal.

Laser radiation of near infrared area can deeply extend in biological fabrics and usually induces acoustic waves at ultrasonic frequencies in some MHz or below. These ultrasonic frequencies are capable to extend of centimetric distances with the minimum attenuation and losses. The combination of pulse near infrared radiation with low ultrasonic frequencies allows to detect images at a depth ~ 5 cm in fabrics. Visible laser impulses can get into biological fabrics on depth of 1-2 mm and induce acoustic waves at frequencies of 10 - 100 MHz. These high-frequency acoustic waves allow to reproduce structure of optical layers of fabric precisely. High-frequency ultrasonic detecting can be used for creation of images of layered structures of fabrics with high resolution [10].

Main text.

Advantages of methods of optoacoustics:

- in comparison with diagnostics by methods of a standard spektrofotometriya and a coherent optical tomography, sensitivity of photoacoustic (optoacoustic) spectroscopy is higher
- at realization of an optoacoustic tomography, higher resolution in comparison with purely optical methods is reached
- are more perspective in comparison with methods purely of ultrasonography

The principle of operation of thermal optoacoustic antennas is based on the phenomenon of thermal change of the volume of water which absorbed energy of a bunch of electromagnetic waves. The electromagnetic wave modulated on intensity (for example, light) falls from the transparent environment (air) on limit of the section with the absorbing environment (water). This wave loses the energy in a sheet of water with characteristic thickness and causes alternate change of its temperature in time. Because of heating there is a change of volume of a layer which extending, excites in water a sound wave like the ordinary electro-acoustic converter [5].

In work [6] results of pilot studies of optoacoustic effect in dense beds of the focused carbon nanotubes for measurement of thickness of films and coefficient of absorption of light are presented. Installation consisted of a pyezopriyemnik on which was located flat plastic a ditch with black ink 9 mm thick – a damper (absorber). On a ditch the sample was located (a substrate with the dense bed of the focused carbon nanotubes applied on it). On a sample the quartz plate 7,5 mm thick was located. A laser beam on AIG: Nd+3 with cascade multiplication of frequency in the second harmonica fell normally on a sample, having passed through a plane-parallel plate and a glass prism. The insignificant part of the world reflected from a plane-parallel plate went to the photo diode. The electric impulse from the photo diode started a digital oscillograph, carrying out synchronization. Energy of a light impulse didn't exceed 0,5 мДж and was an order of this value. Big energy can bring, to damage of a



sample. While small energy isn't allowed to emit reliably a signal against noise [4, 10]. The performed optimization resulted in the above value of energy.

Conclusion and conclusions.

Now optoacoustics is quickly developing area of scientific knowledge and involving a large number of experts around the world. Joint interdisciplinary use of optoacoustic methods and nanotechnologies will allow to receive qualitatively new results in the field of diagnostics of biological structures [23].

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Kravchuk D.A., Kirichenko I.A., Orda-Ghigulina D. V.
THE REVIEW OF METHODS OF USE OF NANODIMENSIONAL
OBJECTS IN BIOMEDICAL RESEARCHES

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In work methods of use of carbon nanomaterials for diagnostic testings of biological structures by means of optoacoustic methods are considered.

Key words: optoacoustic, nanomaterial

Introduction.

Under nanomaterials (nanocrystal, nanocomposite, nanophase, nanofibrous, nanoporous, etc.) it is accepted to understand materials, the basic structural elements (crystallites, fibers, layers, a time) of which don't exceed so-called nanotechnological border – 100 nanometers (1 nanometer = 10^{-9} m), at least, in one direction. One of important components of priority researches in area nanotechnology and nanosciences is development of the biomedical direction including as creation of new medicines and devices of monitoring, and application of the new microdiagnostic means necessary for timely diagnostics of transition physiological processes and selection of adequate therapy.

Review of literature.

So far as the nanomaterials applied in the biomedical direction metal, semiconductor, carbon and organic nanoparticles with sizes from units to hundreds of nanometers, with various physical and chemical properties, in some cases modified by biological markers [1-4, 11] are used.

Among the carbon nanomaterials (UNM) formed only by atoms of carbon fullerenes, nanotubes and nanofibres which can be received by means of various chemical or physical and chemical methods [1-3, 8, 12] are most widespread.

UNM (UNV carbon nanofibres) - the threadlike nanodimensional carbon particles which don't have pronounced cylindrical orientation of graphene layers, and also an internal cavity. Carbon nanofibres (UNV) – the carbon cylindrical nanostructures representing [11] class of such materials in which curved graphene layers or nanocones are put in the form of a quasio-one-dimensional thread, whose internal structure it can be characterized by a corner α between layers of a decanter and an axis of fiber. One of widespread distinctions is noted between two main types of fibers: "Fir-tree", with densely laid conic graphene layers and big α , and "Bamboo", with cylindrical chashepodobny graphene layers and small α which are more similar to multilayered carbon nanotubes. However, in case of the real UNT α it is equal to zero.

Refer such nanoobjects as nanotubes to a class of nanofibres, a nanowire, nanovisker and nanocores. Nanofibres can be rigid (nanocores) or flexible, carrying or not carrying electric current. Carbon nanofibres have diameter of 20-60 nanometers and length from micron shares to several microns, contain an internal cavity with partitions, consist of the distorted cones enclosed each other with



graphene (the grids similar to layers in graphite) walls. Density $\sim 2 \text{ g/cm}^3$, a specific surface $\sim 100 \text{ sq.m/g}$, carry electric current. Contain $\sim 2\%$ of ashes and less than $0,5\%$ can be cleared to an ash-content.

In works [1-4, 9, 10] for the solution of diagnostic tasks it is offered to use a method of a flowing tsitometriya of in vivo which is based on the principles of photothermal and photoacoustic spectroscopy with use of nanodimensional contrast agents. Carbon nanotubes strongly absorb laser radiation [6, 7] and, owing to optoacoustic effect, the sound is found the ultrasonic converter. As carbon nanotubes have strong adhesion to bacterial cages, but not to own cages of a live organism, existence of a signal on the reception ultrasonic converter speaks about presence of bacteria at a blood-groove.

Conclusion and conclusions.

This technique it is possible to call "in vivo an optoacoustic tsitometriya of a stream of blood" because it counts and classifies cages in blood vessels, like the usual tsitometriya based on fluorescent studying of a stream of blood in which cages it is directed proceed through glass capillaries.

In work [10] results of blood tests are presented. In experiment both one-wall, and multiwall carbon nanotubes for detection in real time of the single bacterial cages circulating in an organism of live mice were used. Irradiated with the infrared laser of near range blood vessels in an ear or live leather of the anesthetized mice within a short period of time. In response to a laser impulse the carbon nanotubes which are on bacteria generated ultrasound of sufficient intensity for registration by the ultrasonic converter. Therefore, characteristics of an acoustic signal can be considered as a diagnostic sign.

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THE RESEARCH OF THE Ag-n-GaAs BARRIER TRANSITION INJECTION PROPERTIES

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Abstract. The relationship of the injection level, the manufacturing technological features and the electro physical parameters of the barrier transitions Ag/n-GaAs are studied. The injection has influence on the microwave devices characteristics. It requires additional studies of the metal gallium arsenide barrier transition properties. The barrier transitions on epitaxial films GaAs n-type conductivity, grown on the high-doped substrates (carrier mobility $\mu \geq 5000 \dots 7000 \text{ cm}^2/(\text{V}\cdot\text{s})$). The γ injection coefficient values are determined. The factors that have influence on the injection efficiency value into the barrier metal-semiconductor junctions are determined.

Keywords: injection rate, the barrier height, barrier junction, gallium arsenide, technological modes.

The requirements to quality functions which microwave devices execute, dictate the necessity of deep research of the physical essence of existing processes in them, the influence of different factors on basic devices characteristics, including minority injection in the metal-semiconductor barrier transitions. Nowadays the injection influence on microwave devices characteristics is not fully defined. It causes the necessity of additional research of the metal-GaAs barrier transitions properties.

The one of basic high-quality characteristics of the Schottky barrier is its ϕ_{Bn} height, which determines the transformation losses and the current size in forward direction in the Schottky diodes [1-4]. The determination of the Schottky barrier current saturation at measuring of volt-ampere characteristic in reverse direction is quite difficult [5] because of the surface leakage influence, the impact of the mirror image force and edge effects.

In the thin-film barrier injecting transitions metal-semiconductor (the Schottky barriers) the mechanism of charge carriers transporting during the concentration of free carriers in GaAs $n_{e.l.} = 8 \cdot 10^{15} \dots 6 \cdot 10^{16} \text{ cm}^{-3}$ is determined by thermionic emission (T-emission [4, 5]). At the low injection level the charge transporting in Schottky diodes is carried out by major carriers mainly [4,5].

But at direct displacements, which are large enough, the injection coefficient of minority carriers (the ratio of the minority carriers' current to the total current) grows with the current growth. It is assumed that current drift component increases and becomes much larger than the diffusive one [5]:

$$J_p = q\mu_p p_n E - qD_p \frac{dp_n}{dx}. \quad (1)$$

In the equation (1) at the low injection level it is possible to ignore [5] a drift member as compared to diffusive one. As a result to get injection coefficient γ we use expression [4,5]:



$$\gamma \equiv \frac{J_p}{J_p + J_n} \cong \frac{J_p}{J_n} = \frac{qn_i^2 D_p}{N_D L_p A^{**} T^2 \exp(-q\phi_{Bn}/kT)}$$

The researches were realized on the GaAs n-type epitaxial films, which had been grown on high-alloyed substrates. The carriers concentration in an epitaxial layer is $6 \cdot 10^{15} \dots 2 \cdot 10^{16} \text{ cm}^{-3}$, in the substrate is 10^{18} cm^{-3} , the thickness of the epitaxial layer is 2-10 micrometres, carrier mobility is $m \geq 5000 \dots 7000 \text{ cm}^2/(\text{V} \cdot \text{sec})$.

The silver deposition was performed on the substrate through a molybdenum mask with windows of a certain configuration by vacuum deposition using the installation VUP-2K at a residual pressure of about $2.66 \cdot 10^{-5} \text{ Pa}$. The barrier height is the criterion of its quality. It is determined in this work by the method of current-voltage characteristics (fig.1).

The Schottky Ag/n-GaAs barriers measurements of current-voltage characteristics were carried out at room temperature by four-probe method [1-3].

On the basis of researches [1-3] the influence of technological factors on the Ag/n-GaAs Schottky barrier height determined. To produce the injecting barrier transitions Ag/n-GaAs with a barrier height of 0.9...0.95 V such heat treatment regime was proposed [1]: the substrate temperature - 373 K; the annealing temperature - 823 K; the annealing time - 10 minutes; speed of annealing temperature increasing and annealing cooling speed accordingly $V_{t, \text{incr}} = 15\text{-}20 \text{ degr./min.}$; $V_{\text{col}} = 15\text{-}20 \text{ degr./min.}$

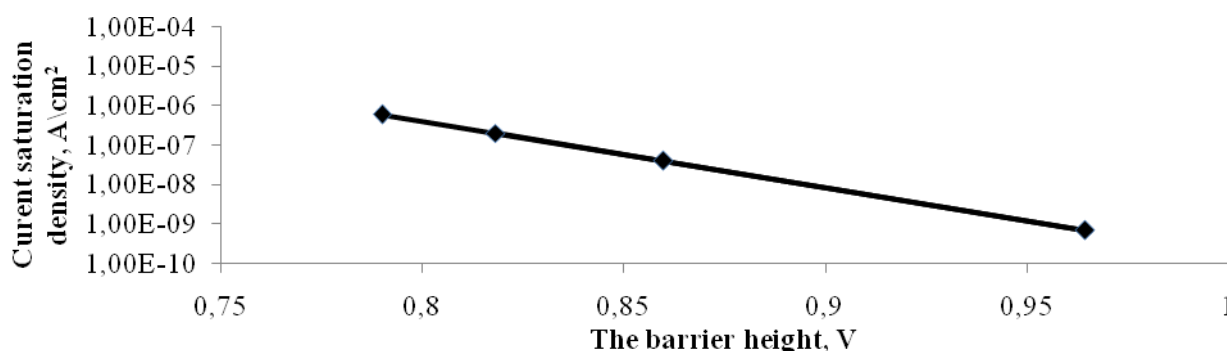


Fig.1. The dependence of the current saturation density on the height of the Schottky barrier Ag/n-GaAs at $T=300 \text{ K}$ and $A^{}=120 \text{ A}/(\text{cm}^2 \cdot \text{K}^2)$**

For injecting Ag/n-GaAs barrier transitions with the different Schottky barrier height, which were made on the GaAs epitaxial layers ($N_d = 10^{15} \dots 10^{16} \text{ cm}^{-3}$) at the different heat treatment modes [1]; the values of the injection coefficient γ were calculated (table 1). The dependence of injection coefficient γ from the ϕ_{Bn} (Fig. 2) was counted. The injection level for different contacts varies within 4-10%.

It was found that the injection coefficient γ is very small at $N_d \text{ GaAs} = 10^{16} \text{ cm}^{-3}$ and $\phi_{Bn \text{ Ag-GaAs}} = 0,8 \text{ V}$ ($\gamma_{\text{Ag-GaAs}} = 10^{-11}$). For comparison for the Au-Si Schottky barriers [5] $\gamma_{\text{Au-Si}}$ is 10^{-4} at the $N_{d \text{ Si}} = 10^{16} \text{ cm}^{-3}$ and $\phi_{Bn \text{ Au-Si}} = 0,8 \text{ V}$.

It was established (table 1) that regardless of barrier height in samples with the higher donors concentration ($N_d = 10^{16} \text{ cm}^{-3}$) and, consequently, less resistance, the



injection coefficient is less. From fig. 2 it is clear, that with barrier height growth, i.e. with decreasing current saturation density (fig.1), the injection coefficient of minority carriers increases slightly. For the same values of Schottky barrier height for the barrier transitions in semiconductors with a different E_g ($E_{gSi}=1,12$ eV [5] and $E_{gGaAs}=1,424$ eV[5]) the injection coefficient decreases with increasing of E_g (for example, at $N_d=10^{16}$ cm⁻³ and $\phi_{Bn}=0,8$ V for Au-Si [5] $\gamma=10^{-4}$, for Ag/n-GaAs $\gamma=10^{-11}$).

Table 1

The results of injection coefficient calculation

ϕ_{Bn} , V	γ	ϕ_{Bn} , V	γ
0,8	$1*10^{-11}$	0,8	$1*10^{-10}$
0,86	$1*10^{-10}$	0,86	$1*10^{-9}$
0,9	$5*10^{-10}$	0,9	$5*10^{-9}$
0,94	$4*10^{-10}$	0,94	$4*10^{-9}$
0,96	$8*10^{-10}$	0,96	$8*10^{-9}$
$N_d = 10^{16}$ cm ⁻³		$N_d = 10^{15}$ cm ⁻³	

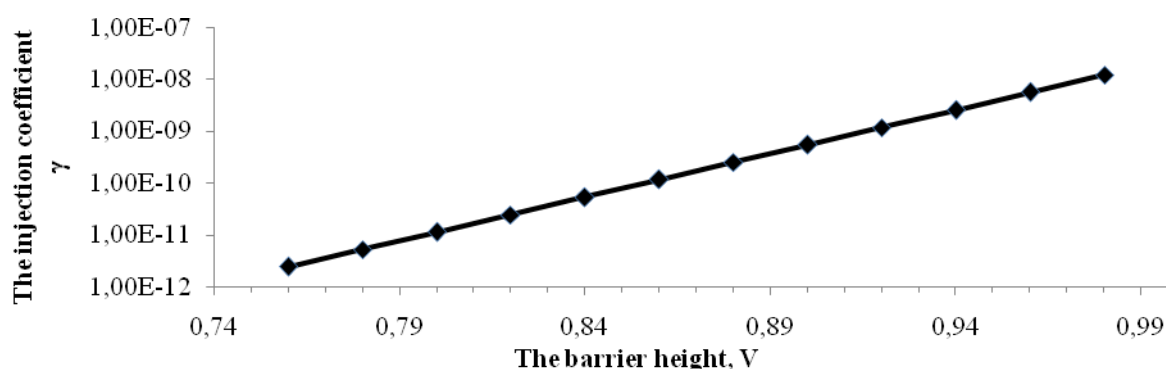


Fig. 2. The influence of the barrier height on the injection coefficient size in the Ag/n-GaAs barrier transitions, $N_d=10^{16}$ cm⁻³

The larger (higher) semiconductor bandgap, the lower its own carriers concentration, and the injection coefficient (for comparison at $n_{iSi}=1,45*10^{10}$ cm⁻³[5], $\gamma_{Au-Si}=10^{-4}$ [5], at $n_{iGaAs}=1,79*10^6$ cm⁻³[5], $\gamma_{AgGaAs} \sim 10^{-10} \dots 10^{-11}$) is less. The calculated values of the injection coefficient γ (fig. 2) for the Schottky barriers Ag/n-GaAs ($N_d=10^{16}$ cm⁻³ and $\phi_{Bn}=0,76$ V...0,96 V) have a very small value of the injection coefficient γ ($\sim 10^{-13} \dots 10^{-9}$), so the holes injection may be neglected. This is the reason that the Schottky diodes are called major carriers devices.

Conclusions.

In the thin-film barrier injecting transitions metal-semiconductor (the Schottky barriers) the mechanism of charge carriers transporting during the concentration of free carriers in GaAs $n_{e.l.}=8*10^{15} \dots 6*10^{16}$ cm⁻³ is determined by thermionic emission



(T-emission). At the low injection level the charge transporting in Schottky diodes is carried out by major carriers mainly.

The barrier transitions on the GaAs n-type epitaxial films, which had been grown on high-alloyed substrates (carrier mobility is $m \geq 5000 \dots 7000 \text{ cm}^2/(\text{V} \cdot \text{sec})$) were researched.

The investigated injective barrier transitions (Schottky barriers) Ag/n-GaAs, made at different heat treatment modes, with ϕ_{Bn} barrier height = 0.76...0.96 V have very small values of injection coefficient γ ($\sim 10^{-13} \dots 10^{-9}$), so the holes injection may be neglected.

Irrespective of the barrier height, at the samples with higher donor concentration of ($N_d = 10^{16} \text{ cm}^{-3}$) and consequently less resistance, the injection coefficient is less.

We can see that with barrier height increasing, i.e. a decrease in the current saturation density, the minority carrier injection coefficient increases slightly.

It was found, that for the same Schottky barrier heights for barrier transitions on semiconductors with different bandgaps, the injection coefficient decreases with E_g increasing.

It was determined that the injection coefficient γ values decrease in a semiconductor with a lower concentration n_i of its own carriers.

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THE MODELING OF THE METAL-SEMICONDUCTOR BARRIER TRANSITIONS, WHICH BASED ON THE CHEMICAL INTERACTION

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Abstract. A general study of the barrier metal-semiconductor transition, which is based on the chemical interaction, is made. The effect of the minority carriers injection on the metal-semiconductor real structure characteristics including the fast and slow conditions effect and the intermediate layer impact in general, which let to determine a lot of new data about the γ coefficient behavior of and let easily take into account any physical mechanism for moving the charge in the metal-semiconductor structure with the kinetic coefficients appropriate choice in the transfer reactions. The general solution for the minority carrier injection coefficient γ at the metal-semiconductor contact is found with the chemical theory help.

Key words: chemical reaction, injection rate, the barrier metal-semiconductor transition, the transfer reaction.

The phenomenon of minority carrier injection is very important for the barrier metal-semiconductor transitions. In many cases, [1-3,6,7] the injection from low-quality ohmic contacts is not allowed and can lead to parameters and characteristics distortions of the devices. It is known [1,2,4,5] that the rectification in the metal-semiconductor transition is determined by the major carriers. The influence of the minority carriers in most cases can be neglected [1,2]. However, this is not always justified. At the real contacts metal-semiconductor structures research [3-7] the presence of the chemical interaction between the contact metal (alloy) and the semiconductor substrate material is revealed.

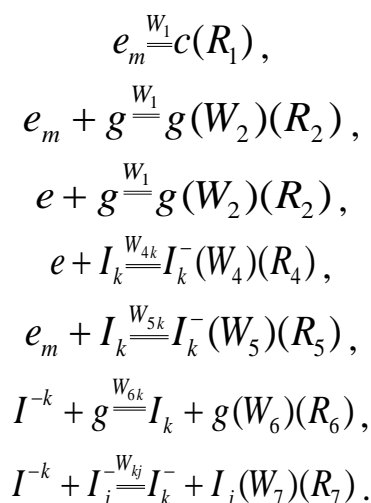
There are several theories that describe the charge transport through the metal-semiconductor contact [1,2]: the diffusion theory [1], which describes the contacts to the semiconductors with low mobility, the thermionic emission theory [1] for the semiconductors with high mobility and the complete emission-diffusion theory [2], that generalizing the first two. Generally, an ohmic contact can be called a three-layer structure [1] $R-n^+-n$ or $R-p^+-p$, which is limited on one side with the metal, and on the other side - the bulk charge region n^+-n and p^+-p , which role is a majority carriers effective injection in the semiconductor volume, and absorption or reflection of the minority carriers. The absorption or reflection domination is determined by the contact type (recombination [1] or anti-locking [1]) and depending on the device functionality. The real contacts are not perfect absorbers or ideal reflectors of minority carriers. To characterize such contacts we can use the concept of the electrons and holes recombination rate [1,2].

The minority carriers injection in Schottky barriers (SB) in terms of the diffusion theory is described in [1,2]. Usually injection coefficient γ can be used as the evaluation of the minority carriers quantity in the SB, and it depends on many physical parameters of the barrier transition [2]. At low current levels for an ideal metal-semiconductor the minority carriers' injection coefficient γ is constant and increases linearly with the current [1,2].



The research results of the real metal-semiconductor contact's structure on a transmission type electron microscope and the received electron diffraction pattern decoding [3-7] showed that at the contact line take place the chemical reaction with the in-between layer formation, which has a certain impact on the barrier transitions electrical parameters. Therefore, a theoretical study of the metal-semiconductor barrier transitions based on the chemical interaction.

In [8] it was proposed to describe the interaction between the metal electrons, boundary conditions and free semiconductor carriers by following chemical reactions:



W_1 is the reaction rate, e_m - the free metal electrons, e - the free semiconductor electrons, g^+ are the ionized atoms on a semiconductor surface (holes density), and I_k and I_k^- are impurities: I_k is neutral, I_k^- - negative ionized when the impurity is acceptor. When I_k is positively ionized than I_k^- - neutral when the impurity is donor.

The impurities create electronic boundary condition. The «k» number means the impurities, which have the same properties. Their density can be written: $I_k + I_k^-$.

In the steady regime (that corresponds or does not correspond to the thermodynamic equilibrium) we can write the following equation [8]:

$$J_n = W_1 - \sum_{k=1}^{k=N} W_{4k}, \quad (1)$$

$$J_p = W_2 - \sum_{k=1}^{k=N} W_{6k} \quad (2),$$

where J_n and J_p – the electron and hole flows, included in the semiconductor. If there is the oxide layer, the chemical reactions kinetic coefficients (1) and (2) are no longer constant as the reactive components don't have the same potential. For their interaction they should cross the oxide layer, that supports the potential drop U_s from the metal to the semiconductor. [8]

$$\overleftarrow{k}_1 / \overrightarrow{k}_1 = c_1 \exp(eU_s / kT), \quad (3)$$

$$\overleftarrow{k}_2 / \overrightarrow{k}_2 = c_2 \exp(eU_s / kT). \quad (4)$$

In the equations (3) and (4) c_1 and c_2 are the constants and they are independent of the potentials.



The expressions for W_1 and W_2 [8]:

$$W_1 = A[n_0 - n \exp(eV/kT)] \quad (5),$$

$$W_2 = B[p \exp(-eV/kT) - p_0] \quad (6),$$

Here V is an external bias.

$$A = \left(\frac{\overrightarrow{k_1}}{\overleftarrow{k_{10}}} \right) \overrightarrow{k_{10}} \exp\left(\frac{eV_{s0}}{kT}\right), \quad (7)$$

$$A = \left(\frac{\overleftarrow{k_1}}{\overrightarrow{k_{20}}} \right) \overleftarrow{k_{20}} \exp\left(-\frac{eV_{s0}}{kT}\right) n_m. \quad (8)$$

In this equations $\overrightarrow{k_{10}}$ and $\overleftarrow{k_{10}}$ are the kinetic coefficients for zero displacements values, A - decreasing bias voltage function, B - an increasing bias voltage function. It is assumed [8] that A and B depend on α , $\alpha = [\exp(eV/kT)]$. $A = A_{(V=0)} \alpha^{-m}$, $B = B_{(V=0)} \alpha^m$. The exponent is a real positive number, which shall not exceed the one [8]. The condition $m > 1$ leads to an electronic (for $V < 0$) or a hole ($V > 0$) current, that flowing through the contact in the direction of the increasing potential. $m = 0,5$ is the critical value. We can see, that for $m < 0,5$ stretching phenomenon ($\delta n < 0$, $\delta n = n - n_0$) places for any general current direction, and for $m > 0,5$ the injection effects occurs ($\delta n > 0$) in any current direction, so that the metal-semiconductor contact becomes ohmic. In the oxide layer presence the slow surface states are important because their density is much higher [7,8] the fast conditions density. At the same time, they can screening the semiconductor volume from the applied field. I.e. the chemical reactions, which include a slow state, proceed in such direction, that the major part of the voltage drop occurs in the oxide layer. This effect results to the m increase and consequently results to the injection increase (i.e. γ). γ is a monotonically decreasing function of current density i (contrary to the general γ behavior).

It is proved [8] that the intermediate oxide layer can greatly change the dependency $\gamma(i)$ shape, obtained in the direct contact case.

The fast surface states effect of the contact boundary depends mainly on their "trapped" properties, while the slow boundary condition of the real structure (with the oxide layer) can radically change the injection coefficient γ dependency of the total current density.

Conclusion. As an estimate of the minority carriers quantity in the SB, the injection efficiency γ can be used. It depends on many physical parameters of the barrier transition [2].

At low current levels for an ideal metal-semiconductor, the minority carriers injection coefficient γ is constant and increases linearly with the current [1,2].

At the research of the real contacts metal-semiconductor structures [3-7] was found the presence of the chemical interaction between the contact metal (alloy) and the semiconductor substrate material.

A general study of the barrier metal-semiconductor transitions, which are based on the chemical interaction, has been done. With the help of chemical theory [8], the general solution of the minority carrier injection coefficient γ at the metal-semiconductor contact obtained.



The influence of minority carrier injection on the characteristics of the real metal-semiconductor structure, which considering the effect of fast and slow conditions and the intermediate layer impact as a whole, has been analyzed.

It was established [8] that the intermediate oxide layer can greatly change the dependency $\gamma(i)$ shape, obtained in the direct contact case.

It is found that the fast surface states effect of the contact boundary depends mainly on their "trapped" properties, while the slow boundary condition of the real structure (with the oxide layer) can radically change the injection coefficient γ dependency of the total current density.

With the help of the chemical interactions theory we can take into account any charge moving physical mechanism in the metal-semiconductor structure by appropriate selection of the kinetic coefficients in the transfer reactions.

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DEVELOPMENT OF A MODULAR SYSTEM ARCHITECTURE BASED ON ASP .NET WEB API

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Abstract. Abstract. The paper considers system controller architecture ASP.NET Web API, proposed separation processing request logical and structural parts.

Keywords: architecture, controller method, REST, service.

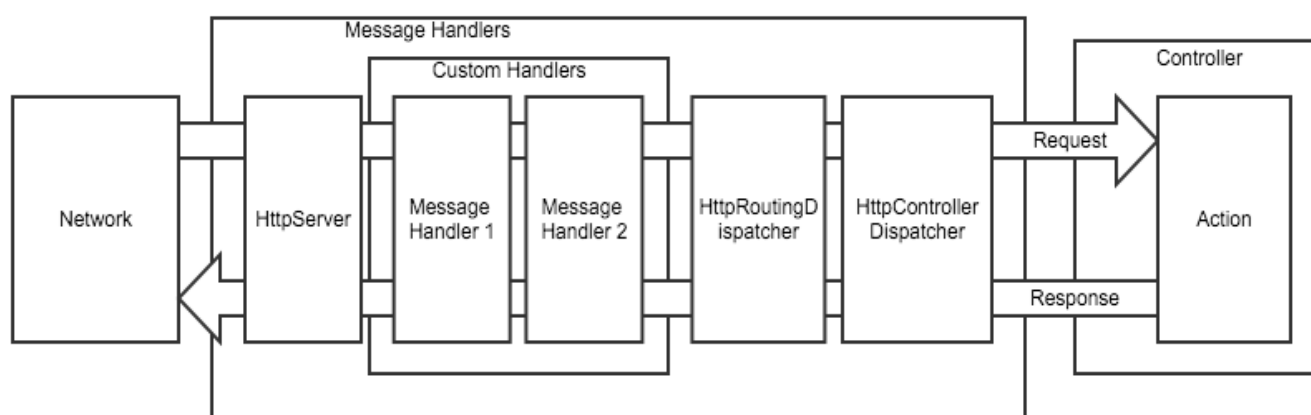
Introduction.

To date, one of the common tools for the development of Web services is a platform developed by Microsoft - ASP.NET. It serves as a base for technologies such as the ASP.NET WebForms, ASP.NET MVC and ASP.NET Web API. Each of them designed to solve a similar problem, but in different ways.

ASP.NET Web API designed solely for building Web services directed to be used with other software applications such as websites, mobile applications, desktop applications, and more.

If we look in detail at the architecture proposed by Microsoft, then you can minimize it to the scheme presented in figure 1.

Figure 1. Request processing in Web API



When designing Web services developers pay the most attention to controllers and methods, which are responsible for processing requests (Actions), as they are the carriers of the business logic of the service.

Literature review.

Today, the most common services meet the RESTful approach. After reviewing the structure of the interface, which described in the publication [1], and analyzing business requirements to such services, it follows that the vast majority of controllers use the same structure and methods [2].

Input and methods.

If we go back to figure 1, we can note that construction of these system components lies entirely on developers. This provides full freedom in approach



choosing and implementation of business logic. Nevertheless, this freedom has another side - in large distributed teams of developers, working on large service, can be difficult to preserve the unique style and approach to the construction of various parts of the system and because of the large number of controllers and methods there is a high probability of code duplication. The above factors badly affect the quality of the developed service and the complexity of its support in the future, increasing the cost for business.

To solve these problems, way out can be found in development of a framework for building controllers, which would not make the system less flexible.

The following requirements should be applied to the developed architecture:

1. The separation of business models (domain model) and user interface (view model) – this is necessary to ensure the ease of making changes to the business logic and the internal organization of the data in the system, without changing the data that gets the user (principle of encapsulation);
2. Separation of request processing into parts;
3. Separation of tasks between the modules – each module should be responsible for the specified task to facilitate understanding of the system;
4. Split system not only on logical, but also on structural components – reduction of connectedness in the system, which will allow developing the components individually and will increase the speed of development.

Results. Discussion and Analysis.

If we generalize requests to the system, they can be divided into two types: “read-write” and “read-only”. The “read-only” methods are OPTION and GET. “Read-write” methods are POST, PUT, PATCH, and DELETE. Let us consider each process separately.

“Read-only” request is responsible for retrieving data from the server without making any changes. Figure 2 shows the proposed model of “read-only” request processing.

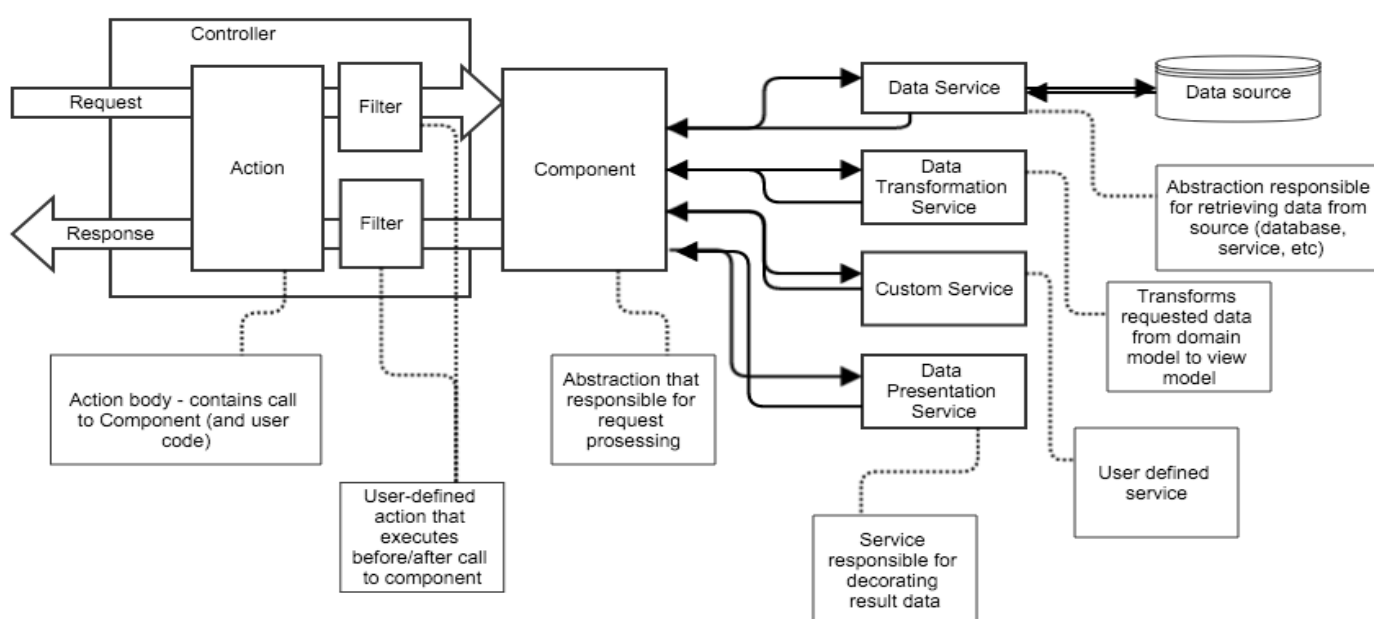


Figure 2. “Read-only” request processing



"Read-write" request is responsible for making changes to the data, whether to add new listings, modification or deletion. Figure 3 shows the proposed model of "read-write" request processing.

In these models, changing behavior of the action is carried out through the change of the certain component or through services replacement. This approach allows components delimiting. As a result, developers can develop a system in parallel.

To ensure the distribution of business model and interface model for each model that used by service consumer, reflection of the business model should be created (view-model). It should not respond to it exactly, and should only reflect the data structure for the resource, which it targets. In other words, there is a ratio of one to many, where one business model can have many reflections (view-models).

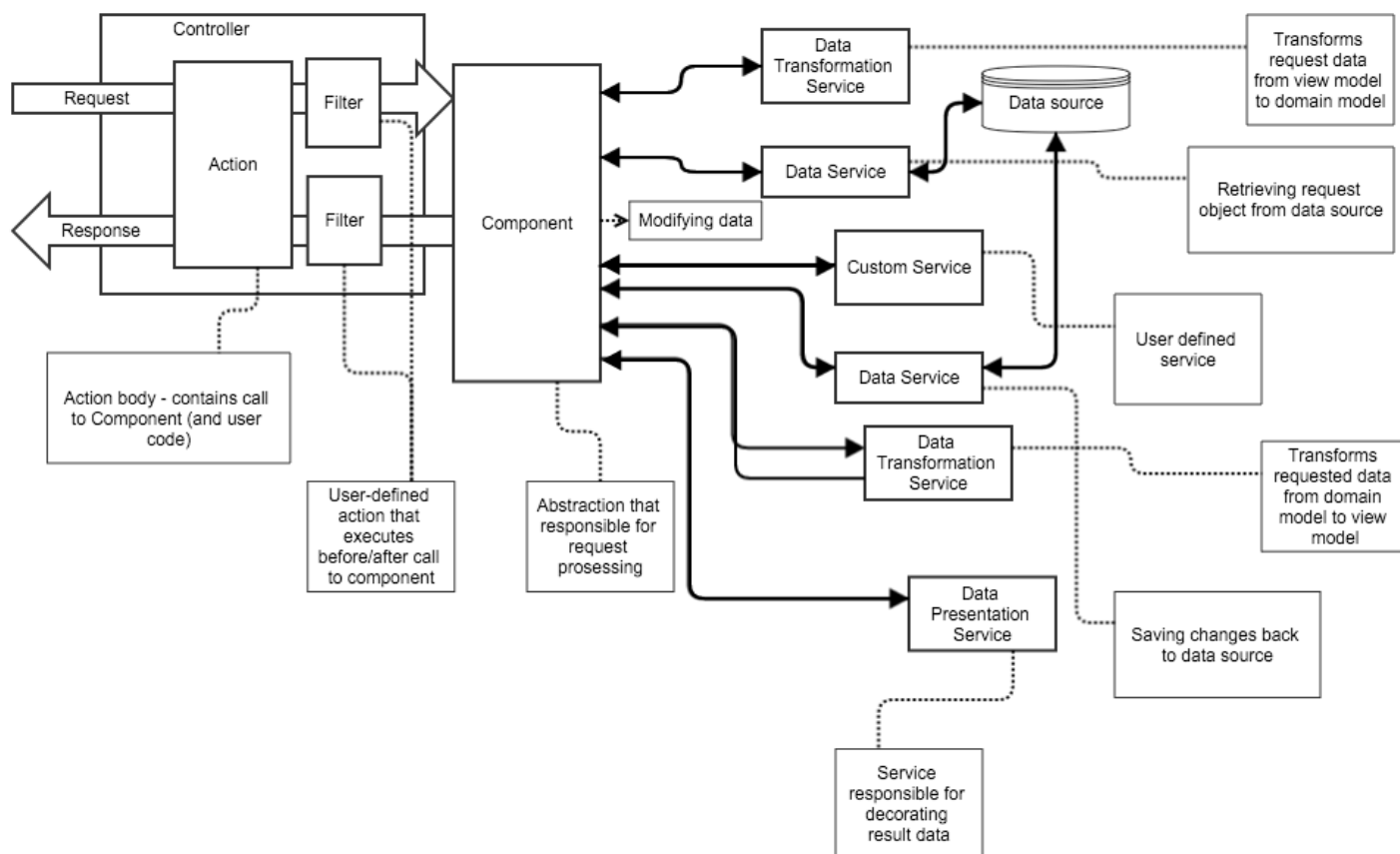


Figure 3. "Read-write" request processing

Disadvantages of the proposed architecture are laid down in its basis. High level of abstraction and limitless possibility to the fragmentation of the components may cause serious difficulties at the stage of service support in case of wrong use.

Summary and Conclusions.

The result of the executed researches was the proposed architecture that meets the standards of REST, modern requirements to Web-oriented services and the needs of the developers of these services.

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SIMPLIFIED METHOD FOR DETERMINING THE VALUE OF THERMAL BIOGAS

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Abstract: *It is proved that due to the depletion of fossil fuels is necessary to develop alternative sources, which include biogas. The main parameter that characterizes the biogas as a fuel is its heating value, which can determine the races-even knowing the way the elemental composition of the biogas or the experimental measurement in a bomb calorimeter. However, both of these methods, optionally necessary to have expensive equipment. It is therefore necessary to define, perhaps less precise, but simpler method of measuring the heat of combustion of biogas. The proposed method consists in determining the heat that is transferred to the water when it is heated burning biogas, adjusted for the dissipation of heat into the environment*

Keywords: *biogas, natural gas, heat of combustion, heat value, a bomb calorimeter.*

Introduction. Despite the fact that natural gas reserves Ukraine occupies the third place in Europe, high energy intensity of production capacities of industrial enterprises in our country has led to the fact that its own reserves of natural gas, we have enough to meet 20% of demand for it [1]. The rest have to buy abroad at high prices.

However, in the course of economic activity generated weight of waste (sewage sludge, manure of farm animals and birds comets, slaughterhouse waste, dairy and sugar factories, pharmaceutical, cosmetics and paper industries, etc.) that need to be disposed of. This can be accomplished by their anaerobic digestion to obtain valuable organic fertilizer and a biogas which can be used as an alternative to natural gas.

Literature review. Biogas in different periods of methane fermentation of raw material has a different composition and energy value. In the design of biogas plants, the planning of biogas production and the possibility of replacing natural gas they need arises in assessing the ability of the biogas energy.

Knowing the percentage of the components can be defined as the periodic calculate the heat of combustion of biogas [2]:

$$Q_u = 128CO + 108H_2 + 234H_2S + 339CH_4 + 589C_nH_m ; \quad (1)$$

where Q_u – net calorific value of biogas, kJ/m^3 ; CO , H_2 , CH_4 , C_nH_m – fuel gas composition, percent by volume under normal conditions (0°C , pressure 760 mm Hg. V.).

However, to determine the elemental composition biogas analyzer is required, the price of which is about 5 thousand. Euro.

There is a method for determining the calorific calorimetry [3]. The calorimetric method for determining the heat of combustion is characterized by high accuracy. However, it is very expensive. Price bomb calorimeter is \$ 3 thousand and above.



Therefore, **the aim of our research** – determine a less precise but more simple way to measure the heat of combustion of biogas.

Results. Discussion and Analysis. The proposed method of determining the heat of combustion of the biogas is that the aluminum container filled with a certain volume of water (1 L), which is integrated into the lid mercury thermometer, heated on a gas stove, gas tanks connected to a biogas plant. By starting temperature is measured by a thermometer in the water tank, and after a certain amount of combustion bigaza (fixed scale attached to a movable piston gasholder), – final temperature. Net calorific value of biogas is determined by the formula:

$$Q_m = c_v \cdot V_v \cdot \rho_v \cdot (t_2 - t_1) / V_{biog} , \quad (2)$$

where Q_n – net calorific value of biogas, J/m³; c_v – specific heat of water, J/(kg·K); V_v – the volume of water filled into the vessel, heated m³; V_{biog} – landfill gas flared m³; ρ_v – water density, kg/m³; t_1 – the initial temperature of the thermometer, °C; t_2 – final temperature thermometer, °C.

Considering that specific binding capacity of water is 4200 J/(kg·K) water density ρ_v – 1000 kg/m³, and the volume of water filled into a heated container V_g – 1 l (10⁻³ m³), the formula (2) can be written as:

$$Q_u = 4200 \cdot (t_2 - t_1) / V_{\text{vessel}} . \quad (3)$$

The heat released in the combustion gas in the burner gas cookers, water goes into heating the aluminum container and is dispersed into the environment. Heat loss to the environment can be considered a system error experience. However, a similar loss of heat will occur when heated container filled with water, by combustion of natural gas. However, the net calorific value of natural gas supplied to consumers, should be at least 31,8 MJ/m³ [4].

According to the proposed method has been determined, the heat of combustion of natural gas supplied to consumers Kiev. The volume of water in the tank was 2 liters. The initial and final water temperature, the volume of gas to the counter expended on its heating, and calculated by the formula (3) the amount of heat goes to the heating water in the vessel by burning a certain amount of natural gas is shown in Table. 1.

Table 1

Determination of the amount of heat goes to the heating 2 l of water temperature t_1 to a temperature t_2 by burning a certain amount of natural gas

Water temperature vessel		The volume of natural gas, m ³	The amount of heat used for heating 2 l of water temperature t_1 before t_2 , MJ/m ³
Elementary t_1	Final t_2		
17,5	51,5	0,013	22,0



17,0	51,5	0,014	20,7
16,5	51,5	0,014	21,0

The average value of the amount of heat consumed for heating 2 liters of water at a temperature t_1 to t_2 , the combustion of a certain amount of natural gas is 21,2 MJ/m³.

Thus, from 31,8 MJ/m³ natural gas combustion heat of 21,2 MJ/m³ is used for heating the water in the tank, and 10,6 MJ/m³ lost. From this we can determine the correction coefficient K , which takes into consideration the system error caused by loss of heat to the environment:

$$K = 31,8/21,2 = 1,5.$$

With the definition of the correction factor formula (2) and (3) take the form:

$$Q_n = K \cdot c_g \cdot V_g \cdot \rho_g \cdot (t_2 - t_1) / V_{\text{bioz}} = 6300 \cdot (t_2 - t_1) / V_{\text{bioz}}. \quad (4)$$

Summary and Conclusions

By introducing a correction factor that takes into account the system measurement error, the proposed express method allows you to quickly determine the heat of combustion of biogas.

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CORROSION'S RESISTANCE OF JOINING USING IN RESTORATION OF THE BASIC PARTS

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Abstract. *The paper presents the methodology and results of comparative tests for leaks and corrosion resistance of the joins used in the elimination of cracks in cast iron body parts. Investigations were carried out to determine the necessary parameters using glue welding, welded and glued joints.*

Keywords: *glue welding, welding, adhesive compound, sealing, corrosion resistance, tests, studies, results.*

INTRODUCTION

During operation, they are subjected to different loads, which appears as a result of a defect intractable as cracking, resulting in a loss of tightness, and as a result - contamination of lubricants abrasive particles and poor lubrication conditions [1, 4]. Leakage of body parts also causes great damage to agriculture as well as spill oil and fuel materials lead to an annual yield loss [2, 5].

When repairing cracks (their elimination) in cast iron body parts, special attention is paid to the creation of a dense and tight connection. This is achieved by using gaskets, seals, sealants, composite compounds and applying welds adhesive compounds [1, 3, 4, 8]. The problem of creating connections that can effectively recover from cast iron parts paid: Paton E.B., Lobanov L.M., Belyiv I.P., Vavilov V.P., V.P. Lyalyakin, Dorofeev A.L., Kluev V.V. Molodik N.V., Tel'nov N.F., Selivanov A.I., Artemyev Y.N. [2, 3] et ct.

Among the range of recoverable parts occupy an important place items made of cast iron with lamellar graphite. They make up about 70% of the total mass of parts of agricultural machinery. The analysis showed that there is no agricultural machine, which would not have cast iron parts. The percentage of such products in a proportion for different units of agricultural machinery is 3,5...45%. And in most cases they determine the life of the machine. This applies in particular to the case details, the percentage of which is from 1,7...24% [11, 17, 19]. These products are characterized by a large diversity: mass, complex geometry, volume, working conditions and the price of a few to several thousand rubles.

Numerous details of gray cast iron is due to several factors: technological material (good casting properties and machinability), performance characteristics and sufficient reliability.

RESEARCH AIM

A comparative study for leaks and corrosion resistance glue welding welded and glued joints and identify possible areas for their use in the removal of cracks in the hull iron details.

METHODOLOGY AND RESULTS



To obtain objective data on the tightness of joints carried out comprehensive studies including: testing of samples in the laboratory bench and operational recovered body parts [3, 4, 5]. Tests were conducted on the hollow cylindrical samples with a diameter of 150 mm. In this case, the crack imitated 4 drilled through holes with a diameter of 4 mm.

In the welded joint decompression occurred at an overpressure of 0,3 mPa through 0.36 hours after application of the load pressure of the liquid. This indicates the need for the sealing layers. Adhesive collapsed at a pressure of 0,4 mPa. Tests were carried out according to the scheme: loading at each stage discretely increased to 1,0 MPa, delayed 0,5 hours.

The tests showed that fluid leakage when using glue welding joints did not happen at all of this work. As expected, the use of an adhesive layer in such a compound ensures perfect seal while eliminating cracks.

Stand for testing leak tests recovered using glue welding cast iron parts in a specialized workshop. Reconditioned gearbox housing in the amount of 10 pieces were mounted on the stand break-after full cure of the adhesive composition. Tests were carried out on the stand-by cycle for 2,0 hours. Depressurization join did not happen. Past bench tests, parts have been installed on the machine, which was sent to the service. During the 10 months of observation were behind them. Machinery (tractor T-150 K) operated under different conditions, according to the regulations on energy-performance test machines.

In operation failure due to depressurization of the plot to eliminate cracks were found. Currently, these parts are further performance tests.

In accordance with the established methodology, conducted the study to the effects of corrosive environments of fuel and oil. Each batch of samples (glue, glue welding and welded joints) was aged for 30, 60 and 90 days. The exposure was performed in: air, 3% solution of salt, water, oil and diesel fuel. Based on the results of experimental studies determined the amount of softening of each of them.

It is established that a greater reduction in strength occurs in 3% aqueous NaCl solution. This environment has the greatest softening effect on the compared connection. As shown by the research results, glue welding has better resistance to softening the effects of the corrosive environment, and the adhesive is the smallest. During 30, 60 and 90 day strength glue welding reduced, respectively: 1,5% , 2,7% and 3,7%; welded - 3,9%, 7,7% and 9,2% adhesive to 8,0%, 14,0% and 18,0% were.

The magnitude of strength loss glue welding connection associated correlation relationship for all kinds of tests in the test environments. This confirms the assertion that reducing their strength is associated only with the defeat of the edge zones of the adhesive layer. The presence of the adhesive layer protects the weld point from damage by corrosion. Its absence in welding connection increases its loss of strength in comparison with glue welding.

Studies have shown high corrosivity of the water, however, the salt solution causes more destruction. In real operating conditions, the external environment is composed of a pair of various salts, dissociation which ions makes them aggressive and corrosive. Therefore, it is of great scientific interest of reducing the strength of



the connections after holding them in the air. Studies have shown that glue welding connection has sufficient protection against the action of the atmosphere.

Test joins after exposure to diesel fuel and mineral oil showed that the softening under their influence does not occur. In the process of experiments, we studied the nature of reduction strength of every of them (Fig. 1).

It was established that in conjunction glue welding joins hearth of destruction at the time of application of the load originates in the marginal zones of overlap on the adhesive bead. Was formed several main cracks propagating at an overlapped area to disbands, with a further full peeling the adhesive layer. Increasing the load resulted in a cut of molten core welding points or snatching it from the iron (sample material).

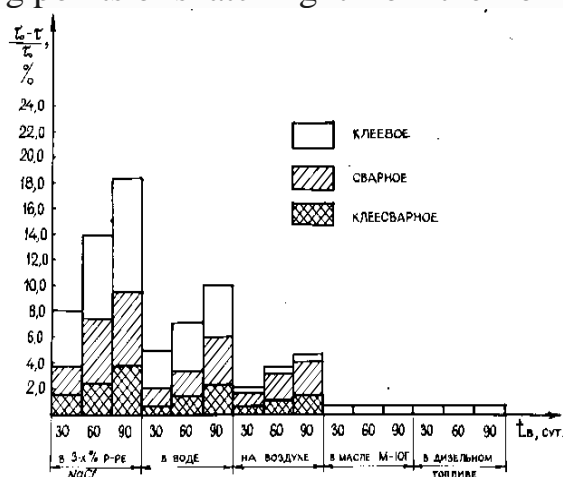


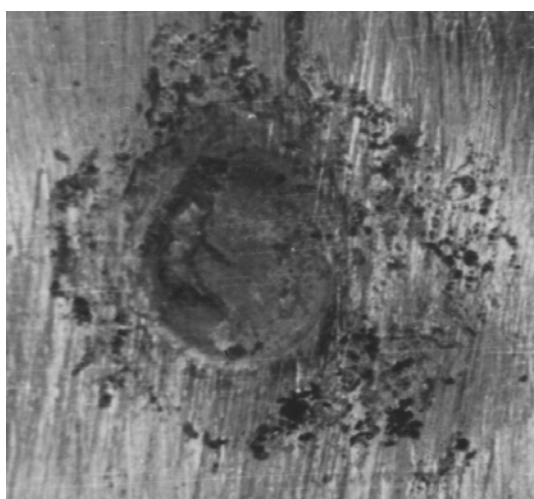
Fig. 1. Softening compounds in corrosion tests

Investigation of the cut surface of the welded core point and its microstructure showed a complete absence of corrosion in it and heat-affected zone. Corrosion damage is detected on the outer parts of the adhesive bead with little penetration under overlapped. This is due to the diffusion of molecules penetration of aggressive environment at the contact area of the adhesive roller to the connecting portion of the sample in vulnerable areas. Thus, the adhesive roller detected microscopic cracks penetrating medium line section glue cast iron item. This causes a wedging compound with corrosion products within the range of corrosive environments. Decrease in strength glue welding joins under the influence of corrosive environment associated with partial loss of strength of the adhesive joint, thus, the welding point - protected from destruction.

In the weld - softening held on zone of broken away from the cast iron welding point. On the outer side of the lining in places of print electrodes corrosive deposits found in the form of concentric rings with the highest concentration in peripheral areas of welding points. This, apparently, is connected with the processes of the current distribution at the contact welding. The combined effect of external and internal areas of corrosion damage in the zone of broken and wedging effect of corrosion products, lowers the strength of the join. Character of corrosion damage of joins for which comparative trials is shown in Fig. 2.



a)



b)

Fig. 2. The nature of the defeat of a corrosive environment:

a) - glue welding, b) - of welded joints

In adhesive bonding, corrosion damage caused by the diffusion of molecules penetration defeat hostile environment under cover. In the outer surface of the adhesive bead were found microscopic cracks disposed across the platen. Start the destructive action of aggressive environment on the adhesive bonding takes place at the interface between the adhesive metal. Penetration occurs medium under overlapped on those areas where the adhesive bonds are broken with adhesive metal and replacing them with the connection metal corrosive environment.

When the connector connection found corrosion damage the surface of the steel plates in the edge zones overlap (pitting). The adhesive layer behind the cast iron parts, which is accompanied by softening joints. Thus, the decisive factor in determining the strength of the adhesive layer in conjunction glue welding is the change of adhesive forces at the interface between the adhesive metal.

An important stage of the research was the definition of resistance comparable types of connections to the effects of oil and fuel environments. Upon exposure of the samples in all types of environments, the lowest softening observed in glue welding, the largest - in the adhesive. Reduction in strength due to glue welding softening the adhesive joint in the edge zones overlap. Statement of welding points at a distance of



no more than 8 mm from the free end lining significantly reduces the harmful effects of media on the strength glue welding joint.

The results of these studies show that water is an aggressive medium with dissolved ions, salts and acids. This leads to the need for protection, particularly welded.

CONCLUSIONS

Conducted comparative tests of specimens with cracks Eliminated adhesive, welded and glue welding joint compounds showed that only glue welding joint has sufficient resistance to the pulsating load, the value of 0,1 - 1,0 MPa. Welded connection depressurized overpressure 0,3 MPa is obtained, and the adhesive – 0,4 MPa.

Study of the surface joins showed that under an overlap occurs corrosion centers, particularly strongly expressed in the vicinity of the welding points (general corrosion).

Thus, our studies revealed glue welding joint compound has a high resistance to aggressive media, water, diesel fuel and mineral oil, which guarantees the durability of body parts in operation. Found that a greater reduction in strength occurs in 3% aqueous Nacl solution. For 30, 60 and 90 day strength glue wtlding reduced, respectively: 1,5%, 2,7% and 3,7%; welded - 3,9%, 7,7% and 9,2% adhesive to 8,0%, 14,0% and 18,0% were.

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SPRAY PARAMETERS DETERMINE THE EFFECT ON ALKALINE BIODIESEL WHEN NEUTRALIZED

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Abstract: *It is known that in the production of biodiesel using homogeneous alkaline catalyst, which remains fully manufactured product and cause corrosion of engine parts. To extract it biodiesel neutralized to alkalinity of less than 5 mg/kg according to DIN 51606, including by spraying an aqueous citric acid solution through the nozzles. The study aims to establish the influence of the parameters of the spray gun to the alkalinity of biodiesel in its neutralization. The results of experimental studies of the influence of parameters on the spray gun when the alkalinity of biodiesel neutralization. The dependence of the alkalinity of biodiesel on the pressure in the system.*

Keywords: *biodiesel, pressure, neutralization, spray pressure, citric acid*

Introduction. In the production of biodiesel according to conventional technology to accelerate the reaction necessarily apply methanolysis catalyst (mainly alkaline homogeneous), which, however, did not react, but only its accelerates. Therefore, in the manufactured biodiesel, he remains completely, causing corrosion of the engine.

Literature review. One way to remove the catalyst from the biodiesel is neutralization with an organic acid followed by removal of formed salts. In [1], the optimal volume of a 1% aqueous solution of citric acid to neutralize the alkalinity of biodiesel to below 5 mg/kg according to DIN 51606 [2], which at pH 9,45 biodiesel constitute 4,5-6 ml per 100 ml methyl ester at pH = 8,32 – 4-5 ml per 100 ml of methyl.

Biodiesel Neutralization solution citric acid may be carried out in several ways: by addition of aqueous citric acid biodiesel with subsequent stirring, spraying an aqueous solution of citric acid over a layer of biodiesel and a combination of these methods.

In [3] investigated the influences of the rotational speed of the agitator shaft alkalinity biodiesel when neutralized with an aqueous solution of citric acid. It is found that when the neutralization temperature 40°C optimal rotational speed of the agitator shaft, whereby biodiesel alkalinity drops below 5 mg/kg, 350 rev/min.

However, the effect of neutralizing the effectiveness of spraying an aqueous solution of citric acid over a layer of biodiesel was not determined.

Therefore, **the aim of our research** is to establish the influence of parameters of the sprayer on the alkalinity of biodiesel in its neutralization.

Research results. The methyl ester was produced for the study with camelina oil by the method described in [3]. Determination of the effectiveness of neutralization of biodiesel while spraying an aqueous solution of citric acid over a layer of methyl ester was carried out in a pilot plant, which consisted of a hydraulic pump, constructed from the tank garden sprayer, compressor "Atlas" to maintain a predetermined pressure, and sprayer "DISC and CORE" set in razor package (Fig. 1). The fluid pressure controlled by the pressure gauge (Fig. 2).



Fig. 1. Experimental setup to determine the effectiveness of neutralization of biodiesel



Fig. 2. Pressure display 1% aqueous solution of citric acid when spraying in the sample of biodiesel

Setting efficiency neutralization biodiesel by spraying an aqueous solution of citric acid over a bed of the methyl ester was determined by spraying a 6 ml aqueous solution of 1% citric acid per 100 ml of biodiesel through the centrifugal full cone spray "DISC and CORE" manufactured TeeJet composed of housing with a nozzle QJ17560A-NJB, bayonet cap CP 26277-1-NY, core-baffle DC-CER, ceramic disk with a hole DCER-2 and the rubber seal CP 18999.

The sample of purified biodiesel from methanol 300 ml was poured into a beaker of 0,5 liter capacity, which is fixed on a tripod and placed in the water, poured into a liquid thermostat TJ-TS-01/16. In the sample of biodiesel sawed 18 ml of an aqueous solution of 1% citric acid using the spray gun mounted on the same rack. When a predetermined pressure for a fixed time by spraying a 1% citric acid in the sample of biodiesel (Fig. 3).



Fig. 3. Spray a 1% citric acid in the sample to determine the impact of biodiesel options sprayer alkalinity biodiesel

The spraying was determined experimentally by measuring the volume of the liquid spray, which is collected in a beaker (Fig. 4a), for a certain time, which was recorded with a stopwatch "Agat" (Fig. 4b).

Spraying time was 1,5 sec at a pressure of 0,25 atm at a pressure of 2 to 0,2 atm, 2,5 seconds at a pressure of 0,15 atm and 3 seconds at a pressure of 0,1 atm.

Results are shown in Fig. 5, which shows that an increase in pressure in the bottle and the temperature increases the test sample biodiesel alkalinity decreases relative to the initial 37,9 mg/kg, but the entire range of investigated pressures and temperatures not lower than 5 mg/kg according to DIN 51606.

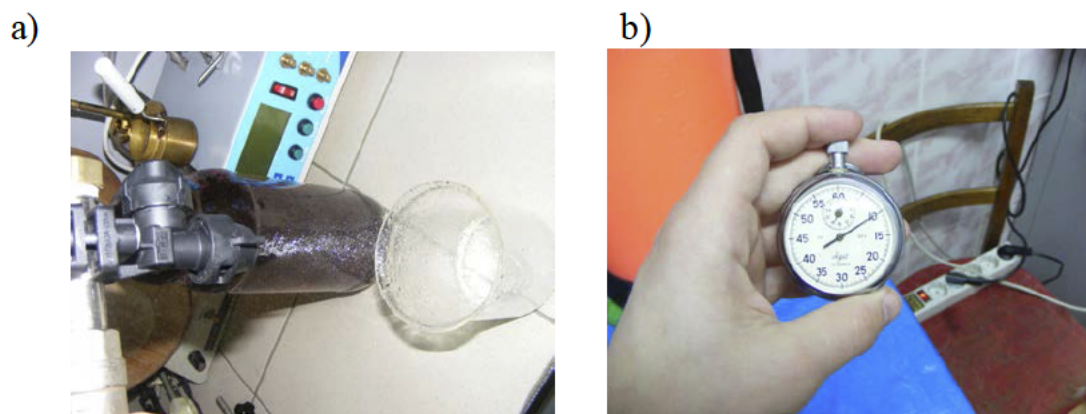


Fig. 4. Experimental determination time spraying an aqueous solution of 1% citric acid: a – spraying the solution in a beaker; b – fixing spray time

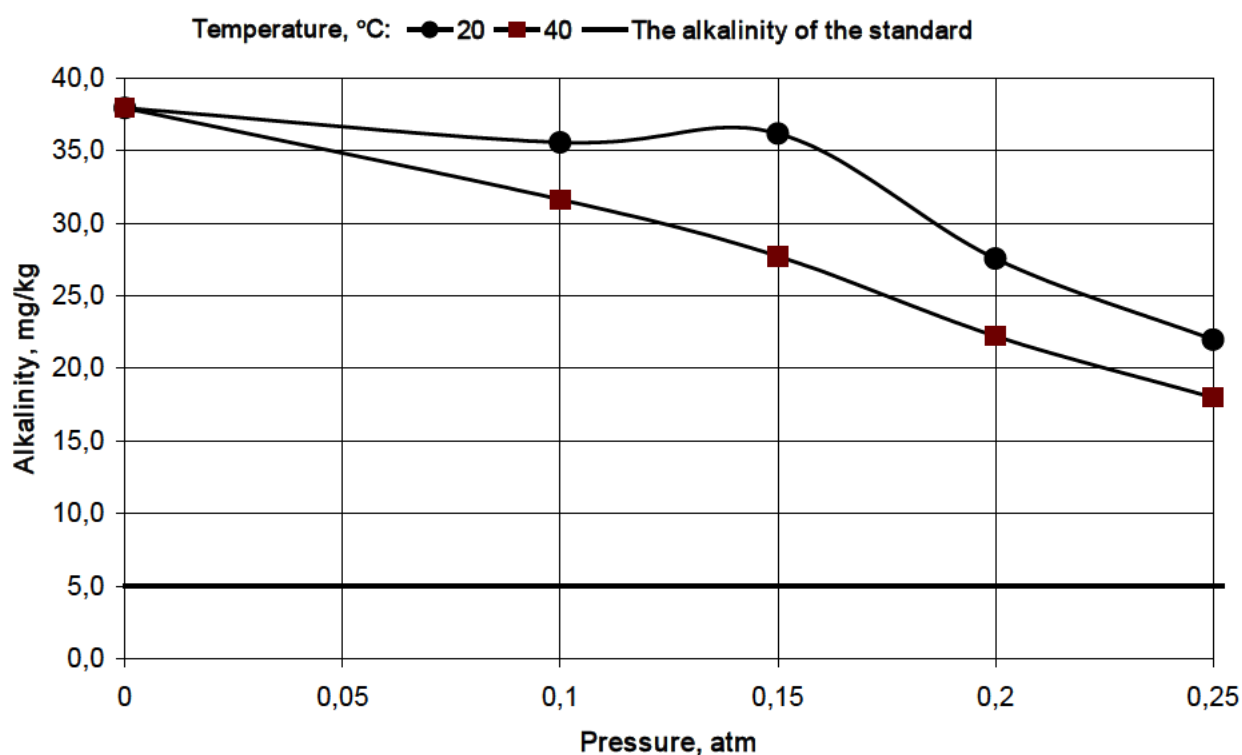


Fig. 5. Dependence of the alkalinity of biodiesel from the system pressure sprayer when neutralized

Summary and Conclusions

Application of spraying an aqueous solution of citric acid over a layer of biodiesel for neutralization is not effective because of its alkalinity throughout the investigated range of pressures and temperatures not lower than 5 mg/kg according to DIN 51606.

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MODELING OF DESCRIPTIVE GEOMETRY USING METHODS THE LOCUS

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Abstract. In the article the problem solving increased complexity for competition on descriptive geometry and its analysis that promotes self-depth study of both students and young teachers.

Keywords: descriptive geometry, geometric space, full-size replacement planes projections.

1. Introduction

Problem Solving descriptive geometry promotes spatial and logical thinking. In the complex problems using geometric space element space.

2. The main part

Methods of solution is the need to analyze the condition, develop a plan for solving the problem of spatial models, burn symbolic algorithm for its solution and finally solve the problem in complex drawings under paragraphs composite algorithm.

The locus elements of space (points, lines, planes) is the set of all possible positions of the elements that satisfy certain conditions. Locus used to solve problems in which the desired geometric image (or its components) associated with the specified requirements geometrical elements such as distance, angles, distances or angles attitude. Each connection identifies a locus in space (set) of elements that satisfy the request. The desired geometric image must meet all the requirements, and thus be at the intersection of the selected locus.

Solving specific tasks depending on the nature of requirements that meets the desired geometric image is appropriate:

1. Build a locus that satisfies both requirements two problems.

2. Build locus, satisfying one of the requirements of the problem, apply a different requirement and, thus, to provide him with a new locus that satisfies two requirements simultaneously.

Consider the example of the problem using this technique.

Condition. Construct a line passing through point A, rivnonahylena to direct a and b and distant from point B to 20 mm (Fig. 1).

In other words, in this problem we find:

1. Locus distant from a given point in a distance of 20 mm is a sphere centered at this point and a radius equal to the given distance.

2. The locus of lines, which are remote from point B to 20 mm and passing through the point A is a set of generators of the cone rotation circumscribing sphere.

3. The axis of the cone will pass through the top center of the sphere A and B.



4. The locus direct rivnonahylenyh set to direct a and b - bisektorna plane angle formed by straight lines that intersect and parallel lines a and b. Bisektornu plane can be viewed as a plane passing through the middle of the foundations of an isosceles triangle CFD perpendicular to the base CD. In this case, the determinant of the plane will direct f and h (Fig. 3).

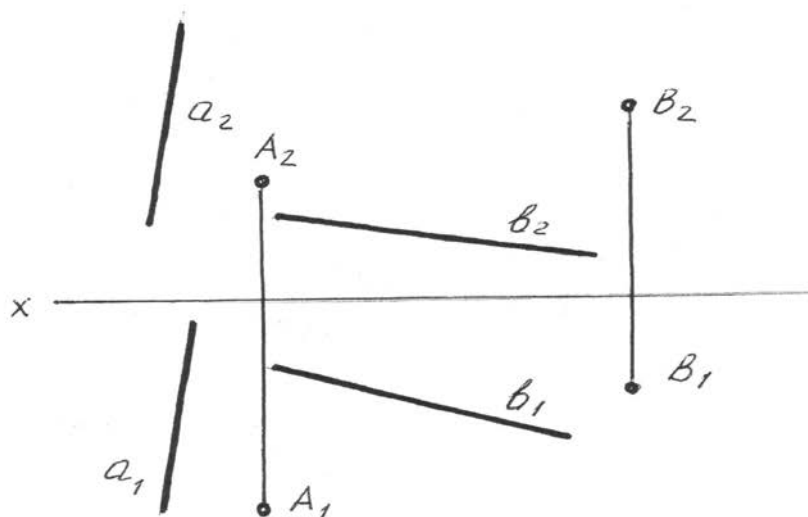


Fig. 1 Graphic condition

Solving. The required directly connected with desired geometric elements such requirements:

1. Direct must pass through point A.
2. Direct should be equally inclined to direct a and b.
3. Direct should be removed from point B to 20 mm (Fig. 2).

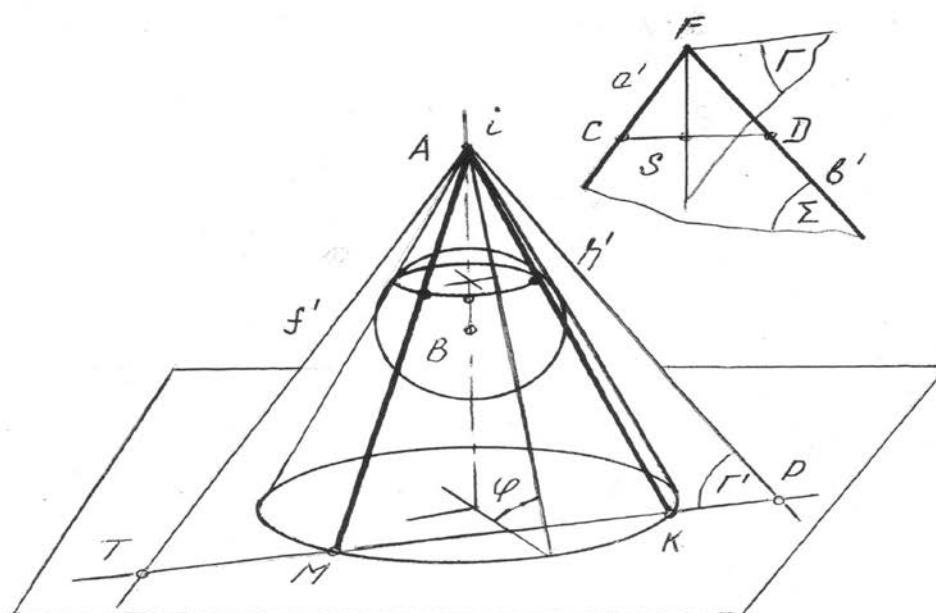


Fig. 2 Spatial Model

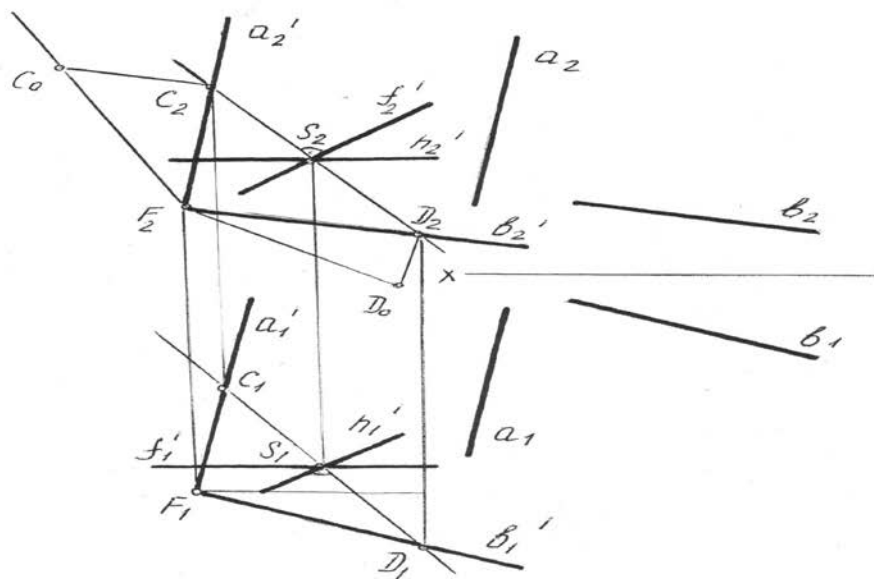


Fig. 3 Building bisector plane

5. The plane, which is held parallel bisektor plane and passing through the top of the cone A is crossed by two generators. The intersection of two geometric places is the solution of this problem (Fig. 4).

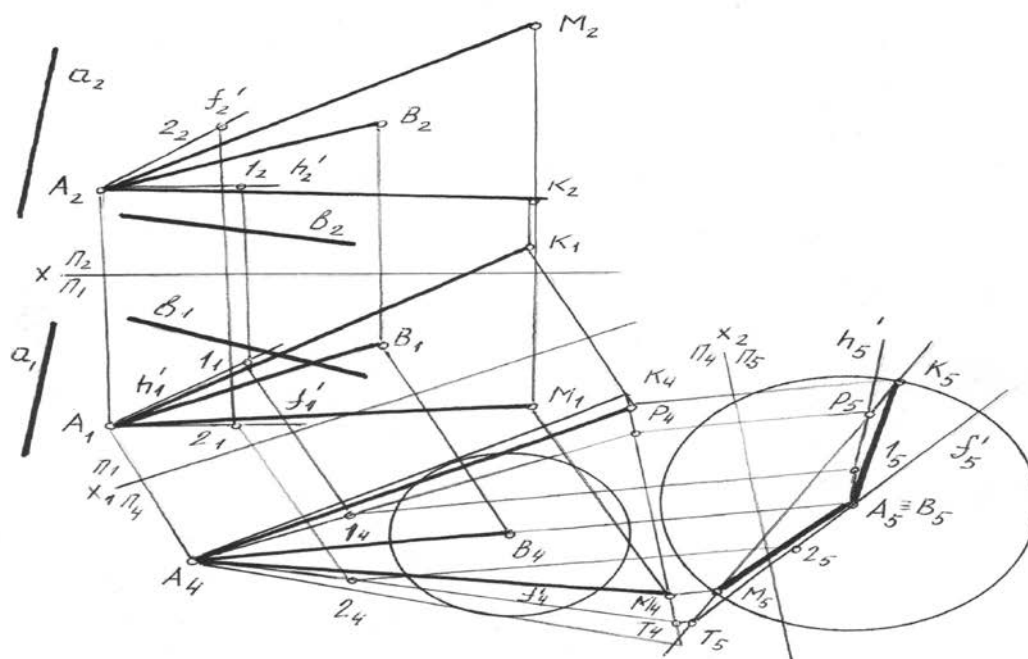


Fig. 4 Solving the problem of algorithm.



Algorithm.

1. $F \in \Sigma (a' \cap b'), a' \parallel a, b' \parallel b.$
2. $|FC| = |FD|, C \in a', D \in b'.$
3. $C \cup D = CD.$
4. $|CS| = |DS|, S \in CD.$
5. $S \in \Gamma (h \cap f) \perp CD.$
6. $A \in \Gamma' (h' \cap f') \parallel \Gamma (h \cap f).$
7. $A \cup B = AB.$
8. $B \in \emptyset, R = 20 \text{ mm}.$
9. $A \in \emptyset' (AB, l_i \text{ tangent to } \emptyset).$
10. $\emptyset' \cap \Gamma' = AM, AK.$ The problem has two solutions.

3. Conclusions

The proposed method of solving the problem provides analysis provided development plan for spatial models, recording the symbolic algorithm and finally solving the problem in a complex drawing algorithm accordingly.

4. Literature

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NUTRITIONAL VALUE OF FRUITS LATE TOMATOES GROWN IN UKRAINE

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The analyzed of researched some components chemical consist in fruits of different varieties of late tomatoes grown in Ukraine are present. Determine the stability of this index by calculating the coefficient of Lewis, as well as the influence of the variety and weather conditions on formation this components.

Key words: fruit, tomato, variety, chemical consist, stability.

Introduction. The main producers of tomatoes (Italy and USA) increase total production by intensification of production technology. Currently, this market is gradually developed by Turkey, Iran, India and especially China (owned 1/3 of world production). Growing tomatoes need is directly connected with multi-use, beside fresh consumption in different products processing (canning, salting, drying, sauces, ketchup, etc.) and also existence of valuable nutrients [1,2, 5, 8].

Fruits of tomato contain vitamins B1, B2, B3, PP, K, C and carotenoids (provitamin A), minerals in an accessible form Fe, K, Na, Ca, Mg, S, I. Due to the high content and balanced content of biologically active substances in fruits of tomato daily use contributes soft regulation of metabolism and functioning of the gastrointestinal tract, improve the functioning of kidneys and other glands.

The composition of tomato fruit are citric and malic acids which stimulate appetite and digestion and inhibit harmful microflora intestine. Organic acids with digestible sugars form a complete and balanced fruit taste, it expects the sugar-acid index. Research has shown that fruit and index 6-7 most harmonious taste [6, 10, 11].

At modern market conditions for fresh consumption and for processing advisable to select varieties that are characterized by the rapid formation of yield, resistance against diseases, suitability for processing and have a high indicators components of the chemical composition [3, 9].

The aim of the research was the study of important indicators of the chemical composition fruits later tomato, their comparative assessment and recommendation producing the best examples for effective growing in Ukraine.

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 Ukrainian Institute examination of plant varieties. At tomato fruits were tested: dry matter (DM), invert sugar and the titrated acid (TA). Components of the chemical composition was determined by accepted methods. Selection of the most valuable samples of tomato was performed by ranging of indicators of the chemical composition the result obtained conditional numbers (points) for each sample [4, 7].



Results and discussion. The studies analyzed nine samples of different varieties and hybrids of tomato late for important indicators (tab. 1-3).

The content of DM in the samples, on average during the years of observation left - 6.41% (table 1.). Their accumulation above the control was observed in the fruit varieties Kik 15 Tolstoy F1 (above 7%). At the same time pointed out that elevated temperatures and drought throughout the growing favor the formation of high concentrations of DM grades Tolstoy F1, (9,6), Kik-15 (9.5) Credo (8,8) and the torch (8,2%). Fruits of the other varieties form the MC of 7% below average, and only Credo - below 6%. It is noted that the varieties with a high content of DM have a solid skin, firm flesh and are more suitable for transport and storage.

Stability analysis was carried out for the DM performance maximum, standard deviation and coefficient of Lewis. The dependences between these indicators. Thus revealed strong direct inverse relationship between the maximum value and the standard deviation ($r = -0,84 \pm 0,13$, $r = -0,87 \pm 0,11$).

1. The solids content of tomato fruit later and its stability

Sort	%					Coefficient Levisa
	average value	max value	min value	max value	standard deviation	
Bogdanivskiy	6,29	3,29	5,00	2,00	3,00	0,91
Denar	6,50	6,50	4,90	1,60	0,75	0,75
Fakel	6,42	8,20	4,50	3,70	1,09	0,55
Gerkules	5,90	7,00	4,20	2,80	1,49	0,60
Gusar	5,59	7,00	4,10	2,90	0,96	0,59
Kik-15	7,73	9,50	5,50	4,00	1,71	0,58
Credo	5,85	8,80	4,30	4,50	1,48	0,49
Listopad	6,20	7,40	5,50	1,90	0,91	0,74
Tolstoy F ₁	7,25	9,60	6,40	3,20	1,22	0,67
Average for the varieties	6,41	-	-	-	-	0,68
SID ₀₅	0,45	-	-	-	-	-

The highest stability of the DM investigated tomato varieties with exponent Lewis Bogdanivsky ratio (0.91), Denard (0.75) and Falling Leaves (0.74), but in general, all the other varieties had the figure above 0.5.

Dispersion analysis effect of varietal characteristics and weather conditions of growing eggplant in the formation of solids in the fruit found that this figure is largely dependent on the varietal characteristics (49%), and the weather conditions and the interaction of factors up to 38%.

According to the recommendations of the chemical-technological tests vegetables for the processing industry in tomatoes must be at least 5% DM. For processing, you can use all sorts of investigation and hybrids (in accordance recommendations for the canning industry).

Technology is an important indicator of the sugar content in fruits of investigated varieties and hybrids in an average of 3.25% (table. 2). Depending on the variety or hybrid tomato fruit later accumulate from 2.7 to 4.33% sugar. The highest concentrations observed in samples Kik-15 (4.33) and Tolstoy F₁ (3,74), remaining samples accumulated in the fruits of up to 3.5%. Statistical analysis found that



between dry matter and sugar content in the fruit is tomato communication medium strength ($r = 0,60 \pm 0,25$).

2. The content of simple sugars in the fruit of tomato late and its stability

Sort	%					Coefficient Levisa
	average value	max value	min value	max value	standard deviation	
Bogdanivskiy	3,29	5,00	2,00	3,00	0,91	0,40
Denar	2,70	3,20	2,40	0,80	0,44	0,75
Fakel	3,38	7,00	2,00	5,00	1,20	0,29
Gerkules	3,17	3,80	2,00	1,80	1,01	0,53
Gusar	2,85	4,60	1,80	2,80	0,86	0,39
Kik-15	4,33	5,00	3,00	2,00	0,91	0,60
Credo	2,56	3,50	2,00	1,50	0,56	0,57
Listopad	3,40	4,40	3,00	1,40	0,67	0,68
Tolstoy F ₁	3,74	4,90	2,70	2,20	0,81	0,55
Average for the varieties	3,27	-	-	-	-	0,53
SID ₀₅	0,31	-	-	-	-	-

3. The content and stability of titrated acids in the fruit of tomato late

Sort	%					Coefficient Levisa
	average value	max value	min value	max value	standard deviation	
Bogdanivskiy	0,45	0,60	0,40	0,20	0,07	0,67
Denar	0,29	0,35	0,21	0,14	0,07	0,60
Fakel	0,50	0,70	0,30	0,40	0,10	0,43
Gerkules	0,43	0,60	0,30	0,30	0,15	0,50
Gusar	0,39	0,54	0,28	0,26	0,09	0,52
Kik-15	0,58	0,70	0,40	0,30	0,13	0,57
Credo	0,41	0,50	0,30	0,20	0,07	0,60
Listopad	0,43	0,50	0,30	0,20	0,09	0,60
Tolstoy F ₁	0,35	0,35	0,35	0,35	0,35	0,35
Average for the varieties	0,43	-	-	-	-	0,54
SID ₀₅	0,14	-	-	-	-	-

An important component that forms the fullness of taste is the concentration of organic acids. Total acidity titrated later studied fruit tomatoes an average of 0.49%. The discrepancy between the concentration of TC on grades ranging from 0.29 to 0.58%. The lowest concentrations were found in samples of fruits, Denar, Tolstoy F₁, Gusar and relatively high - Kick-15 and flare.

To balance the taste characteristics of vegetables use sugar-acid index. Practice found that tomato fruit with balanced sweet-sour taste with its meaning at least 6-7. These requirements correspond to an average of nearly all samples, only the taste of fruits and Tolstoy F₁ denarius was sweet and sour.



The complex analysis of the components studied the chemical composition of tomato fruits later allowed to place samples in descending order of value: Kick-15 Fakel, Bogdanivskiy, Listopad, Tolstoy F_1 , Hercules, Denar and Gusar.

Conclusions. The research allowed for the first time to analyze the chemical composition of tomato fruits grown in later Ukraine. Found most valuable varieties and hybrids chemical composition: Kik-15, Fakel, Bogdanivskiy, Listipad, Tolstoy F_1 . First established relationship between some components of the chemical composition of tomato fruits later, allowing indirectly determine the concentration of sugar content by dry matter. The data is expedient to consider when planning and selection of fruit assortments late tomato for growing high-quality and valuable products.

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THE CONTENT OF FREE ESSENTIAL AMINO ACIDS IN STRAWBERRY JUICE PREPARED USING THE INFUSION OF PULP

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The results on the effect of the insisting strawberry pulp at the content of free essential amino acids was established. Was established that use insisting of strawberry pulp enhances the content of essential amino acids in 2 times, and their total amount by 45%

Key words: free amino acids, strawberry juice, insisting of pulp

Introduction. Rational people feed - one of the most important conditions to ensure their longevity and working capacity, as well as one of the priorities of the state policies of developed countries. World production of strawberry is more than 4.5 bln. tons, with a growth trend of up to 3% per year. The demand for fresh berries and a variety of processed products is constantly growing [3, 6, 11].

In modern conditions of life of mankind a lot of attention in developed countries focused on the biological value of any product. An important issue at this stage of processing of fruit raw material is to increase the biological value of blended ingredients (raw wine, juices), which are used for the preparation of wines and beverages. An important quality characteristic of fruit juices is their amino acid composition, since the latter influence how the taste and juices on the technological properties, including their stability [1, 5, 7].

Each of the essential amino group plays a defined role. Their lack or excess leads to negative impact on the metabolism of the human body. There are standards of balance of NAC, tailored to the age data. For an adult human (g / day): tryptophan - 1, 4-6 leucine, isoleucine 3-4, 3-4 valine, threonine 2.3, lysine 3.5, methionine and tsistinal, 1.5-2.5, phenylalanine and 5-6 tyrosine, histidine 1.5-2 [2, 8].

The body's need of essential amino acids is satisfied mainly due to endogenous synthesis or reutilization. By reutilization formed 2/3 of the body's own proteins. The estimated daily need of an adult in basic amino acids the following (g / day): arginine - 6, cystine - 2.3, tyrosine - 3-4, alanine - 3, serine - 3, glutamic acid - 16 aspartic acid - 6, proline - 5 glyukokol (glycine) - 3-essential amino acids in the body carry very important functions, some of which (arginine, cystine, tyrosine, glutamic acid), play an important physiological role less than the indispensable (essential) amino acids [2, 8].

In order to maximize the extraction of valuable components of the biochemical composition of the fruit raw material used in the production of a variety of processing methods, the simplest of which is the insistence of pulp. The effect of this process is included on the amino acid composition of juice has been insufficiently studied [5, 10].

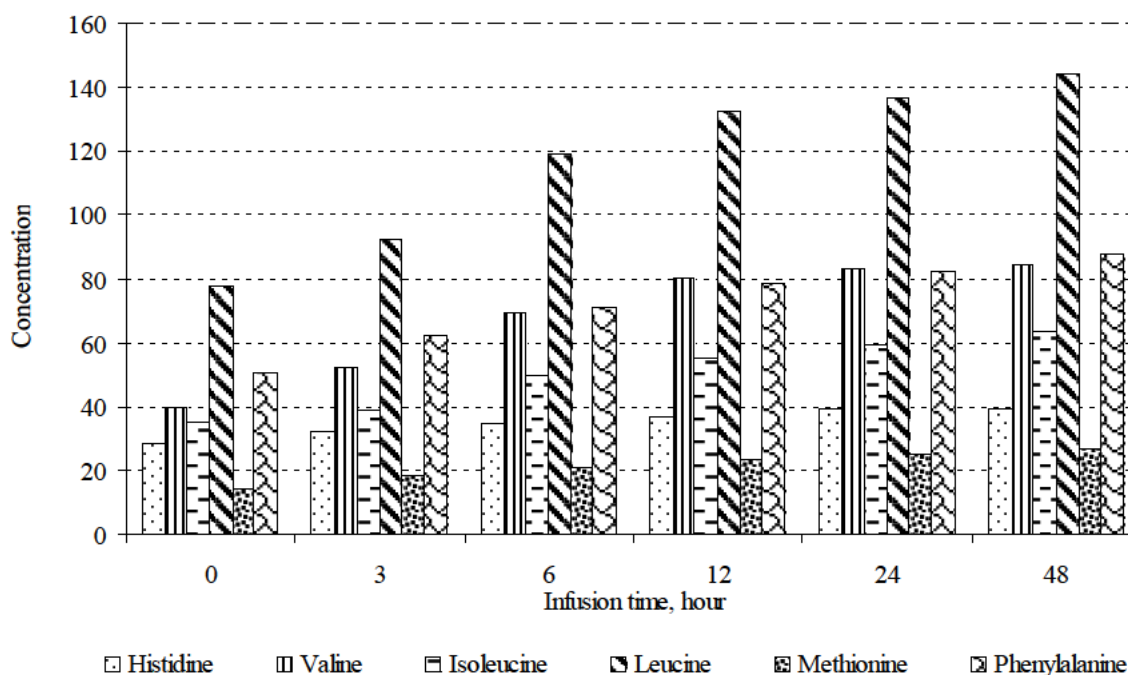


The purpose of research. The aim of this research was to investigate the influence of technological receiving infusion mash on the content of free essential amino acids strawberry juice.

The objectives of our study was to analyze the amino acid composition of strawberry juice, in the production of which was used technological method infusion mash of different exposure.

Materials and methods. Location, facilities and methods of the study. Investigations conducted in the laboratory of innovative food technologies and Horticulture NAAS Institute of Technology at the Department of storage, processing and standardization of products of Plant. B.V.Lesika National University of Life and Environmental Sciences of Ukraine. The fruits were selected for the experiments in consumer Jasna degree of maturity varieties with plants SE "Novoselki" Institute of Horticulture NAAS. Fruits and berries are crushed and filled with enamel dish with the addition of SO₂ at a dose of 50-75 mg / kg. exposure infusion mash was as follows: 3, 6, 12, 24, 48 hours at temperature of 18-22 °C. For reference control was used freshly squeezed juice and settled water. Determination of amino acids was performed on aminoanalizatore "Biotronic" [4, 9]

Results and discussion. The studies found 6 out of 10 essential amino acids (Figure). Identified these amino acids: Histidine, Valine, Isoleucine, Leucine, Methionine and Phenylalanine. The content of free essential amino acids in strawberry juice at insisting significantly increased. Their total content after 48 hrs infusion - increases by more than 494 mg / dm³. Prolonged infusion non-significantly increases the concentration of free essential amino acids (2.3%) but significantly decreases the quality of the juice and pulp physical properties observed fermentation processes.



The content of essential free amino acids in strawberry juice pulp using infusion, mg/l



It is noted that the pulp insisting for 48 hours in a qualitatively sectional concentration increase observed in almost all amino acids 38 to 111%. However greatest changes was observed on concentration of Valine, Leucine, Methionine (86-111%) (Figure).

Conclusions. The use of additional treatment mash strawberries by infusion, makes better use of the technological supply of free essential amino acids that form the food and biological value of strawberry juice. The use of infusion to 48 hours for strawberry pulp improves essential amino acid content 2x times. It is advisable to take into account obtained results in the production of new domestic competitive products increased biological value.

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1Voytsekhovskiy V., 2Voytsekhivskaya O., 3Smetanska I
BASIS OF INTERNAL AUDIT QUALITY MANAGEMENT SYSTEM
PRODUCTS TO AGRICULTURAL ENTERPRISES FOR GROWING AND
PROCESSING FRUIT AND BERRY PRODUCTS

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The article analyzes the base aspects of internal audit quality management system to agricultural enterprises. Based on international experience proved that the internal audit will improve the quality of certain technological operations and finished products.

Key words: audit, quality management system, processing plant material.

Ukraine has favorable agro-climatic conditions for effective growing and processing fruit production. Today there is a trend increase in gross fees, which in recent years have reached almost 2 million. M. A significant part of the raw material is processed at sulfital puree, natural and concentrated juices and others. Product quality is the fundamental component of competitiveness in terms of modern advancement in the market [6, 8].

In developed countries, the quality of management of the company has a special focus, which can affect the competitiveness of the products or services provided. For better communication and getting a good result at the predicted agricultural enterprises started the process of implementing different approaches to the quality management system, respectively ISO 9000. Product quality (including originality, technical level, the absence of defects, suitability for storage, food and biological value) is one of the most important means of competition, development and retention of the positions in the market. Effective audit (control) the quality of the company can significantly improve the organizational process, and ultimately improve the quality of the product [7, 9].

Organization of rational and efficient work the implemented quality management system is carried out under the scheme: Market monitoring and development of quality requirements for finished products; consideration of factors forming the necessary properties of raw materials; monitoring compliance with quality of raw materials and finished products at the current regulatory documentation or planned actions to address the identified deviations. Modern quality management system implemented according to ISO 9000, is the exposure of the subject to the object through the implementation of the established methods of management functions. When considering the quality management principles has been identified following composition of functions: policy and planning quality, quality information, education and motivation of staff, the organization of work on quality, quality control, development activities, decisions by management, the implementation of measures in the production process, the interaction with the outside environment (suppliers, consumers and governments) on quality. Thus it is



logical that some of these functions refers to the total quality management (quality management), and some - the operational quality management (quality control). But all of these functions are interconnected in the form of quality loops and together constitute the quality management process across the enterprise [4,10].

Quality policy in the company - one of the most important elements of a quality management system in the enterprise. She - includes the main directions and goals of the organization in the field of quality as formally expressed by management. In a note to this definition, it observed that the quality policy is an element of a general policy and approved by the company management. In other words, the policy quality - it is a benchmark for the overall direction of the company in the field of quality. It is drawn up in the form of a brief statement of the director and, as a rule, included in the "Quality Guidelines," which serves as a description of the quality system and provide the customer with contracts. The main factors influencing the formation of policy in the field of quality are: the situation on the markets, technological progress and the achievement of competitors, the situation within the company, as well - the overall economic situation and the availability of investment in the development of the enterprise. In conditions of stable economic development the main focus of the quality policy must be obvious an active research, the development of perspective directions activity, the introduction of advanced technologies in order to advance competitors in the markets. In periods of crisis, when the decline of production and deficit investments in the quality policy, in the first place, it is necessary to provide for the preservation of the achieved level of quality, capable of some time to support the demand for the products. At the same time connivance unacceptable in connection with the difficult economic, political or other force majeure. Although in such periods the main efforts of the administration is really aimed at finding orders and investments in market conditions, these efforts will be in vain if they are not supported by the production of competitive products. And then the change of ownership or bankruptcy would be the most probable result. Therefore, the main focus in the quality policy in crisis situations should be the use of all available internal resources to maintain the quality and the search for solutions that would allow without reducing the quality to cut costs [2, 3].

In addition to this it is advisable to provide for a more active cooperation with customers and suppliers in order to jointly overcome the difficulties. At such times, it is also necessary to provide for a permanent analysis of the economic situation, market conditions for the purpose of the operational use of any opportunities to improve the quality, which will appear as the economic recovery. In all the the cases company's quality policy must be very convincing for the customer (consumer) that the company is true to determine the vector of development and objectives in the field of quality and mastering real means to achieve them, which will allow the company to deliver products of the desired quality. Quality planning also plays an important role in building a quality management system in the enterprise. Quality planning also covers the evaluation of the quality, the quality of training systems and the quality of the program, the provisions of the production quality improvement.

Quality planning g is carried out on 2 levels: strategical planning and current planning of quality. This events usually include: removing from production of



unyielding varieties and hybrids, low-efficient pesticides; Purchase of resistant varieties and hybrids, modernization of equipment; design and development of new activities (storage, primary and secondary processing); conducting research works. Quality planning is carried out on the basis of market requirements. Quality Plans developed planning authorities and the quality of service based on customer surveys, analytical department of marketing or market trends. Before the approval of plans of all these proposals should be linked to each other and to consider at the production meeting, identifying the main weaknesses or unaccounted risks.

Quality Audit - a systematic and independent analysis, which allows to determine the conformity of the activities and in the quality of the results of the planned activities, and the effectiveness of their implementation. Quality system audit is to assess the overall performance of the company developed and implemented a quality system with the help of some of its elements control techniques. In the process of evaluation is made according to the approved technology and regulations. It is used in the system of quality certification systems. When the audit products are mapping methods and means of production of [1, 3].

Internal audit of the quality necessary to obtain information on the status of quality assurance in the company and is an integral part of quality management system itself. Internal quality audits are carried out by persons who do not bear direct responsibility for the area being audited. One type of internal audit - quality control of technological operations, and finished products. In the glossary of the European Organization for Quality is defined as follows: the test definition or study of one or more characteristics of the product under the influence of physical, chemical, natural or operational factors and conditions. The external audit is to verify the correctness activities to ensure the quality of the company by external expertise second or third parties. Quality audit system includes control objects, control operations and their sequence, technical equipment, methods, means of mechanization, automatization and computerization of the control operations are an integral part of the production process [1, 5, 6].

Summing up the analyzed information, the following conclusions, the main tasks of the internal audit in the agricultural enterprises for growing and processing of fruit products are: a) internal audit (control), appropriately organized on a regular basis, which helps to identify inconsistencies, keeping the proper level of production and achieve the planned product quality; b) development and implementation of recommendations on improving the production technology (on the results of the audit report is made, with a clear assessment, conclusions and recommendations. Troubleshooting identified inconsistencies in the mandatory locks in laced logs to track trends; c) the development of training systems in quality hobby groups with bringing bases of quality management systems directly to employees of different ranks (basic understanding of quality management ideas will increase the motivation for the quality of work); d) the ultimate goal of the company - implementation of standards ISO 9000, ISO 10000, ISO 22000 and other international regulations. Conducting the audit on agricultural enterprises with the primary processing of products will not only improve the quality and competitiveness, but will open up new opportunities to expand the market.

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J11610-021

¹Slododyanik G., ²Voytsekhivskiy V.**THE NUTRITIONAL VALUE OF LEEK FOR INFLUENCE
FERTILIZATION**¹National university of horticulture, Uman²National university of life and environmental sciences of Ukraine, Kiev

The article impact varietal characteristics and fertilization on the formation of the concentration of nutritional value in different parts of leeks are present. It was established that the use of fertilizers and promotes dry matter, simple sugars and formation of the top green part of the false leek stems much larger than the bottom bleached.

Fruits, leeks, variety, nutritional value.

Taste, nutritional value, especially the biochemical composition, therapeutic properties and enhance specific taste leek popularity among consumers. In the false leek bulbs, depending on the variety, hybrid and growing conditions dry matter content ranged from 10.0 to 20.8% in the leaves 9,0-17,1%. For more inherent onion dry matter accumulation in the inner bulb scales than external, leeks but this difference is less pronounced, since no private domestic scales and nutrients through the bottom evenly bulb [1].

Under the traditional system of cultivation blanched leek stalk contains 20.4% dry matter, provided planting in deep grooves - 18.7%. Dry matter content in the green leek is respectively 15.5 and 14.9% [2]. According to IE Tihunovoyi variety Syzokryl provided seedlings growing method and timing of planting early dry matter content in stem false leek - 21,8-21,9%. However, against the background bezrozsadnoyi technologies and crops in the second decade of March the dry matter content higher - 26.2% [3]. Comparing the value of biochemical products for environmental leeks, extensive and intensive cultivation technology GI Stauhaytys and others argue that without the use of fertilizers and pesticides has the best products leeks biochemical composition [4].

In the false leek bulb contains 2,1-3,0% of the protein in the leaves - 1,5-2,0 fiber - 1% of free organic acids - 0,1%. Also, the leek has a high sugar content in the leaves and bulb - respectively 3,1-5,1% and 6,8-12,3%, which is 3 or 1.5 times more than the onion. [1] The high content of sugars provides cold resistance and keeping quality leeks. AF Agafonov and IV Medvedev found that the higher the sugar content (especially sucrose), the higher the hardiness of plants leeks - Cr = 0,74-0,79. The maximum seed production leek that peredzymovyy period contains 12% sugar, and plants that rolled less than 9% sugar - vymerzaly [5].

The composition of the ash plant leeks are sodium - 6,85-14,2%; phosphorus - 7,6-10,7; magnesium - 2,9-4,4%. Calcium, phosphorus and iron leeks twice that of onions, and potassium reaches 225 mg / 100 g leeks in essential oil contains up to 37 mg / 100 g of sulfur, which causes a specific taste food with him.

Blanched leek stalk unreal provided irrigation and moderate temperatures has a mild pleasant flavor, so you can eat and children in gastric diseases. The



accumulation of chemicals affect postharvest quality leeks and keeping quality during winter-spring period.

The quality of the leeks must meet EU standards FFV-21, which stated that the first commercial grade products belonging to white or greenish with 1 / 2-1 / 3 of the false stem, the second commercial grade - with ¼ white or greenish tint unreal part stems, tender stems presence allowed inside the legs, small pomyatosti, thrips damage on the leaves. The minimum diameter for early ripening varieties - 8 mm -10 mm to others [8].

The aim of our research was the study of the effect of mineral fertilizers DripFert 20-20-20 + Me (B, Cu, Fe, Mn, Zn) and biological Biocomplex-BTU performance in nutritional value leek varieties Holias and Columbus.

Research conducted during the 2013-2015 biennium. NNVV on irrigated field Uman Nous. Planted in open soil 60-day seedlings. Collected harvest in the second week of October. Accounting harvest was performed by weight, laboratory studies included determination of soluble dry matter sugar accepted metodykay.

The level of basic chemical indicators of commercial products (blanched stems) differ depending spent feeding (see table).

**The chemical composition of the false leek stalks after harvest
(average for two years)**

Copt	Fertilization	Content			
		sugar, %		dry cyxoï solute, %	
		bleached lower part	green upper part	bleached lower part	green upper part
Golias	wIthout fertilizer (control)	12,6	10,2	17,7	15,8
	DripFert 20-20-20	12,9	9,7	18,2	16,6
	DripFert 20-20-20 + Biocomplex - BTU	13,5	10,6	19,7	17,8
Kolumbus	Without fertilizer (control)	12,4	11,8	18,6	16,4
	DripFert 20-20-20	13,5	12,1	20,2	18,3
	DripFert 20-20-20 + Biocomplex - BTU	13,8	12,9	21,5	19,9

In terms of dry solute on average two years stands recharge option DripFert 20-20-20 + Biocomplex-BTU - in 19,7-21,5% of bleached and 17,8-19,9% - in green. By making DripFert 20-20-20 content of soluble dry matter compared with control increased - up to 18,2-20,2% of bleached and 16,6-18,3% - in a green sort of advantage Columbus.



Thanks to the integrated nourishment DripFert 20-20-20 + Biocomplex BTU-bleached sugar in the stem was 13,5-13,8% while without fertilizing - 12,4-12,6%. Sugar in the top green part of the stem was lower respectively by 0.9 and 2.4%. Regardless of variety, there is a direct correlation between sugar and soluble dry matter in the lower and upper parts of the stem. That is, a larger accumulation of nutrients in the leaves, their content in more false stem.

On average two years more dry matter and soluble sugar accumulated at the plant complex fertilizer grade and Columbus.

Conclusion. Thus, to obtain quality products leek variety advisable to grow against the backdrop Columbus feeding DripFert 20-20-20 + Biocomplex-BTU. The results expedient to consider when planning the cultivation of high-quality and competitive products of high marketability.

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BIOCHEMICAL QUALITY ASSESSMENT CONES AND PELLETS OF HOPS FOR BREWING

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Abstract. The results of biochemical studies as cones and hop pellets domestic production used in brewing. On the basis of biochemical parameters revealed the advantages and disadvantages of hop cones and granules that must be considered during the storage, processing and use in brewing.

Key words: Quality, hops variety, products hops, hop cones, hop pellets type 90.

The use of hops and its products in brewing due to the fact that his cones contain a large number of biologically active substances such as bitter substances, polyphenols, and essential oil. Specific substances give beer bitterness unique and specific flavor, are involved in light and foaming, enhance its stability during storage [6].

The tendency of growth of beer production in Ukraine stimulates demand for hop field, necessitates a balanced development of the industry to meet the needs of the brewing industry. However, competition in the market wins not the one who makes more, but mediocre hop, but the one who does it better quality and cheaper price. Even in the current difficult circumstances, there are opportunities and room for production of high commodity hops, including aromatic [9].

In brewing uses about 90% of hop. Demand for hops growing, but the industry is not fully satisfy the domestic market. Today, the brewing industry in Ukraine is not used more than 20% of domestic production. The overwhelming share of imported raw materials, creating dependence on world markets. This area is divided between countries such as Germany, Czech Republic, Poland, Austria, USA, Canada, Australia and China [3,4,6].

As the market research, the global market receives only about 10 % of natural cones hops and hop granules processed to extract – 90 % of the total received products hops. Only breweries remained low power classic technology of making beer in which to addition of hop beer wort is traditionally used cones pressed hops. Powerful breweries Ukraine switched to different types of grains, ethanol and carbon dioxide extracts of hops [8, 9].

However, despite the fact that the world is more than 90% of native (cones) hops processed into hop drugs, almost no data of scientific studies on the quality in terms of selection of varieties with different content and composition of bitter substances, polyphenols and essential oils. Skilled agricultural and brewing industry should know the basic advantages and disadvantages of these products, especially in literature, especially in advertising media tend to write more about their benefits without focusing on the flaws.

The aim of research was comprehensive biochemical assessment cones and pellet hops aroma and bitter varieties.

Material and methods of research. Research carried out in 2014 - 2015 rr. At the department of technology of storing, processing and product standardization Ya.



prof. B.V. Lesik National University of Life and Environmental Sciences of Ukraine and certified laboratories in the Department of Biochemistry of hops and beer Institute of Agriculture Polissia NAAS (c. Zhitomir). Given the significant differences in the biochemical composition of aromatic and bitter varieties of hops for experiments as research objects were taken, cones and hop pellets type 90 typical of these groups of aromatic varieties (Slavyanka, National, Zagrava) and bitter (Al'ta) types, most common in industrial environments.

We used the well-known and common in industrial practice and research methods of quality assessment, provided current regulatory and technical documents, and used in the world for more in-depth evaluation of quality hops and products hops [6].

Results. Biochemical characterization of the most common varieties cones and granulated hops used in the brewing industry in the table. From the data table shows that the studied variants of α -acid content ranged from 3.8 to 10.1 %. The highest content of α -acids found in cones of hop varieties such bitter Al'ta - 8.8 %. Among grains, the figure in the maximum hop pellets type 90 bitter varieties Al'ta - 10.1 %. Hop pellets type 90 domestic production accommodate the full range of necessary materials for brewing and hop cones equivalent [1]. A characteristic feature cones hops and hop pellets type 90, including aromatic varieties have a high positive coefficient between aromaticity content of β - and α -acids is from 0.9 to 1.8. This is a critical feature in the evaluation of quality hops and brewing products hops. On average two years of research a higher aromaticity characterized as bumps and pellet hops varieties Slavyanka and National.

Unlike cones and granular aromatic hop varieties, cones and pellets bitter hop varieties Alta characterized by a sharp flavor and high content of α -acids. Value β -acids to α -acids in hops cones and granules bitter varieties was 0,52-0,53 (Table.).

Brewers give special attention indicator index oxidation bitter substances, because they consider it a major quality indicators hop cones and products hops. When purchasing hops and parties products hops must monitor this metric along with the content of alpha acids. The lower rate of oxidation index of bitter substances considered products hops the better.

According to the table index oxidation during years of observations as to cones and granulated hops ranged 0,33-0,50 never exceeded the norm standards [2,10]. Minimal oxidation index set to hop cones Zagrava class - 0.33, maximum to hop pellets type 90 varieties Slavyanka - 0.50. Established in pellet hops oxidation index slightly higher compared to cones hops. This indicates that the quality of hop pellets type 90 is virtually identical to cones, and quantitative and qualitative composition of bitter substances depends on breeding varieties from which they are derived. At the organoleptic properties of beer made from different products hops, also affects different content of polyphenolic compounds. Along with bitter substances polyphenols play an important role in shaping the fullness and purity of taste of the drink, as well as directly affecting pinostiyskist and stability of beer during storage. Always gets better assessment beer made from hops polyphenols containing at least 4.5% [7].



Biochemical characterization cones and pellet hops for brewing (average for 2014-2015 years.)

Samples of hop	a-acids, %	β - acids, %	Value β/a (EBC method 7.7)	Index oxidation, I_o	General polyphenols, %	Essential oils, mg/100 g	Loading polyphenols to 1 g a-acids, %	Loading essential oil, 1 g ml a-acids, %
Cones of hop varieties Slavyanka	3.8	5.4	1.79	0.34	5.0	0.78	1.3	0.21
Cones of hop varieties National	5.4	5.4	1.15	0.37	5.5	0.48	1.0	0.09
Cones of hop varieties Zahrava	5.7	4.7	1.06	0.33	6.6	0.67	1.2	0.12
Cones of hop varieties Al'ta	8.8	4.0	0.52	0.36	5.9	1.22	0.8	0.14
Hop's pellet type 90 varieties Slavyanka	4.6	4.2	1.28	0.50	6.0	0.36	1.3	0.08
Hop's pellet type 90 varieties National	6.3	5.1	1.17	0.41	4.9	0.51	0.8	0.08
Hop's pellet type 90 varieties Zahrava	6.4	4.3	0.92	0.45	6.5	0.49	1.0	0.08
Hop's pellet type 90 varieties Al'ta	10.1	4.3	0.53	0.40	4.5	0.87	0.4	0.09



The content of polyphenolic compounds investigated cones and hop granules according to the table ranged from 4.5 to 6.6%. However, the main feature products hops this indicator is not determined by their overall content and load polyphenolic compounds in 1g of α -acids. If the aromatic varieties of hop cones, this value is from 1.0 to 1.3, hop pellets type 90 from 0.8 to 1.3, the cones and hop pellets type 90 bitter varieties Al'ta from 0.4 to 0.8, that is 2.0-2.5 times less.

The content of essential oil in the studied cones and hop granules ranges from 0.36 to 1.22 mg / 100 g highest content of essential oil found in cones of hop varieties Alta. However, important in the brewing also has loads of essential oil per 1 g of α -acids as normal hops that bring in beer wort is calculated taking into account the contents of α -acids. Unlike grains, hops traced in cones more load of essential oil per 1 g of α -acids, which gives a aromatnishoho beer.

Conclusions

1. As a result of studies found that hop cones Ukrainian varieties used in brewing meet the requirements of ISO 7067: 2009 Hops. Specifications. Unlike granules cones hop seen more load of essential oil per 1 g of α -acids, which gives a aromatnishoho beer.

2. Hop pellets type 90 domestic production accommodate the full range of necessary materials for brewing and hop cones are equal, and its quality meet the requirements of ISO 707028: 2009. Wood hops. Specifications.

3. Given the advantages and disadvantages of hops and processed products for efficient use in brewing is necessary to produce different types of hop preparations to implement and use a particular drug or combination thereof, depending on the market situation and customer requirements.

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J11610-023

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IMPROVEMENT OF TECHNOLOGICAL METHODS PRODUCTION FERMENTED PRODUCTS ON THE BASE MUSHROOMS OF OYSTER PLEUROTUS AND VEGETABLES

Abstract. Results of study improving technological methods of production pickled products on the based industrial cultivated mushrooms of Oyster Pleurotus and vegetables were presented.

Key words: mushrooms, Oyster Pleurotus, technological methods of production, pickled products.

Introduction. Deficiency of protein in the world is estimated at 15 millions tonnes with the vast majority of the deficit accounted for developing countries and some CIS countries, including Ukraine. That is why the the search for new sources of protein, including non-traditional, are actual today [1]. One decision of this problem is the use of cultivated mushrooms, which contain over 35% protein (on dry matter), all essential amino acids, unsaturated fatty acids, vitamins, macro- and microelements [2]. Mushrooms valued as low-calorie product and as raw materials for the production medical and preventive products [3, 4]. The most widespread among cultivated mushrooms are *Champignon Bisporod* and *Oyster Pleurotus* [5, 6].

Due to the specific growth and short-term storage of mushrooms, there is a need their efficient storage and processing. One of the widespread ways of processing plant production is fermentation [7].

Aim of study: improvement elements of the production technology of fermented products based edible mushrooms *dvosporova* and vegetables (carrots, sweet peppers).

Materials and methods. For the production of experimental samples of pickled products used mushrooms fresh *Oyster Pleurotus* strain Amycel 3000, fresh carrots variety Lasunka and fresh red sweet pepper hybrid Nikolka F₁. Pickled mushrooms with vegetables produced the following titles: "Pickled mushrooms with carrots"; "Pickled mushrooms with sweet peppers", "Pickled mushrooms with carrots and sweet peppers".

At the production of experimental samples of products, vegetables, cut into strips with width: 3-6 mm – carrots, 4-7 mm – sweet pepper and the length – 2.5-4.0 cm. Prepared ingredients are mixed, added spices and salt according to the recipe. Temperature of fermentation was within 21-24 °C until the acidity in the brine increase up to 0.7% (calculated on lactic acid). Then products were stored at a temperature at 1-3 °C and every day testing their taste properties for defined term when they becomes suitable for consumption.

Determination the main ratio ingredients of new products (mushrooms:vegetables) is carried out in the following variants: 70:30; 80:20; 90:10%.

Results. Pickled mushrooms are sources of plant proteins. However, these products are depleted in vitamins, so prospective is the development of recipes with added vegetables with high content of vitamins. As a result of the literature review



were selected for testing following raw materials for improvement elements of technology production of fermented products on the base mushrooms of *Oyster Pleurotus* and vegetables (carrots and sweet peppers).

Table 1

The content of chemical substances in raw materials, which selected for scientific research (average for long-term data)

Raw materials	Chemical substances				
	dry matter, %	protein nitrogen, %	ascorbic acid, mg%	β -carotene, mg%	sugar, %
Oyster pleurotus	10,2	2,9	10,3	0,0	1,4
Pepper sweet red	9,5	0,2	176,5	1,8	3,5
Carrot	10,5	1,1	4,8	7,2	4,7

Mushrooms have high protein content; in carrots contains large amounts of β -carotene but a sweet pepper has a significant amount of vitamin C. According to research results (tabl. 1), mushrooms contain 2,9 % protein nitrogen, in carrots - 7.2 mg% β -carotene, and in sweet red peppers – 176.5 mg% of ascorbic acid. For technology of pickles are important indicator available sugars. In mushrooms sugars content was 1.4 % in sweet peppers - 3.5% and carrots - 4.7%.

Obtained results indicate that the addition of vegetables to the recipe pickled *Oyster Pleurotus*, helped accelerate the fermentation process, as happened in the studies which we conducted earlier [8]. *Oyster Pleurotus* mushrooms contain small amounts of sugar 1.4%, so the development of lactic acid bacteria was slowly. We know that only with 1.5% of sugar may form 1% lactic acid, which becomes preservative.

Table 2

Dynamics accumulation of lactic acid in the brine during fermentation process for production of mushrooms, depending on correlation the main ingredients, %

Type of pickled products	Correlation mushrooms: vegetables, %	Duration of fermentation, day					
		2	3	5	7	9	11
Oyster Pleurotus with carrot	70 : 30	0,2	0,4	0,6	0,7		
	80 : 20	0,1	0,3	0,5	0,7		
	90 : 10	0,1	0,2	0,4	0,6	0,7	
Oyster Pleurotus with sweet pepper	70 : 30	0,2	0,3	0,5	0,7		
	80 : 20	0,1	0,2	0,4	0,6	0,7	
	90 : 10	0,1	0,2	0,3	0,5	0,7	
Oyster Pleurotus with sweet pepper and carrot	70 : 15 : 15	0,2	0,3	0,6	0,7		
	80 : 10 : 10	0,1	0,2	0,5	0,6	0,7	
	90 : 5 : 5	0,1	0,2	0,4	0,5	0,7	



Oyster Pleurotus (control)	100 : 0	0,1	0,1	0,2	0,3	0,5	0,7
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Addition to the recipes of pickled mushrooms vegetables (carrots and sweet peppers) that are relatively a lot of sugar (4.7 and 3.5%, respectively) stimulated fermentation and as a result – the rapid accumulation of lactic acid after 7-9 days of fermentation. However, in the control variant 0.7% lactic acid accumulates only 11 days (tabl. 2). In experimental variants on the 4-5 days observed a stormy fermentation (strong clouding, emission of carbon dioxide), when the control variantis registered only slight clouding.

After stop the main active phase of the fermentation process, the taste properties of pickled mushrooms are not suitable for consumption. Therefore, they put on the storage at 1-3 °C, where productions continued slow enzymatic processes (ripening) and it obtain the characteristic taste properties.

During storage, the taste characteristics, determining the readiness of production to consumption. Experimental options products (with vegetables) have the necessary taste properties through 14-18 days, while the control variants were ready for consumption only after 19-22 days. Obviously, the presence of vegetables has accelerated the process of fermentation and, thus, received the finished product for 4-6 days earlier than control.

Work tasting commission estimated ready to consumption experimental samples of fermented product by organoleptic characteristics. Combining vegetables with Oyster Pleurotus liked all tasters. The most favorable ratio in the pickled products where correlation between mushrooms to vegetables was 90:10% (organoleptic value - 4,9-5,0 points). Increasing the quantity of vegetables up to 20-30% negative affects on all organoleptic properties of products (mushrooms lost unique taste and aroma).

Conclusions

The inclusion vegetables to the recipes of pickled mushrooms enhance their biological value by increasing the amount of vitamin C and β -carotene.

Adding vegetables stimulates fermentation process due to the high sugar content in the carrots and sweet pepper, and as a result – provided a rapid accumulation of lactic acid (7-9 days). However, in the control variant 0.7% lactic acid accumulates only 11 days.

Experimental variants product pickled mushrooms with vegetables get required taste on 16 day but control only 19 days from the date originally process of pickling.

The most favorable ratio in the pickled products where correlation between mushrooms to vegetables was 90:10% (organoleptic value - 4,9-5,0 points). Control variant of products (ratio mushrooms and vegetables – 90:10) has all indexes quality lower and obtained general score 4.3.

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J11610-024

Polischuk A.V., Kosak N.I., Polischuk V.N.
RESEARC PARAMETERS AND MODES WASH AEROSOL
BIODIESEL

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Abstract: The article substantiates the need for purification of biodiesel from potassium salts. Description method for purifying biodiesel through its spray washing. The above procedure, and the main parameters and modes aerosol washing biodiesel.

Keywords: Biodiesel, flushing, potassium salt, atomizer, alkalinity

Introduction. Renewable fuels are now coming to play an important role in meeting the world's energy needs. In connection with economic and environmental problems associated with the use of fossil fuels, a growing interest in liquid biofuels as a supplement to petroleum fuels, or as an independent type of fuel. For positive ignition engines used gasoline with ethanol content. Studies are under way to obtain cheaper butanol. For diesel engines, the best substitute for diesel oil biodiesel is considered, which is the fatty acid methyl esters derived from vegetable oils or animal fats and methanol in the presence of a catalyst (potassium hydroxide). However, the catalyst does not react, and only accelerates it, while remaining completely in the biodiesel. Therefore, to obtain high-quality biodiesel in accordance with domestic DSTU 6081:2009 "Motor fuel Esters of fatty acid methyl fats and oils for diesel engines Specifications" it must be cleaned.

Analysis of recent research. One way to remove the catalyst from the biodiesel in conventional technology of its production is the neutralization with a weak solution of citric acid [1] in which it formed salts (citrates) of calcium which, together with water together in the plate in the shape close to the shape of a cylinder, with a diameter less than 100 microns. At this time, the deposition of potassium salts is more than 10 hours. [2].

One way to release from biodiesel potassium salt aerosol is its rinsing. For this purpose a system of nozzles located over the layer of biodiesel through which water is sprayed to form droplets and their passage through the layer of methyl [3]. At the same time large drops of water moving through a layer of biodiesel, grab small plates of potassium citrate. The deposition rate drops of 1 mm in diameter is less than 2 minutes. When reducing the speed of dispersion of droplets of deposition increases considerably [2].

Unlike the bulk of research washing biodiesel [4], in the literature there are no data on the optimum parameters and modes of spray washing biodiesel.

The purpose of research. Determine the optimal parameters and modes of spray washing of biodiesel from the alkaline catalyst to ensure specified parameters of its quality.

The results of research. The inverted bottle PET (not the bottom) of 2 liters, in which the cover faucet mounted water drain, pour 300 ml of biodiesel. Above it is placed a centrifugal Full cone dispenser "DISC and CORE" TeeJet company,



consisting of a housing with a nozzle QJ17560A-NJB, bayonet cap CP 26277-1-NY, baffle core, the ceramic disk with a hole DCER-2 with a diameter of 1 mm and a rubber seal CP-18999. The PET bottle with biodiesel through a full cone spray gun "and CORE DISC" using a hydraulic pump, a tank constructed with a garden sprayer and compressor "Atlas" from the refrigerator to maintain a given pressure, sprayed water (Fig. 1).

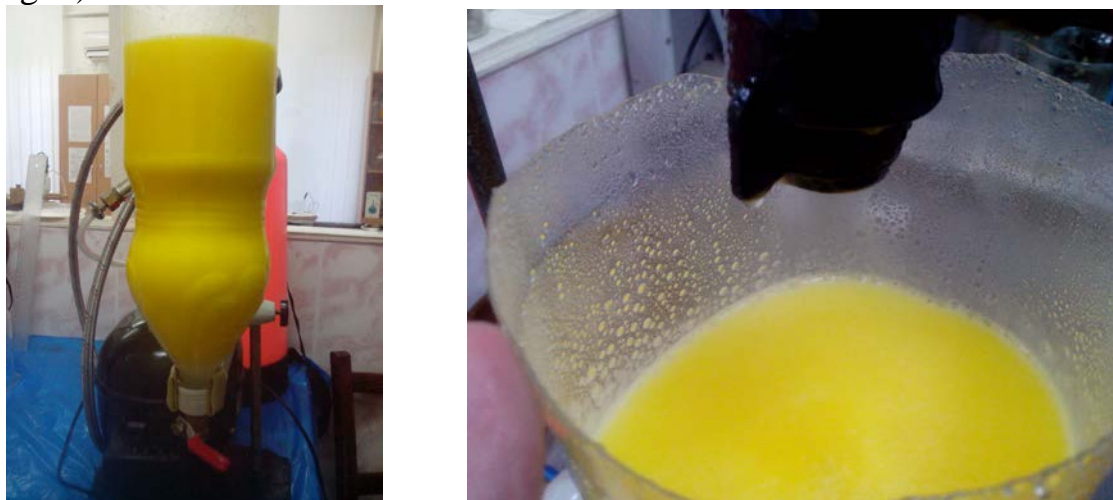


Fig. 1. Research spray washing biodiesel: 1 - a mix of biodiesel with water; 2 - water spraying process over a layer of biodiesel

Over time, biodiesel bundle was observed, and water (Fig. 2). The intensity of the bundle increased vibration bottle PET walls.



Fig. 2. The process of separation with spray washing of biodiesel: 1 - the beginning; 2 – end

Excess water is drained through the valve in the cap of the bottle. The pressure was maintained in the range of 1-2 bar. Three types of baffles used: DC-CER-31 with one hole, DC-CER-33 with two holes 56 and the DC-to-CER four holes.

The time of the experiment was 5 hours. The selection of biodiesel samples to defined-tion of its alkalinity was carried out every hour.

Dynamics of changes in the alkalinity of biodiesel with spray washing is induced in Fig. 3, from which it is seen that during the first two hours of flushing alkalinity biodiesel is significantly reduced, but then some of its growth is observed



at the next rinsing for 1-2 hours. Subsequently alkalinity biodiesel gradually decreases.

The resulting biodiesel alkalinity is reduced by about a factor of 2, and the tendency to reduce it for a longer washing time.

When atomizing washing (energizer DC-31) resulting alkalinity of biodiesel only close to the standard value of 5 mg/kg, whereas in srednekapelnom (energizer DC-33) and globular (energizer DC-56) for the fifth hour reaches 3.5-4 mg/kg under the same initial values, which corresponds to the theoretical calculations presented in [2].

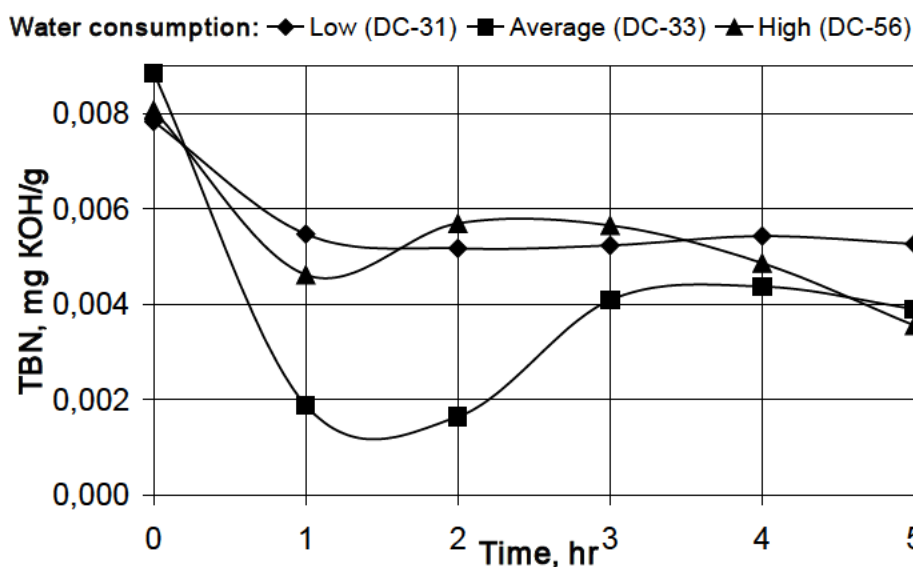


Fig. 3. Dynamics of changes in the alkalinity of biodiesel in time with the spray wash

Summary and Conclusions

To achieve the desired performance of its biodiesel quality spray washing should be carried out by medium and coarse spray of water droplets. washing time should be more than 5 hours.

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**J11610-025**

Filatov P.S., Pivovarov S.A., Burlak I.I., Polezhaev A.S.
SAFE OPERATION OF OVERHEAD TRANSMISSION LINES WITH
VOLTAGE 110 KV

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Abstract. The paper considers aspects of electrical workers in the operation of overhead lines with voltage 110 kV power supply systems of district of electric networks in phase repairs.

Key words: electrical safety, employee, maintenance, network, repair, overhead line, grounding.

Operation responsible consumers of electrical networks (ES) 110kv voltage depends on the timely repair air lines (VL). When operating the VL are changing and affecting factors of electric current, which are deadly for the employee. In accordance with the normative and technical documentation (NTD) for performing basic repair VL cannot stop power supply important consumers, because the execution of organizational and technical activities involves a number of difficulties, such as those related to compliance with regulations and security measures [1-8].

During operation without disabling the VL for elimination of detected faults apply phased method of repair of electrical installations. During the repair of one phase turn off, observing the necessary rules, while the two remaining below voltage phase continue to supply electricity to responsible consumers. [9-15].

At performance of works on VL disconnecting all three phases, producing only one repair faulty phase, which reduces the reliability of electricity supply important consumers. At the time phased repair personnel is in high-risk environments, and the probability that workers of an electric shock is increased due to:

- on a disconnected wire dangerous potential, induced in this phase as a result of electrostatic and electromagnetic influences other phases wires;
- small distances between the wire and the disconnected under voltage the other two wires;
- possible electrical arcing, which causes capacitive current when applying and removing temporary grounding wire repaired.

These causes and define rules for phased renovation and determine compliance with organizational and technical activities that create all the conditions for a safe and highly effective work of repair personnel. On NTD basic technical exercise is to reduce capacity to secure value for the employee performing the troubleshooting for the VL. Reducing hazardous potential is carried out on a disconnected wire VL locally grown works portable grounding, which set a particular way.

When operating the VL important correctly to define the length of the line, where workers are not at risk of electric shock from an invalid value touch voltage to a disconnected wire. Staff undertaking the repair of VL should comply with safety distances to motives under voltage. The imposition and removal of portable grounding with a disconnected line section perform special dugogasâsim device,



namely, post-gasitelem. All phase repair VL exercise Brigade workers under constant supervision and control from the individual producer works.

In accordance with NTD comply with the special conditions of repair works and analyze the electromagnetic phenomena that occur on the disconnected wire VL, as well as perform technical activities, which provides security personnel during the repair.

When operating on a disconnected wire is a dangerous electrostatic potential, as a disconnected wire in electrostatic field is VL, remaining under voltage.

When touching the repaired the disconnected wire under electrostatic potential worker ES exposes a possible fatal shock where hazard defeat depends on the value of the electrical current passing through the human body and touch voltage:

If the value of resistance of the worker's body is small, for example, 1000Om, and the length of the VL 100 km less than the touch voltage would be dangerous, because the wire, though disconnected from both sides, but is susceptible to electrostatic influence two wires under voltage.

Thus, employees serving the OTL should know a list of lines that are after you disable under dangerous voltage induced, which shows the values of induced voltages on disconnected wires VL, as well as on the wires with different schemas grounding VL fixed grounding (earthing disconnectors, earthing knives) in the switchgear of a particular transformer substation of district power network.

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DETERMINING THE INTENSITY OF THE PROCESS OF DESTRUCTION OF SOIL LOOSENING RODS MERCATORHALLE EQUIPMENT*The Yuri Gagarin State Technical University of Saratov**Saratov, 77 Politechnicheskaya street, 410054*

Abstract. *This article discusses the process of force action loosening elements Mercatorhalle equipment on frozen ground. This equipment is composed of a screw working bodies, which perform the pulling function and carry out a dive loosening of elements realizing the destruction. This paper presents an analytical dependence of the resistance of soil to degradation from the geometric parameters of loosening elements and graphical dependence of the torque value on the geometric parameters of the screw tip forces and external loads*

Keywords: *constrained conditions, frozen ground, Mercatorhalle equipment, screw tip, loosening the rod, the energy intensity of destruction, torque.*

For excavation works during the winter period, when cramped conditions of the construction get the greatest use jackhammers due to the lack of other advanced machines capable of competing with them. But they have significant drawbacks, such as perception, operator shock – vibration and high noise level, which leads to occupational diseases. Also the negative impact of shock and vibration loads and provides for the work to be performed, in case of emergency, such as opening emergency pipeline vibration is not highly desirable, since these loads can lead to complication of the situation.

This problem will solve new Mercatorhalle the tool described in [1,2,3] engaged in unstressed destruction of the soil (Fig.1.a).

A dynamic impact on the developed environment is provided by loosening the rods by means of a static implementation, which is screw tips. Screw bits perform the pulling function, developing considerable efforts on the introduction of loosening rods at a low power actuator. Such equipment operates as follows. To rods with screw lugs mounted in operating position, is applied initial axial force, and torque, they screwed into the ground. At a certain depth of screwing in of the screw blade occurs the driving force, which is working on the introduction of loosening of the rods, as they dip due to the increase of the cross section of rods experiencing the stress of separation of the soil, leading to its destruction (Fig.1.b).

The main parameters that determine the efficiency of the twin screw Mercatorhalle equipment, are the amount of shearing of the soil and the intensity of the process of destruction. The amount of shearing of the soil depends on the geometric parameters of loosening of the rods, the distance between these rods and the distance from the wall of slaughter [5].

For the functional operation of the equipment you need to meet the conditions under which screw ferrules, savienibas in the ground, provide the ability to dive to a loosening of the rods before reaching the critical depth at which will occur the destruction of the soil element.

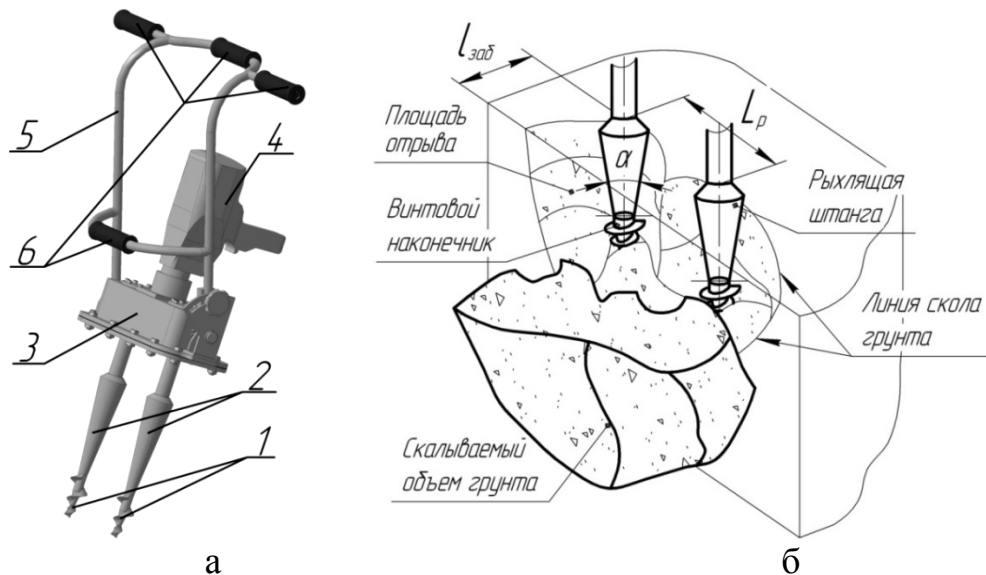


Fig.1. a - manual Mercatorhalle tool; b – scheme of soil destruction in the direction of the face: 1 - screw ferrules, 2 - loosening the rod, 3-housing, 4-drive, 5-frame, 6 – handle.

This condition is ensured by the power balance between the tractive ability of the screw tip and the forces of resistance to the introduction of data bits and the forces of the external load applied to the screw lugs from impact forces resistance to soil destruction in the implementation loosening rods.

The condition of power balance between work items Mercatorhalle equipment is determined by the following relationship [4]:

$$P_{\text{мтз}} \geq \sum P_i + W \quad (1)$$

where: $P_{\text{мтз}}$ – the traction ability of the screw tip;

$\sum P_i$ – the forces of the external load caused by the resistance of soil to degradation from exposure to loosening rods $F_{\text{ш}}$;

W – the sum of the forces of resistance of the soil to the introduction of elements of screw tip;

Power external loads applied to the screw lugs W , correspond to the forces of resistance of a soil to destruction $F_{\text{ш}}$ and are determined by the dependence (Fig.2.):

$$W = F_{\text{ш}} = F_{\text{см}} + F_{\text{тр}} + F_{\text{отп}} \quad (2)$$

where: $F_{\text{ш}}$ – the resistance of soil to degradation from exposure to loosening rods; $F_{\text{см}}$ – the resistance of a soil to compaction loosening rods; $F_{\text{тр}}$ – the resistance force of the soil friction on the surface of the loosening rods; $F_{\text{отп}}$ – the resistance of soil to detachment of the soil element at the open side wall of the face from the effects of loosening rods.

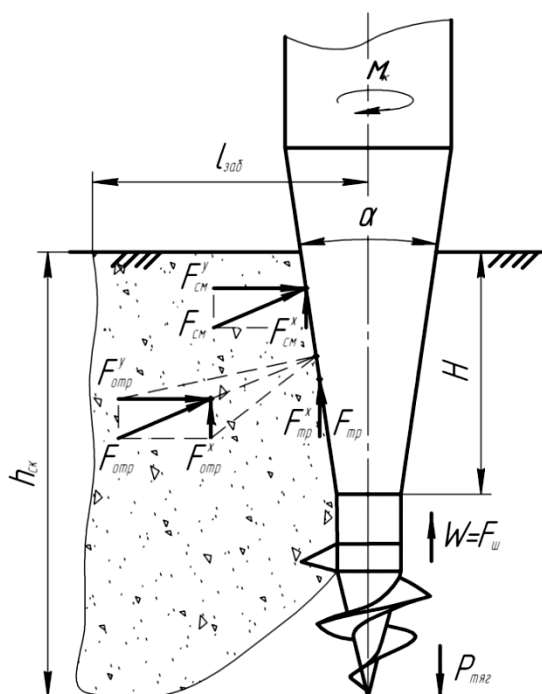


Fig.2. A diagram of the power impact loosening the rod on the excavated soil.

On the basis of the conducted analytical research identified a composite resistance force of soil destruction F_{CM} , F_{MP} , F_{OMP} on the angle of taper loosening the rod, then the dependence (2) takes the form:

$$\begin{aligned}
 W = F_u = & \left[P_o \cdot \left(\frac{\sin \frac{\alpha}{2}}{\cos \varphi} \right)^\mu \cdot \frac{(r_2 - r_1)^2 \cdot \left(2 \cdot \pi^2 \cdot \frac{(r_2 - r_1)}{\tan \frac{\alpha}{2}} \right)^\mu}{(3 + \mu) \cdot \sin \frac{\alpha}{2}} \cdot \cos \frac{\alpha}{2} \right] + \\
 & + \left[\tau_{np} \cdot 2 \right. \\
 & \cdot \sqrt{p \cdot \left(p - \frac{l_{3a\delta}}{\sin \gamma_e} \right) \cdot \left[p - \sqrt{\left(\frac{l_{3a\delta}}{\sin \gamma_e} \right)^2 + h_{ek}^2} - \left(2 \cdot \frac{l_{3a\delta}}{\sin \gamma_e} \cdot h_{ek} \cdot \cos \delta_e \right) \right] \cdot (p - h_{ek}) \cdot \cos \frac{\alpha}{2}} \right] + \\
 & + \left[P_o \cdot \left(\frac{\sin \frac{\alpha}{2}}{\cos \varphi} \right)^\mu \cdot \frac{(r_2 - r_1)^2 \cdot \left(2 \cdot \pi^2 \cdot \frac{(r_2 - r_1)}{\tan \frac{\alpha}{2}} \right)^\mu}{(3 + \mu) \cdot \sin \frac{\alpha}{2}} \cdot \operatorname{tg} \varphi \cdot \cos \frac{\alpha}{2} \right]
 \end{aligned}$$

the resistivity of the soil indentations;

де:

is the parameter characterizing the increase in the resistance of a soil to compaction with increasing strain;



- the angle of taper of the envelope surface of a truncated cone;
- the angle of friction of soil on the material of the working body;
- the limiting value of soil strength at break;
- pauperised;
- the distance from the open wall of the mine;
- the angle of cleavage;
- the depth of the chip;
- the value of the radius of the cylindrical portion of the screw tip;
- the value of the radius of the upper base loosening the rod.

Figure 3 presents the dependence of the distribution of forces of resistance to degradation from soil angle of taper loosening the rod. Analyzing this dependence we can say that increasing the angle of taper leads to a reduction of the force of resistance of a soil to compaction F_{cm} forces and resistance of the soil friction on the working surface of the rod F_{mp} .

Significant role in the process of destruction of the frozen soil resistance force plays frozen soil separation, as shown, this force is constant and does not depend on the angle of taper loosening the rod. The resistance of the isolation depends on the width of the loosening elements, the limit values of tensile frozen soil rupture τ_{np} , and surface area of separation, in our case the area of separation is characterized by the distance of the working bodies to the open bottom wall of the l_{3ab} , the distance between loosening rods, as well as the depth of the cleavage.

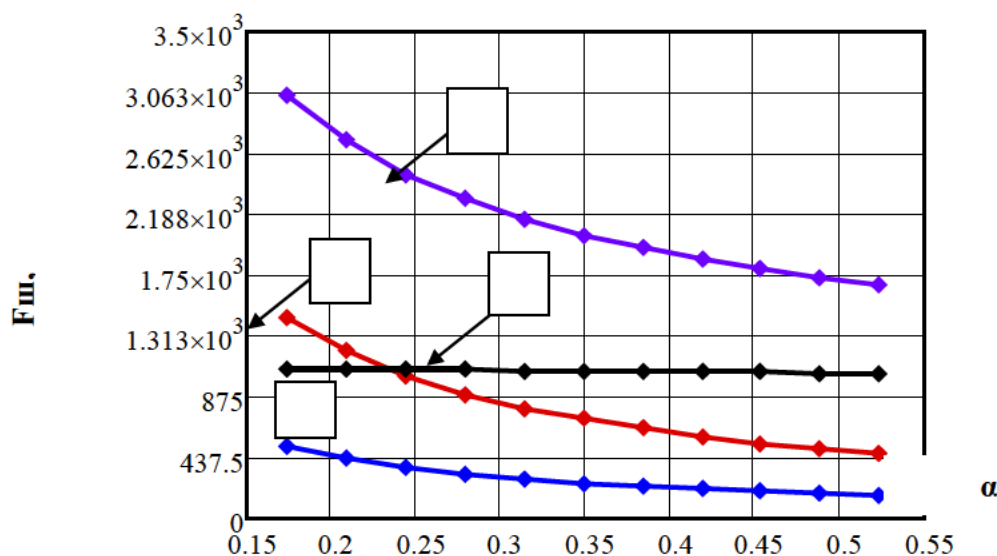


Fig.3. The dependence of the change forces the various processes occurring during the introduction of loosening one rod in the ground on the angle of inclination of rod $\alpha = 10 \dots 30^\circ$: 1 - total value of resistance forces, the introduction of rod F_{m1} ,
2 - Power resistance of a soil to compaction F_{cm} , 3 - is the resistance of soil to



detachment F_{omp} , 4 is the resistance of soil friction F_{mp} , with

$$P_0 = 40 \cdot 10^5 \text{Па}, \tau_{np} = 1 \cdot 10^5 \text{Па}, \varphi = 20^\circ.$$

The main factor determining the intensity of the process of implementation of the working bodies in the ground, with the subsequent destruction of the soil mass is torque introduction of screw bits, [4, 5] under the action of external loads caused by the resistance of a soil to razrusheniyu.

The main parameters that affect the magnitude of the torque is the diameter of the upper helical blade D_s , the number of turns and the strength of the external load.

Figure 4 shows the dependences of change of torque values of the screw tip under the action of external load and without it, also traction $P_{m\pi z}$ from the upper radius of the helical blade.

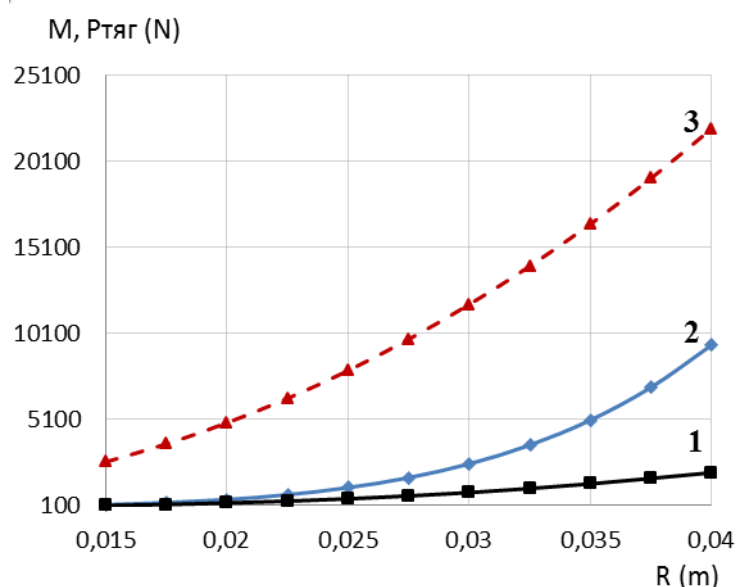


Fig.4. A graph of the influence of the radius of the top of the screw blade R_s on the amount of torque M_x and traction $P_{m\pi z}$; 1 – the dependence of torque without the influence of external forces M_1 ; 2 – the dependence of torque under the influence of external loads, M_2 ; 3 – maximum traction force developed by the screw tip $P_{m\pi z}$.

Analyzing the data dependence (Fig.4.) we can say that increasing the radius of the upper helical blade R_s leads to a significant increase in torque and tractive capability of the screw tip. The magnitude of the external load acting on the screw tip, due to the stock traction $P_{m\pi z}$ implemented in the power of resistance to the introduction of loosening rod F_{uu} dependent on the geometric parameters of the rod itself. That is, the graph shows the dependence of the maximum torque from the application of the external load of the entire inventory tractive capability of the screw tip.



When choosing the geometric parameters of the screw tip must proceed from the drive power operating equipment. On the basis of recommendations [3] the diameter of the helical blade for manual tool you can take $D_s = 35 \dots 50$, according to the schedule (Fig.2.) there is an increase in torque in the interval: M_1 - torque screw tip without the action of external forces is increased 2.9-fold; M_2 - torque under the action of external forces is increased by 4.3 times this is due to the increased traction, while its full implementation.

Proceeding from above stated, with respect to the minimum energy intensity of the process of soil destruction, loosening elements Mercatorhalle equipment and the least torque the most efficient angle of taper loosening of the rod is $\alpha = 25 \dots 30^\circ$.

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J11610-027

Kolesnikov A.Y.

EXPERIMENTAL STUDY OF THE EFFECT OF THE ANGLE OF INCLINATION OF THE UPPER GENERATRIX OF THE SURFACE OF THE HELICAL BLADE ON THE BEARING CAPACITY OF THE HELICAL ANCHOR DEVICE

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Abstract. In this article the question of the influence of geometrical parameters on the value of bearing capacity. Experimental investigation aimed at studying the influence of the angle of inclination of the upper generatrix of the surface of the support element and the helical blade on the value of bearing capacity.

Key words. Helical anchor, helical blade, the angle of inclination of the upper forming surface, soil environment, soil form, geometrical parameters.

At the Department of construction and road machines" of Saratov state technical University named after Gagarin propose a new design of screw anchor device for the temporary fixing of construction machinery to the ground. Feature of the new anchor is a high bearing capacity, at relatively small size of the screw blade. [1]

To determine the effectiveness of the proposed design of screw anchoring devices were experimental studies, whose task was to identify the influence of the angle of inclination of the upper generatrix of the surface of the helical blade on the value of bearing capacity.

These experimental studies were carried out in laboratory conditions on a specialized stand, equipped with a control-measuring apparatus (Fig.1).

Design laboratory bench allowed them to control the change of the resistance force to move the model anchor device in a soil medium throughout the experiment.



Figure 1. Laboratory experimental equipment

As the medium of interaction with the anchor device model was chosen loamy soil, artificially prepared in the laboratory [2].



As samples were used models of anchor devices, which is a rod made from a metal rod on the end of which was located supporting element (Fig.2). The dimensions of the test sample and the dimensions of the shape selected in accordance with the methodology of modeling the interaction with the environment of the working bodies of building and road machines, proposed by V. I. Balovnev [3].

This design model anchor device was chosen in order to exclude the influence of other geometrical parameters of screw anchor (pitch of arrangement of the blades, the angle of elevation helix, etc.) on the purity of the experiment.

In this case, the variable parameter was the angle of the top surface of the support element, which was 30, 45, 60 and 90 degrees to the rod axis.

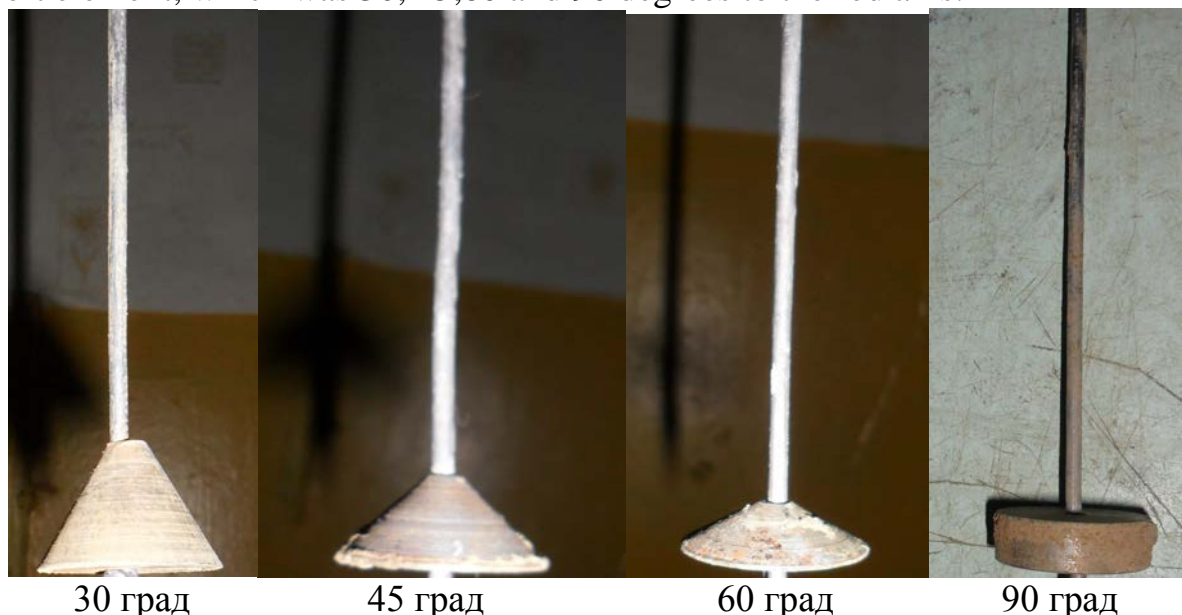


Figure 2. The model of anchor devices.

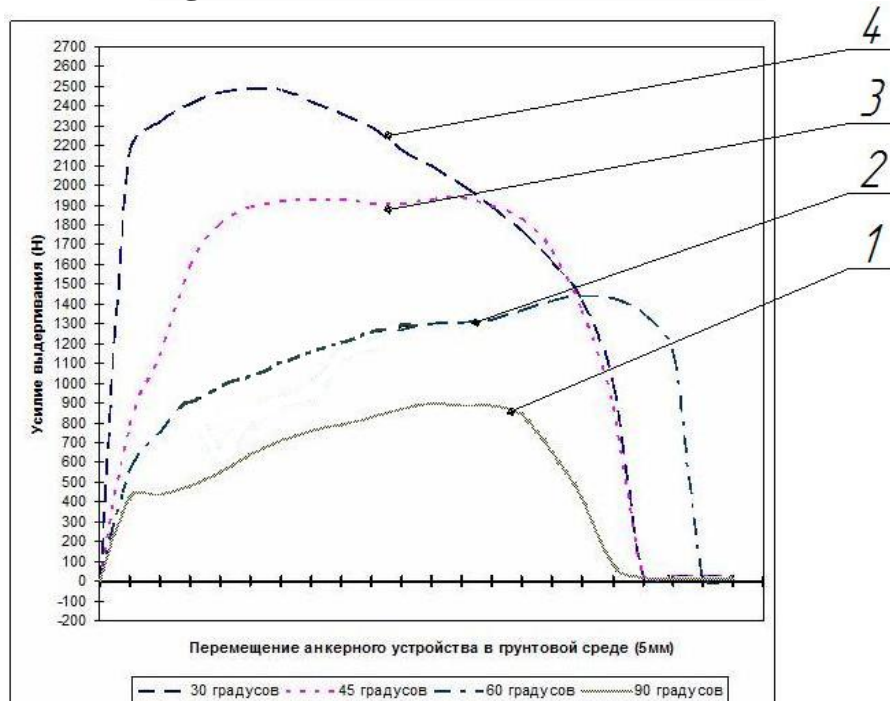


Figure 3. A graph of the resistance value of the axial movement of the anchor models of devices in a soil medium, under the pulling action of external loads.

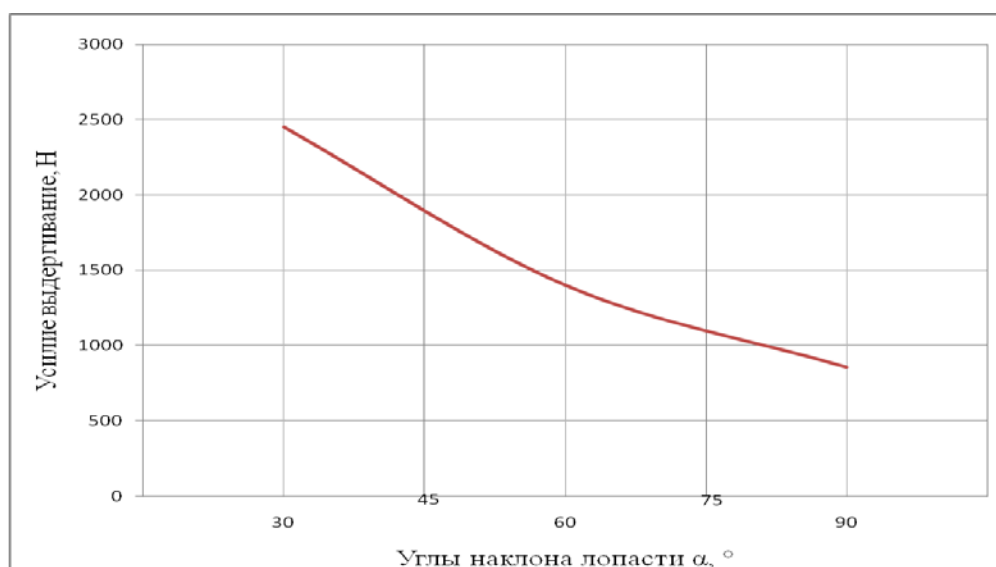


Figure 4. A graph of the efforts of pulling out from the angle of the blade anchor device.

Methodology of experimental research were as follows: in ground form established models of screw anchoring devices, then forms with models in turn were mounted on a laboratory bench where he had been pulling models anchor device from dirt forms, the magnitude of the resistance force to move the model in a soil medium were recorded from the initial moment of application of the load to full varova.

Obtained during the experiments the results were processed using dispersion analysis [4] and presented in graphs in figures 3 and 4.

In General the results of experimental studies have pointed to the increasing magnitude of the axial movement of the anchor device model in a soil environment, with a decrease in the angle of inclination of the upper generatrix of the surface of the support element.

Considering the nature of the curves presented in the chart (Fig. 3), we can note that the model anchor device with an angle of inclination of the support element 30 deg is a dramatic increase in efforts from the starting of application of the axial load. The maximum value of R is achieved when the axial displacement of 5 mm. Upon further movement of the force begins to decrease smoothly from 2500 N to 1400 N, then there is a complete pull-out models from the ground.

The model anchor device forming surface of the support element which is formed at an angle of 45 degrees relative to the axis, there is a sharp increase of the force P when moving to 15mm. which is 1900 N. Upon further axial movement of from 15 to 60 mm. the force shall be maintained, and after a complete pull-out model of the anchor from the ground.

When the angle of inclination of 60 degrees, the maximum value of R is achieved when the model moves along its axis at 75mm, and is 1400 N. With further movement has been a sharp decline of axial force and full pull-out models from the ground.

At an angle of 90 P value at the beginning of the movement was 400N, then with further movement of the anchor along the axis 60 mm, the magnitude of the force of resistance to movement of the anchoring device in a soil medium, under the



action of external pulling the load P has peaked and reached N . After that, there was a sharp reduction efforts and there was a full pull-out model of the soil.

Thus, in experimental studies it was found that the greatest amount of resistance to the axial movement is a model of the anchor device, the angle of inclination of the upper generatrix of the surface of which is 30° . The lowest value of the axial displacement was observed in the anchoring device, forming the upper surface of the support element which is made at right angles to the rod axis. Thus, the bearing capacity of the anchor with the angle of inclination of 30° , 2.5 times higher than the model that forms the surface of the support element which is made at right angles to the rod axis.

To confirm the results obtained on screw anchoring devices was held the second stage of experimental studies by the same method as in the first stage, only in the quality of the samples used specially manufactured models of screw anchors (Fig. 5).

The diameter of the helical blade of experimental models of screw anchors correspond to the diameter of the support element models of the anchor device in the first stage of experimental research. The height of the upper forming surfaces of the screw blades, relative to the trunk were selected in accordance with the maximum and minimum values of the bearing capacity obtained in the first stage of the experiments.

During this stage of the research it was found that the maximum value of the bearing capacity of the anchor IN, the tilt angle is achieved, and the minimum value of the bearing capacity N observed in anchor with the angle of inclination of the upper surface of the blade.



$\alpha = 90^\circ$

$\alpha = 30^\circ$

Figure 5. Models of screw anchors.



Comparative analysis of the bearing capacity values obtained during the first and second stage of the research showed that the discrepancy between the results does not exceed 9%.

Thus it can be noted that when the angle of inclination of the upper generatrix of the surface of the helical blade 30 degrees relative to the axis of the stem of the anchor, the load capacity is 2.7 times higher compared to anchor the device at a right angle to the top surface of the screw blade which is 90 degrees.

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J11610-028

УДК 624.139:624.132

Martyuchenko I.G., Ivanov S.V.

TO THE QUESTION OF INTERACTION LOOSENING OF ELEMENTS OF DIFFERENT SHAPES WITH FROZEN SOIL

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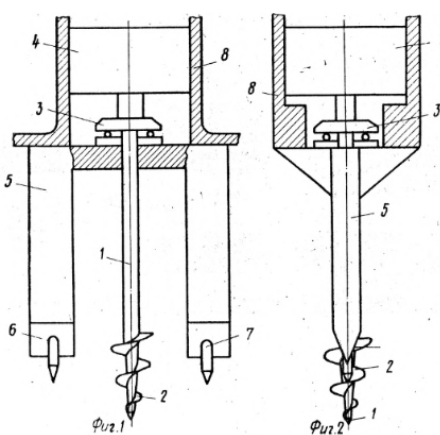
Abstract. This article discusses physical picture of the destruction of the frozen soil from the impact of loosening working bodies having different geometric parameters and the shape. Also presents a graphical dependence of the resistance of soil to degradation from geometrical parameters loosening working bodies, as well as the dependence of the change of the torque value from the use of different loosening elements.

Keywords: frozen ground, screw tip, loosening elements, torque.

Currently there is a considerable diversity of methods and means of mechanization for development of frozen soils, but not resolved the question remains the production of low-volume winter excavation in the cramped conditions of construction, this leads to the fact that up to 30% of the work is done manually, because the cramped conditions severely limit the application of existing machines. [1,2].

Priority direction of development of special Mercatorhalle equipment is to use it in a spiral bits perform the traction function. Traction screw the lugs in turn, carry out the dip loosening of elements that implement the process of soil destruction. This equipment (Fig.1.) performs mechanical destruction without the use of dynamic loads and implements less energy-intensive type of avulsion fracture from the array or spading the soil to the side of the face.

Based on the analysis of existing designs, Mercatorhalle equipment [A. S. 205766; A. S. 901413; A. S. 706500; A. S. 238425; A. S. 581208; A. S. 589345; A. S. 723057; A. S. 825804 (Fig.1.b); a Patent. 1461836; A. S. 883275 (Fig.1.a)] engaged in unstressed destruction of the soil, were the main drawbacks such as large energy consumption of the process of implementation of the working bodies and the perception by the operator of the reactive torque. [1]



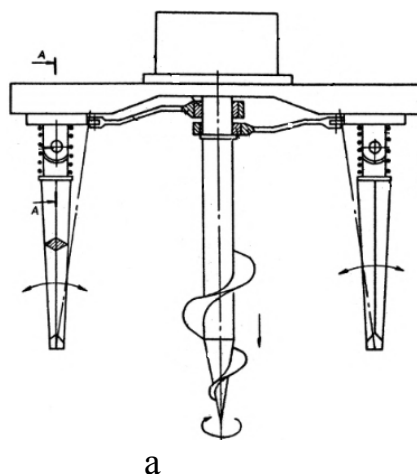


Fig.1. Design Vitalyevich of Mercatorhalle

To address deficiencies in equipment [3] proposed the SDM Department of Saratov state technical University named after Gagarin Yu. a. use two screw tip, and instead of loosening of the wedges are applied loosening rod tapered (Fig.2.). Such embodiment of the working bodies is to ensure that the impact on the operator of the reactive torque, to reduce the energy intensity of the process of destruction, because the workflow involves two rotors instead of three.

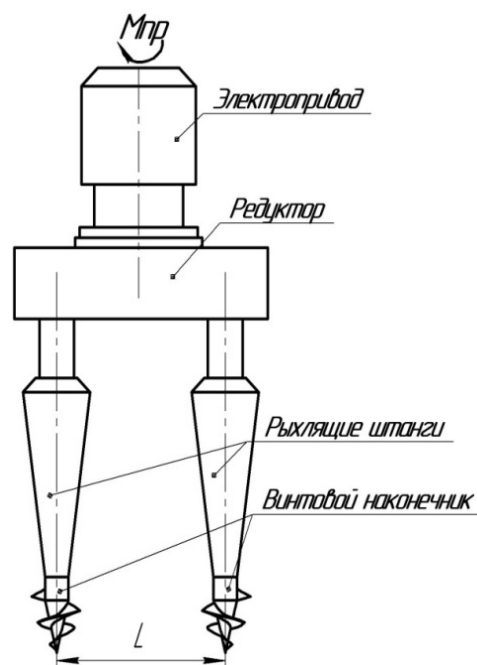
Fig.2. Mercatorhalle tool

When the equipment is operated on frozen ground, there is a considerable torque that makes use of a more powerful drive, therefore increasing the overall dimensions and weight of equipment. The reduction of torque can be produced through the use of several screw bits smaller size instead of one while also keeping traction. D. A. Lozovik the proposed equation to determine the torque based on the diameter of the upper helical blade D being in a power law. In accordance with this by putting a condition that several screw bits with smaller sizes and diameters equal to one tip $(n \cdot d) = D$ have the same traction, then the dependence for determining the torque will be:

$$M_x = P_0(K_1 + K_2 \cdot f) \cdot n \cdot \left(\frac{D}{\sqrt[n]{n}} \right)^{\mu+3} \quad (1)$$

where: n – number of screw working bodies.

This dependence allows to determine the effectiveness of using several screw bits in Mercatorhalle equipment (Fig.3.).



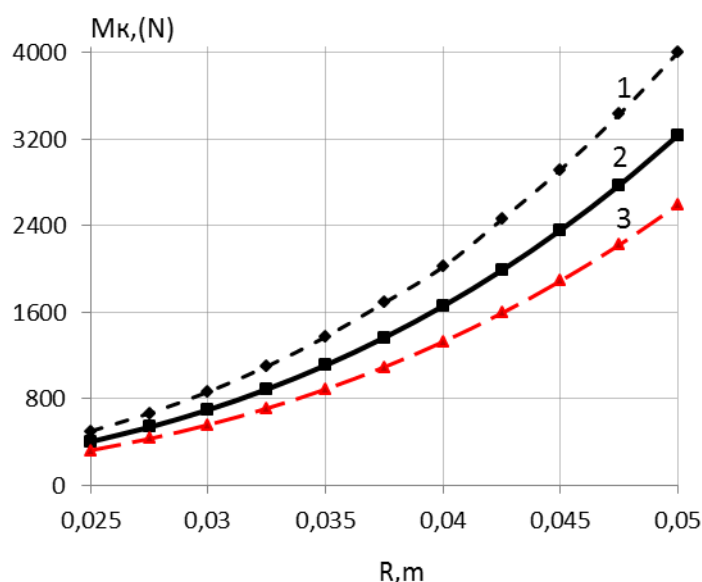


Fig.3. A graph of changes in the magnitude of torque M_k from the upper radius of the helical blade R with different number of screw tips and the same pulling power P_{max} ; 1 – single screw tip; 2 – two screw tip; 3 – three screw tip;

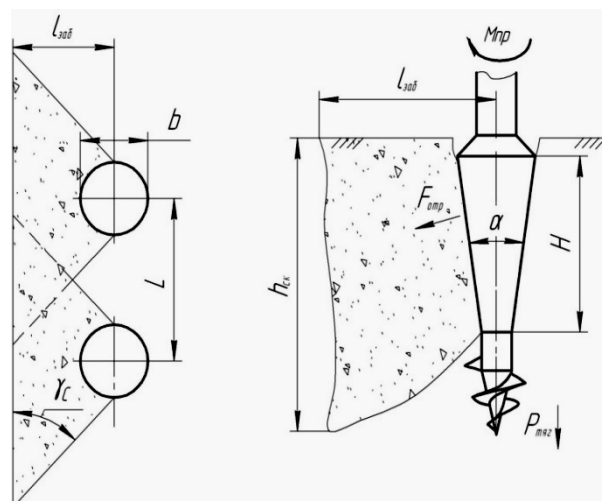
Analyzing dependencies (Fig.3.) we can say that the use of multiple screw bits smaller than one, reduces torque, when using two arrowheads in 1.3 times, using three screw lugs 1.54 times, while maintaining traction.

Basic workflow manual Mercatorhalle equipment aimed at the destruction of frozen soil is a major cleavage in the direction of the open wall of slaughter.

Significant role in the destruction of the soil plays the distance from the wall of slaughter to loosening of the elements, since with the increase in distance increases the area of separation, which affects the resistance of a soil to detachment, and there comes a time when the soil element does not splinter in the side of the face. This is because the resistance force of the soil of the gap exceeds a wedging force is created by loosening elements. On the recommendations of D. A. Lozovoga and A. I. Kuzaeva, M. A. Gurina, I.V. Pryazhinskina, A. N. Zelenina effective working distance of the body from the edge of slaughtering should be equal to 2-2.5 widths loosening the working body.

The destruction of the soil caused by the occurrence of fractures, the distribution of which determines the dimensions of the shearing of the soil element, characterized by the angles γ^c formed by the direction of the cracks in the side face, the distance to the wall of slaughter $l_{\text{заб}}$ and depth of cleavage $h_{\text{ск}}$ (Fig.4.). [2]

Fig.4. Scheme of soil destruction
In studies conducted by D. A.





Lozovim in the study of the physical picture of the process of soil destruction of various types of loads created wedge working bodies falling hammered and implemented statically type it is noted that the process of soil destruction by various efforts largely similar. Also provides a comparison of the physical picture of the destruction of various materials (paraffin, special composition, frozen soil, frozen ground) when using the working bodies of different shapes (cone, wedge, three and four-sided pyramid), these experiments indicate that the nature of the destruction is almost identical. The same conclusions were reached by other researchers A. I. Kuzyaev, A. N. Zelenin, Y. M. Trushin, V. V. Surikov, etc.

Corners cracks that characterize the cleavage of the soil in the bottom, presented in table 1.6. [2]. As noted by many scholars, on the corner of cleavage, largely influenced by the mechanical properties of frozen soil, usually with an increase in the fragile soil properties the value of the angle decreases. The angle γ° is almost independent of the parameters and type of the active body and the distance from the bottom (tab.1.).

The depth of spalling h_{ex} also largely depends on the properties of frozen soil and the distance from the edge of the pit, the parameters of the working body have no effect on the depth (tab.1.6) [2].

Table 1

The dimensions of the chip when the shape of the operating body and the distance from the edge of his face.

Type of work equipment	Sand $\omega = 17\%$; $t = -10^\circ \text{C}$.					Clay $\omega = 25\%$; $t = -10^\circ \text{C}$			
	l_3, mm	20	30	40	50	20	30	40	50
Dubrosky wedge $2\alpha = 30^\circ$	γ°	$\frac{25}{21}$	$\frac{24}{22}$	$\frac{23}{23}$	$\frac{24}{21}$	$\frac{—}{30}$	$\frac{—}{29}$	$\frac{33}{32}$	$\frac{—}{31}$
	h_{ex} (mm)	$\frac{36}{35}$	$\frac{48}{52}$	$\frac{57}{58}$	$\frac{82}{75}$	$\frac{—}{28}$	$\frac{—}{36}$	$\frac{43}{42}$	$\frac{—}{54}$
Cone	γ°	$\frac{24}{26}$	$\frac{26}{27}$	$\frac{25}{25}$	$\frac{25}{23}$	$\frac{—}{31}$	$\frac{—}{32}$	$\frac{34}{36}$	$\frac{—}{32}$
	h_{ex} (mm)	$\frac{34}{35}$	$\frac{42}{44}$	$\frac{66}{59}$	$\frac{92}{74}$	$\frac{—}{30}$	$\frac{—}{34}$	$\frac{46}{43}$	$\frac{—}{53}$
Triangular pyramid $2\alpha = 15^\circ$	γ°	$\frac{22}{23}$	$\frac{24}{26}$	$\frac{25}{27}$	$\frac{23}{24}$	$\frac{—}{36}$	$\frac{—}{32}$	$\frac{35}{34}$	$\frac{—}{35}$
	h_{ex} (mm)	$\frac{34}{35}$	$\frac{48}{50}$	$\frac{59}{57}$	$\frac{82}{84}$	$\frac{—}{26}$	$\frac{—}{32}$	$\frac{44}{48}$	$\frac{—}{58}$

Mostly geometrical parameters of V-working bodies affect the depth at which the formation of shear fractures H_{mp} , this parameter is the key parameter which determines the intensity of the process of destruction. Along with the geometric parameters on depth is influenced by the distance from the bottom and physico-



mechanical properties of frozen soil. In studies of D. A. Lozovoy it is noted that the depth at which cracks spalling proportional to the distance to the bottom and the maximum depth observed in the implementation of the working body of the cone shape. [2]

After analyzing the existing research we can say that the nature of the occurrence and distribution of fractures in the destruction of the soil working bodies of different geometric shape is almost identical, therefore, the use of equipment in loosening of the elements is also advisable, as is the loosening of the wedges.

Based on our research identified analytical dependence of the resistance forces of soil destruction F_c working bodies having the shape of a cone and a wedge, which allows to compare them from the point of view of energy intensity of the process of destruction of the angle of taper loosening data elements. Figure 5A graphically depicts these results.

Determining a parameter that characterizes the intensity of the process of introduction of the screw lugs from loosening rods, torque is (1) dependent geometric parameters of the screw tip, the forces and external loads due to the resistance of soil destruction (Fig.5.b)

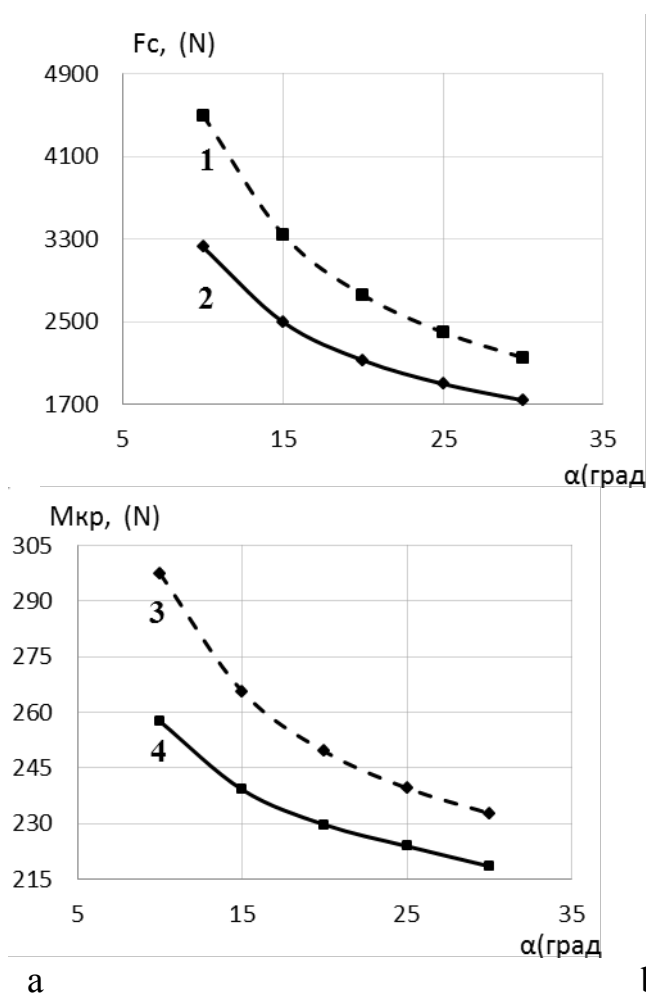


Fig.2. a – graph of changes in the magnitude of the resistance force of soil destruction on the angle of taper loosening of the element; 1- is in the form of a wedge; 2 - in the form of a cone; b is a graph of changes in the magnitude of torque $M_{кр}$



on the angle of taper loosening element with a fixed screw tip diameter $D = 35\text{mm}$; 4

– in the form of a wedge; 5 – in the shape of a cone.

By analyzing the data dependencies can say that the use of the loosening elements tapered in Mercatorhalle equipment will reduce the ground resistance to destruction by 30% and torque by 13% while maintaining the amount of shearing of the soil.

As a result of theoretical studies were identified analytical dependences: determine the effectiveness of using several screw bits; changes of torque forces from external loads acting on the screw tip is caused by the resistance of soil destruction; according to the changes of the resistance forces of soil destruction from the geometric parameters of loosening elements having a different shape. Also the analysis of existing studies of the physical picture of the depravity of different soil working bodies.

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EQUIPMENT FOR MOLDING CONSTRUCTION PRODUCTION

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Abstract. The work substantiates the effectiveness of the use of multiposition equipment with conical punch for molding building products.

Keywords: building products, tiles, equipment for molding building products, conical punch, multi-position equipment

Equipment with conical stamp, commits a spherical movement, is widely used to produce various range of building products: paving, curbs, fences, etc [1]. These products differ in a variety of shapes and sizes. Manufactured products stamp, the linear dimensions of which correspond to the dimensions of the product and, therefore, increase with its size. This leads to an increase in the mass of equipment and energy consumption for the production of products.

In addition, rotation of stamp as the element offset relative to the axis of rotation of the centre of gravity is accompanied by vibrations that create significant dynamic loads on the actuator and forms, and the dynamic effect increases with the increase of the linear parameters of the stamp.

Largely to exclude the listed adverse events allows the use of multilateration equipment, including several concurrent stamps [2].

The benefits of multilateration equipment is demonstrated on the example of molding products in the form of a square tile sizes $L_{изд} \times L_{изд}$.

In the manufacture of products stamped with a linear parameter $L = L_{изд}$ (Fig.1, the drive power is [3])

$$N = 0,019 \frac{qL^3_{изд}\omega}{\eta} \quad (1)$$

where: q - specific contact pressure,

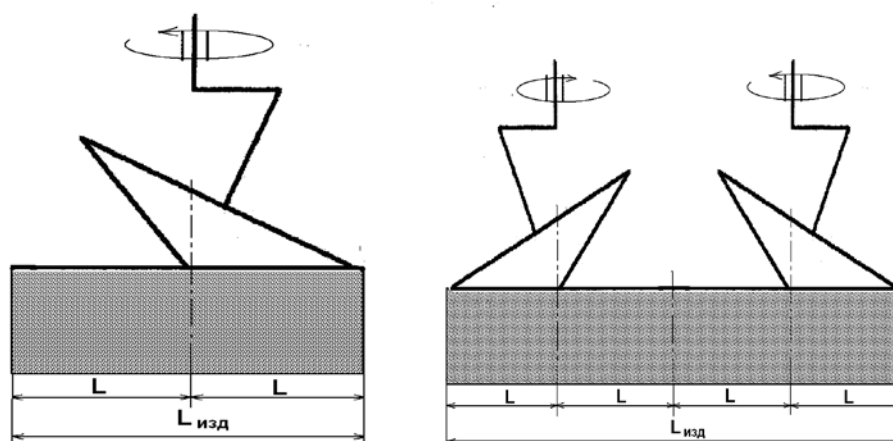
L - the length of the generatrix of the conical surface of the stamp (linear parameter conical stamp),

ω - angular velocity of rotation of the drive shaft,

η - КПД.

In the manufacture of products with multiple stamps (Fig.1,b) with linear parameters $L = L_{изд}/n$ (the number of dies for square section will be n^2) drive power will be:

$$N = 0,0192q \left(\frac{L_{изд}}{n} \right)^3 n^2 \frac{\omega}{\eta} = 0,019 \frac{qL^3_{изд}\omega}{n\eta^n} \quad (2)$$



a)

b)

Fig.1. Molding conical working bodies:

a) single station equipment; b) – multi-position equipment

As can be seen from formulas (1) and (2), the use of several dies and reduction of linear parameters n times reduces the drive power is almost n times (without taking into account the efficiency of the mechanism).

In addition, the reduction of the unbalanced mass of the stamps and the possibility of rotation in different directions can create the effect of damping and reduce the dynamic load on the drive.

However, despite the seeming simplicity of this technical solution there are a number of factors limiting the number of stamps in multi-station equipment.

First, when reducing the linear parameters of the sealing of the working body decreases the depth of the compacted layer. Consequently, the number of stamps and their linear sizes are limited by the thickness of the final product.

Secondly, research shows that when reducing the linear parameters of a stamp increases the number of repetitions of application of the load, thereby increasing the cycle time compaction and decreases the performance of the equipment. Consequently, in conditions when, on the one hand, reduction of the linear parameters of the stamp will reduce the drive power N , on the other hand, performance P , the criterion for determining the optimal number of stamps and their linear parameters should be specific power consumption $N_{y\partial}$

$$N_{y\partial} = \frac{N_{y\partial}}{P} \rightarrow \min \quad (3)$$

Currently, the Saratov state technical University at the Department of Construction and road machines " studies on the determination of parameters of multi-sealing equipment.

Conclusions

1. The use of multilateration of the working body can reduce the drive power of the forming equipment, and the capacity decreases with increase in the number of stamps.

2. The linear decrease of the parameters of a stamp and the increase in the working body is limited by the thickness of the final product.



3. To determine the optimal number of stamps in your body it is necessary to investigate the dependence of the energy intensity of the process of formation of products.

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RELAXATION RESIDUAL STRESSES BY THE ULTRASONIC VIBRATIONS

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Abstract. The paper studies the effectiveness of new techniques of stabilizing the geometrical parameters of bearing rings in comparison with the thermal stabilization. Processing of bearing rings is made on a special machine in a liquid medium where the ultrasonic vibrations are excited. It is shown that roundness of the rings after ultrasonic stabilization is substantially lower than after the heat treatment.

Keywords: ultrasonic treatment, removal of residual stresses, bearing.

Modern industry, in particular automotive, places heavy demands on a long time safety of precision and other performance attributes obtained in the manufacture of bearings.

After the various manufacturing operations of bearings production (grinding, finishing, heat treatment, etc.), as well as inserting on the shaft and during the casting on the rings of plastic rims, in the bearings are formed the residual stresses. Relaxation process of such stresses can cause a continuous deformation of bearing components in operation. Therefore, it is not unusual, when part of purchased bearings are cannot passes through customer's inspection test by reason of axial clearances are overstep the limits of tolerance, noise in operation etc., and the manufacturer receives the reclamations.

One of the main reasons of these bearings in the commodity market is the changing of the geometrical dimensions of the bearing parts after passing through the outgoing inspection of manufacturer as a result of the above-mentioned the residual stresses relaxation. A large body of stress relaxation research suggest that the stress caused by mechanical and thermal effects on the billet, relax not in direct proportion to time, as it's generally agreed. Partially stress is relax in a relative short period of time, such as during the operational life of components, resulting a system in equilibrium state of stress, but having a negative impact on the operational performance of a product as this changes the dimensions of the part. Then there is a deceleration of relaxation in time and total relaxation occurs over a time period greater then separate part's or machine's life, and therefore it is not hazardous in terms of impact on the performances stability of operated products. I.e. residual stresses caused by the temperature or mechanical effects, can be divided into the most unfavorable "fast relaxing" and "slow relaxing" components. Obviously, the accelerated reduction "fast relaxation" components of residual stresses would lead to partial or complete dimensions time-stabilization of manufactured bearings, and rather to improvement of it geometric form as compared with the initial.

EPK Saratov Ltd. (European Bearing Corporation), RME NMP Ltd. (Research



and Manufacturing Enterprise of Nonstandard Machine-Building Products), SSTU (Yuri Gagarin State Technical University of Saratov) explored the different ways of reduction of residual stresses: thermal, cryogenic, mechanical, and ultrasonic. As a result, they chose the ultrasonic method of residual stresses reduction as the most promising. In the studies the ultrasonic vibrations act on billet through a liquid medium and the contact method.

To realize the method of ultrasonic stress relaxation in a liquid medium the specialists of EPK Saratov Ltd., RME NMP Ltd. and SSTU was designed and manufactured the machine USRM-1 (Ultrasonic Stress Reduction Machine). Machine is equipped with technological facilities for the treatment of external bearing rings 2108-1006120-01, 2112-1006135-01, 6-830900AE2.91-01, 6-830900AE1.91-01, 6-830900AKE.91-01.

Rings represent the combined construction consist of the finally treated with prescribed geometric parameters metal part, the external surface of which is welded polyamide rims (Fig. 1). Provided stress action evolved from welding of rims, rings are deformed and lose their initial geometrical parameters. As a result, the bearing in operating gets increased vibration, reducing its durability.

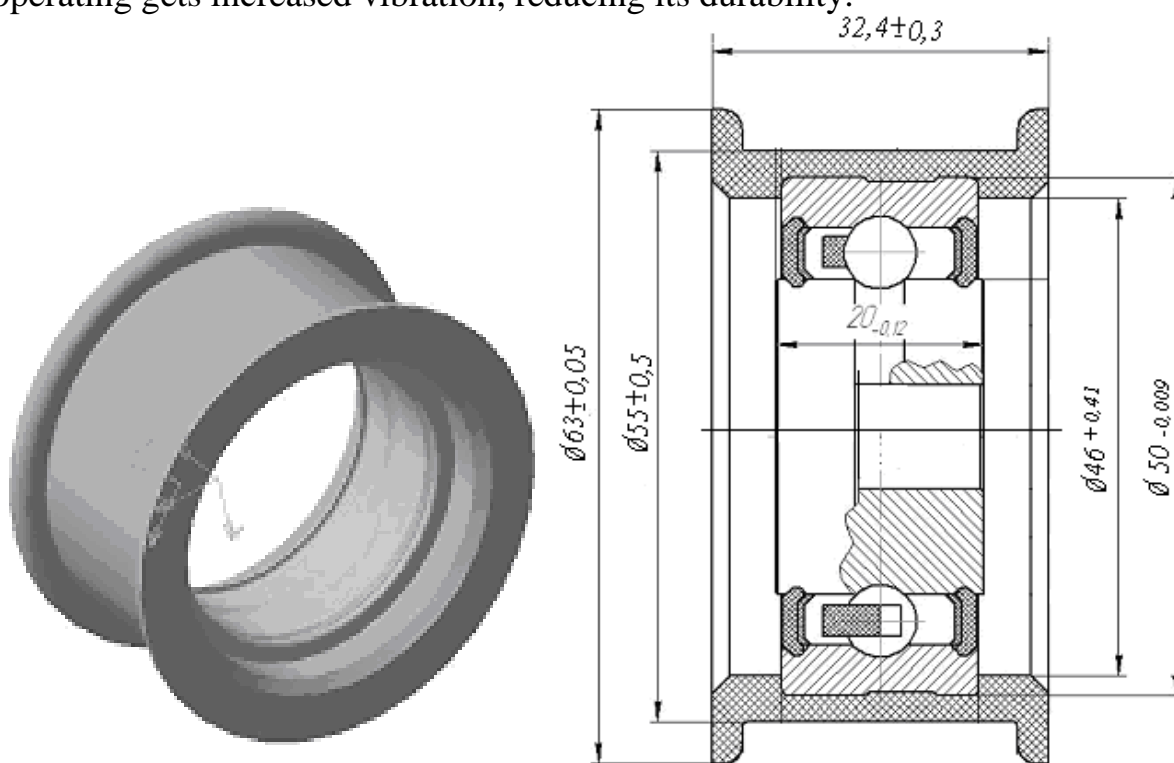


Fig. 1. The external ring of the bearing 2108-1006120-01 with polyamide rims

Specifications of machine USRM-1 shown in Table 1, the kinematics of the machine shown in Fig. 2.

The general principle of operation of machine is:

- Processed rings with polyamide rims roll along two parallel charging sloping chutes 6 under the action of dead weight;
- A pusher 2, connected by the two tractions 5 with the rod of air actuator 4,



reciprocates and lifts the processed rings 1 (two-rings-at-a-time) and moves it to the unloading zone 7 and, after that "pushes" the rings into the two parallel discharging chutes 8;

- When the rings are moving down along the sloping chute, its passing along the radiating converters surface - for each stream is provides the single converter;

- Adjusting the time domains of feed compressed air in pneumatic actuator, provide the residence time of every billet in the ultrasonic processing zone for at least 10 minutes.

Table 1

Primary performance attributes of machine USRM-1

Characteristic	Value
Number of position	1
Processed rings diameter, mm	
max	75
min	60
Processed rings height, mm	
max	35
min	23
Number of simultaneously processed rings	40
Operating frequency of ultrasonic vibrations, kHz	18±7,5%
Operating environment (process liquid)	Tap water with anti-corrosion components
Volume of the operating environment, l	80-90
Temperature of the operating environment, °C	10...100
Total power, kW	7
Productivity (depending on the ring dimensions), rings per hour	120-150
Climatic version	TC, GOST 15150-69
Dimensions of the machine (without ultrasonic generator), length × width × height, mm	2550×530×1700
Dimensions of the generator USG-3/4, length × width × height, mm	500×272×1200

In order to confirm the stabilizing effect of ultrasonic treatment on the rings with casted armamid rims on the USRM-1, were performed next operations [1]:

- Researched the effect of ultrasound on the change in the rim diameter of the rings 2112-1006135-01;

- Researched the effect of ultrasound on deviation from roundness of the rings race 2108-1006120-01;

- Researched the effect of ultrasound on stabilization of the bearing radial clearance 2108-1006120-01, wherein rings with rims processed by ultrasonic vibrations;

- Researched the effect of ultrasound on stabilization of overall vibration level of the bearing 2108-1006120-01.

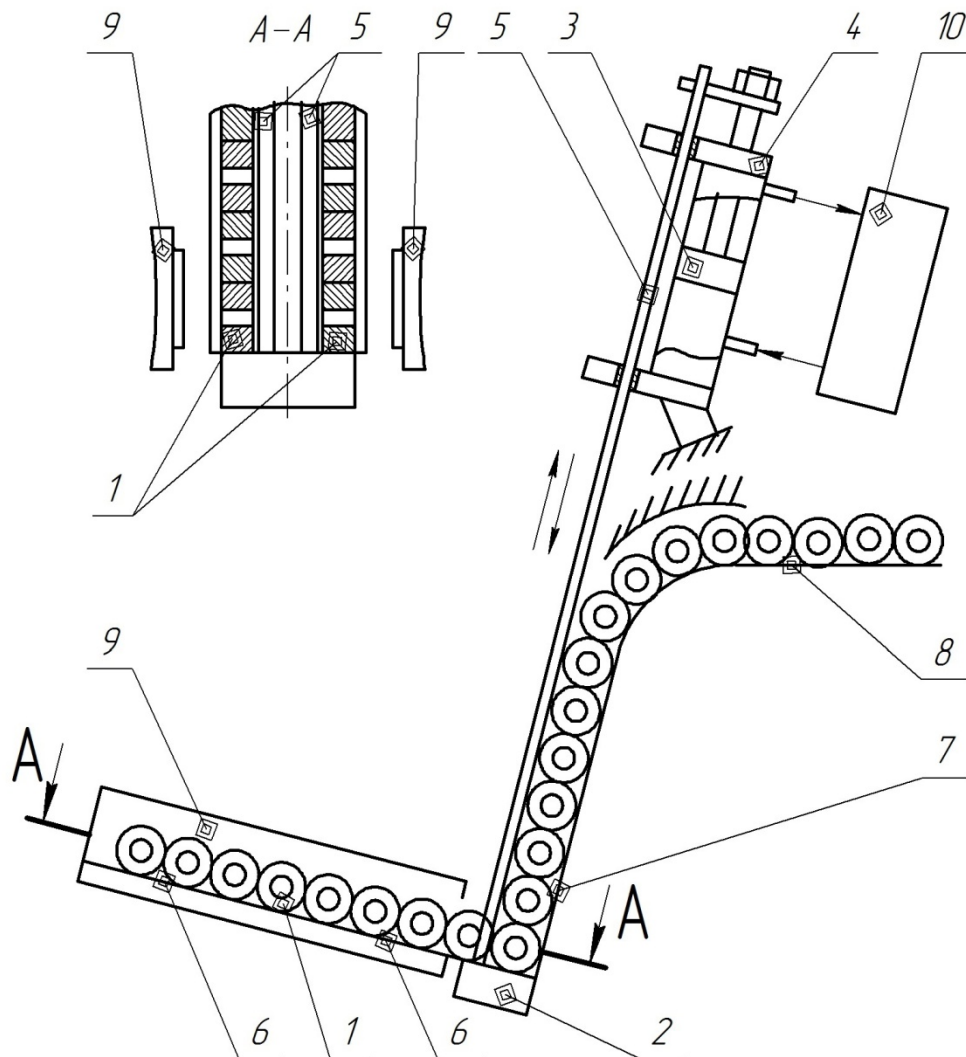


Fig. 2. Kinematic scheme of the machine USRM-1
where 1- processed rings; 2 – pusher (lifter); 3 – piston; 4 – pneumatic
actuator; 5 – traction (2 items); 6 - charging chute; 7 - unloading zone;
8 - discharging chute; 9 – converter.

As an example, Fig. 3 is a graph of average values of the deviations from roundness ring race 2108-1006120-01 before and after of rims filling, and after 14 days relaxation.

As can be seen from Fig. 3, chute diameter deviations of the billets that were processed by sonication, either stabilize or aspire to return to the rings chute deviation before filling. Similar results have been obtained in other researches.

Tests of the residual stresses relaxation method by contact [2, 3] were carried out on rings 206-01B taken after the grinding operation on the outer and inner diameters and pregrinding of the chute.

According to the developed research methodology, as covered factors were taken:

- D_k – outer rings diameter;
- V_k - deviations from chute roundness on the smallest diameter;
- H_m - rigidity of the material.

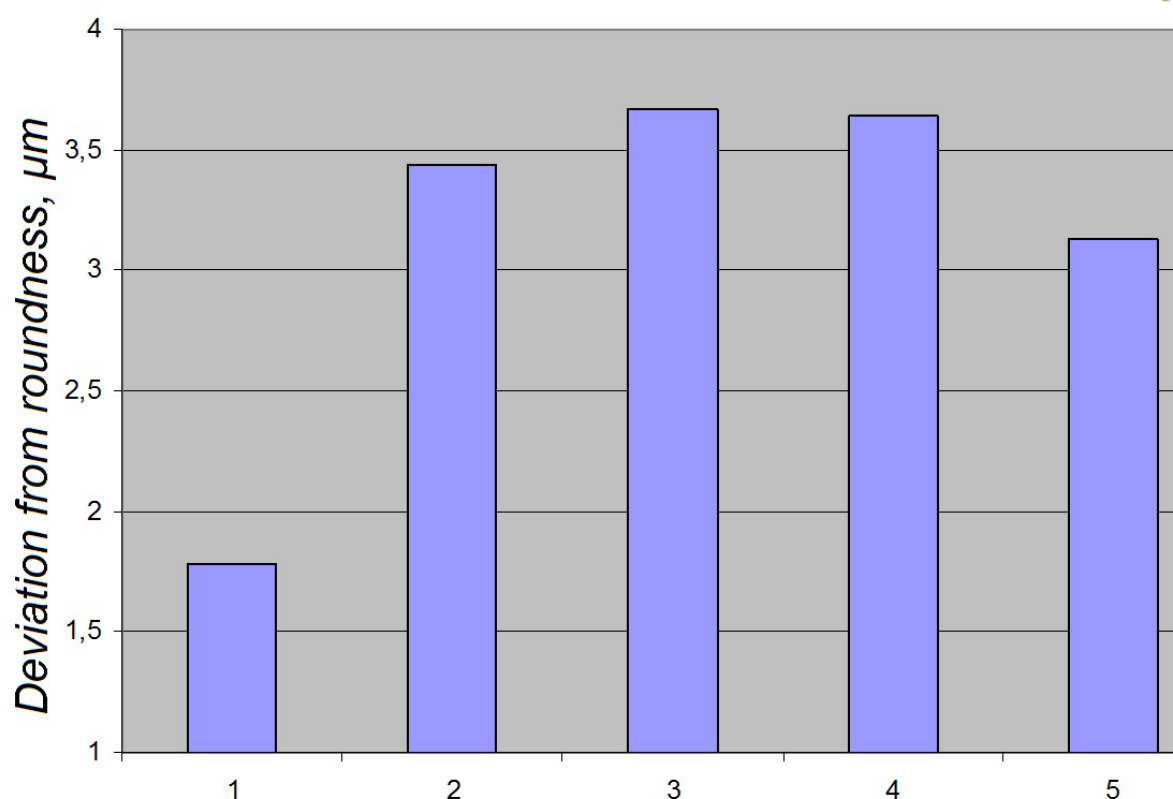


Fig. 3. Average values of the deviations of ring 2108-1006120-01: 1 – before filling of rim; 2 – after filling; 3 – after 14 days of control rings; 4 – after sonication; 5 –14 days after sonication.

Ultrasonic treatment was carried out in the RME NMP Ltd. laboratory on the MEC experimental plant to perfect stabilization technology. In this case, comparing three groups of rings, 1st of which was treated by the base technology of additional tempering (furnace tempering under the temperature of 150 °C for 3 hours), 2nd ring group was treated with rings on the average conditions of sonication, and the 3rd check group was not exposed to any kind of treatment.

To determine the value of residual stresses was accepted next procedure. In the test samples (rings) was measured outer diameter up to 1 micron: ring was cut and measured its outer diameter in the plane perpendicular to cut. At the same time, provided the internal stresses in the ring material, the value of its outer diameter varied - increase or decrease depend on the voltage sign up to the position of static equilibrium.

After the cutting ring is represent a springing element, characterized by a quantity of rigidity. Defining the ring rigidity and knowing the value of changes its outer diameter is possible to calculate the value of residual stresses in the rings material.

Ring rigidity was determined experimentally on the plant for determining friction coefficients in the materials. The work was conducted in the laboratory of SSTU hardware department.



Table 2

**The average values of controlled characteristics and of residual stresses
after various treatments**

Treatment	Characteristics					
	Change of outer diameter ΔD , μm	Change of deviation from roundness ΔV , μm	Change of hardness ΔH , HRC	Difference between the diameter before and after cutting D , μm	Strength of the inner stresses F , N	The value of internal stresses σ , N/mm^2
Furnace tempering under the temperature of 150 °C for 3 hours	0.0017	0.48	-0.19	-16.66	4.298	12.39
Sonication: $\delta=0.3$ mm; $A=10$ μm ; $t=15$ s	0.00	0.263	0.00	-10.66	2.455	7.5
Control group (not treated)	0.0001	0.086	-0.18	-21.6	5.302	15.30

Based on an average of the change value in the outer diameter after cutting the rings providing the average of rings rigidity value, was calculated the values of existing loads and stresses in the rings material for all groups of samples.

Table 2 presents the average values of controlled characteristics and of residual stresses in the rings after additional tempering, ultrasonic stabilization providing the average conditions and in the rings of the control group.

Table 2 shows that ultrasonic treatment provides the best performance for all controlled characteristics accepted in the program:

- after sonication, the value of the outer ring diameter does not change, whereas after additional tempering it's increased by an average of 1-2 microns;
- compared to the additional tempering after sonication deviation from roundness of the rings decreases by 1.8 times;
- ultrasonic treatment increase the hardness of the ring material by an average of 0.18-0.19 HRC compared with additional tempering and the control group of rings, respectively
- ultrasonic treatment provides more efficient removal of stress (an average of 1.4 times) compared to additional tempering (see Table 2).

An additional point to emphasize is that ultrasonic relaxation of residual stresses has a wonderful quality: it provides both of more efficient reduction of residual stress and less billets deformation during relaxation, preserving its original geometric shape.

By this means, the ultrasonic relaxation of residual stresses can effectively replace the traditional method of relaxation in the furnaces and provides essential reduction of bearing manufacturing complexity, lower energy consumption and improving the processing quality.



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EXPERIMENTAL STUDIES OF WATERJET CUTTING ON THE BASIS COMPUTER SIMULATION

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Among the promising process of cutting materials include pressure water cutting based on the processes of deterioration of the supersonic flow of fluid and abrasive. [1].

Experimental studies of waterjet cutting performed on the software package «Jet of Hope», which is designed to simulate the process [2].

For mathematical model of waterjet processing has been carried out a full factorial experiment. In the course, for which the value of the parameter optimization take metal removal in a single blow of the abrasive particles q , and of factors - the current water nozzle inner radius r , the initial weight of the liquid flow rate Q_1 , the initial weight of the abrasive flow rate Q_2 and the initial velocity of the jet v_0 .

For simulation studies used materials and steel 20 and 30HGSA. Taking into account the information on the best modes of waterjet cutting, comparative experimental simulation studies to determine the optimization q settings have been carried out under the following processing conditions: the concentration of abrasive particles in the jet axis of 10 m^{-3} , the initial fluid velocity of 900 m/s , the initial velocity of the impurity to 10 m/s , the distance from the nozzle to the surface to be treated of 1 mm , average particle diameter 0.25 mm the abrasive, the abrasive particle density 0.0042 g/mm^3 , the bearing capacity coefficient of the contact surface 1 and the mechanical properties of the steel 20 and 30HGSA. Laying the processing modes of waterjet cutting was done by computer simulation on the software package «Jet of Hope».

The software package «Jet of Hope» (fig. 1) is intelligent information systems to determine the rational parameters of waterjet cutting includes input and adjustment of technological parameters of processing, simulation of the cutting process, the generation and display of the information unit of the results of the simulation processing. In the development of software used in the system of analytical equations that represent waterjet cutting process based on a twisting stream of the working fluid and without twisting. [3]. Interface software package consists of a main form, which is located on the main menu. The program interface is designed in the most convenient and understandable for the user form. The cells are shown as rectangles with rounded corners, inside which produces initial data input (machining parameters). Once the desired settings are specified, and you can proceed to the calculation, it needs to press the "Start calculation". Next, a dialog box appears with a report on the results of simulations with the ability to make adjustments to processing parameters.



Jet of Hope

Текущий внутренний радиус водяного сопла, мм	<input type="text"/>	Начальная скорость струи, мм/мин	<input type="text"/>
Начальный весовой секундный расход жидкости, л/мин	<input type="text"/>	Расстояние от сопла до обрабатываемой поверхности, мм	<input type="text"/>
Начальный весовой секундный расход частиц, г/мин	<input type="text"/>	Средний диаметр частиц абразива, мм	<input type="text"/>
Начальная скорость струи в сопле, мм/мин	<input type="text"/>	Плотность частиц абразива, г/мм ³	<input type="text"/>
Концентрация частиц абразива на оси струи, м ⁻³	<input type="text"/>	Коэффициент, оценивающий несущую способность контактной поверхности	<input type="text"/>
Начальная скорость жидкости, м/с	<input type="text"/>	Предел текучести материала детали, МПа	<input type="text"/>
Начальная скорость примеси, м/с	<input type="text"/>	Плотность материала детали, кг/мм ³	<input type="text"/>

[Начать расчет](#)

Fig. 1. The main form of software «Jet of Hope»

The amount of metal removal q is an important factor in determining the hydrodynamic and geometric parameters of the jet. The larger the metal removal, the jet is more compact, increased performance, improved cutting ability of the jet and saved more energy in the process of water-jet cutting, and, when exposed to the treated material, create a high surface pressure, which is indicative of the high stability of the jet without loss of destroying ability.

After processing the results of experiments obtained the following regression equation, reflecting the dependence of the removal of the treated metal with a single blow abrasive particles q from processing modes without twist (1) and with a twist (2):

$$q = 0,894 \cdot r^{-0,029} \cdot Q_1^{-0,016} \cdot Q_2^{0,014} \cdot v_0^{0,003} \quad (1)$$

$$q = 0,998 \cdot r^{-0,0003} \cdot Q_1^{-0,0002} \cdot Q_2^{0,0001} \cdot v_0^{0,00003} \quad (2)$$

where q - the value of the processed material removal with a single blow of the abrasive particles; r - inner radius of the current water nozzle; Q_1 - the initial weight of the liquid flow rate; Q_2 - the initial weight of the abrasive flow rate; v_0 - the initial velocity of the jet.

Based on the regression equations (1, 2) are constructed a graph of the parameter optimization q of all four factors r , Q_1 , Q_2 and v_0 .

Figures 2 - 5 are based, reflecting the impact of the current inner radius of the water nozzle r , the initial weight of the liquid flow rate Q_1 , the initial weight of the abrasive flow rate Q_2 and the initial velocity of the jet v_0 on the value of the treated mother's pickup with a single blow of the abrasive particles q .

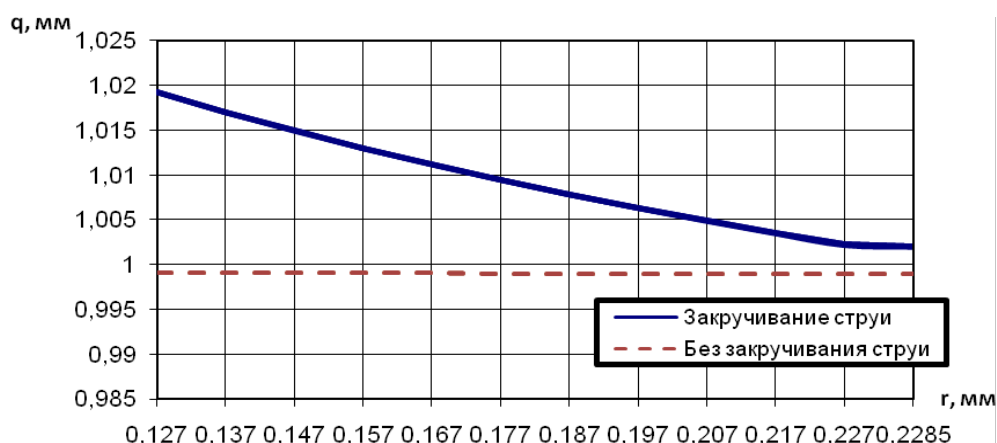


Fig. 2. Effect of the current inner radius of the water nozzle r on the value of the processed material removal with a single blow of the abrasive particles q

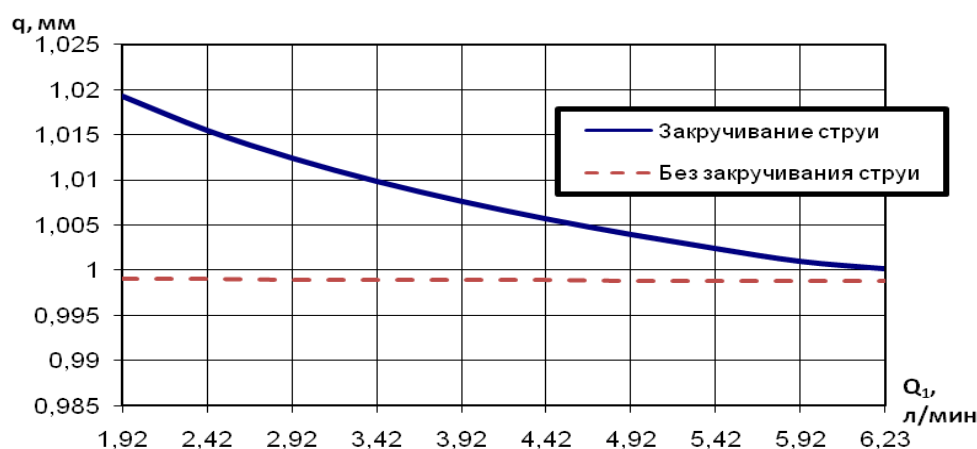


Fig. 3. The impact of the initial weight of the liquid flow rate Q_1 by the amount of removal of the material being processed with a single blow of the abrasive particles q

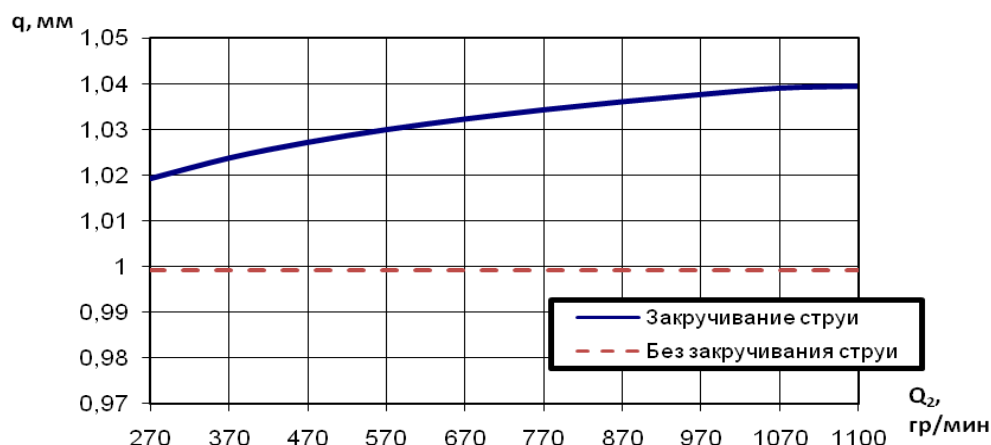


Fig. 4. Effect of the initial weight of the abrasive flow rate Q_2 by the amount of removal of the processed material at one blow abrasive particles q

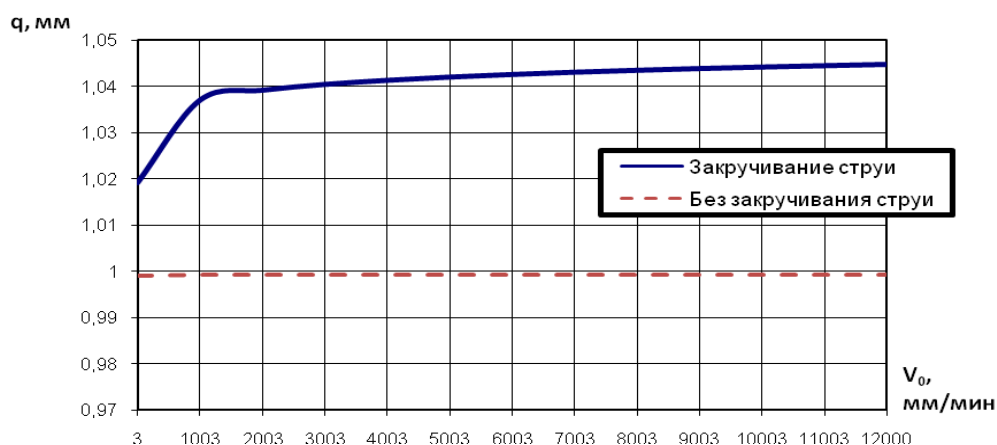


Fig. 5. The impact of the initial velocity of the jet v_0 on the value of the processed material removal with a single blow of the abrasive particles q

The resulting image, depending clearly reflect the relationship and the degree of influence of modes waterjet treatment on the removal of the processed material shows that the performance of water-jet treatment as a result of tightening waterjet stream is higher than without twisting. This is because the water jet stream, further passing through the spiral groove and is twisted by the operation of the centrifugal forces are concentrated on the abrasive particles to the jet axis, which leads to an increase in the kinetic energy of impact of the jet on the material. Moreover, twisting of the jet gives it "drilling" effect, resulting in improved waterjet cutting ability of the jet, and hence the processing performance [4, 5].

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Пахотин Н.Е., Осадчий Ю.П., Пахотина И.Н.
НОВЫЕ ТЕХНОЛОГИИ РЕГЕНЕРАЦИИ ОТРАБОТАННЫХ
МОТОРНЫХ МАСЕЛ

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NEW TECHNOLOGIES OF REGENERATION OF USED MOTOR OIL
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Аннотация. Отработанные масла собирают и подвергают регенерации с целью повторного их использования. Для восстановления отработанных масел применяются разнообразные технологические операции. Предлагается новая комбинированная система регенерации отработанного моторного масла.

Ключевые слова: отработанное моторное масло, регенерация, ультрафильтрация, мембрана.

Abstract. Waste oil is collected and subjected to regeneration to re-use them. For recovery of waste oils used a variety of manufacturing operations. A new combined system of regeneration of used motor oil.

Keywords: used motor oil, regeneration, ultrafiltration, membrane.

Regeneration of used motor oil is one of the most promising ways to save lubricants, as well as protection of the environment from getting into the oil directly, and combustion products at their disposal. During operation the oil accumulated therein oxidation products, dirt and other impurities which drastically reduce the quality of oils. Oils containing contaminants are unable to meet the requirements imposed on them and should be replaced with fresh oil. Waste oil is collected and subjected to regeneration in order to maintain a valuable raw material, which is economically advantageous. For the year in the Russian Federation is going to about 1.7 million. Tonnes of oil processed approximately 0.25 million. Tons, less than 15% [1]. Recycle used motor oil, together with the oil at the refinery impossible, since additives contained in the oils disrupt oil refining equipment. Depending on the process of regeneration obtained base oil fractions 2-3. Of these, compounding and administration of additives can be prepared Commodity oils - motor, transmission, hydraulic, coolant, grease. The average yield of recovered oil from waste oil is 70-85% [2]. For recovery of waste oils used a variety of manufacturing operations, based on the physical, physico-chemical and chemical processes. The processes generally observe the following methods: mechanical - for the removal of oil free water and solid contaminants; Thermophysical - evaporation, vacuum distillation, physical and chemical - coagulation, adsorption. If there are not enough ways to use chemical oil recovery associated with the use of more sophisticated equipment. The main obstacle to improving the purification of waste motor oils is the presence of detergent and dispersant additives. These additives in the oil exploitation can not occur completely and hold dirt in suspension. As a result, adsorption, mechanical filtration and other



types of treatment are ineffective. At present, we are actively searching for new methods of recovery of used motor oil using membrane separation.

It offers a combined regeneration system used motor oil, including pre-cleaning - centrifugal separation and mechanical filtration and membrane separation by ultrafiltration. Membrane processes - a separation processes carried out at a semipermeable membrane under an applied driving force. The most common industrial membrane processes include reverse osmosis, ultra-, micro- and nanofiltration, the characteristics of which are presented in table 1 [3].

Table 1. - Classification baromembrane filtering techniques

Method	Removable substance	Pore size	Step membrane
Microfiltration	Suspended particles, large colloids, emulsions	> 50 нм	Separation due to the effect screen
Ultrafiltration	All suspended solids, colloids, organic macromolecular compound	2–50 нм, обычно 20 нм	Separation due to the effect screen
Nanofiltration	All the suspended particles and colloids, dissolved organic matter and multivalent monovalent ions	~1 нм	Separation through a combination of effects and different screen permeability
Reverse osmosis	All the suspended particles and colloids, all dissolved organic substances	~0,1 нм	Separation of solutes on physico-chemical mechanism

The most effective are ultrafiltratsionnye membrane, as they capture the fine inclusions, and their use does not require large expenditures. In plants using ultrafiltration tubular roll, hollow and flat membranes. The material for the manufacture of cellulose acetate membranes are used, ftorplast, carbon fiber and other. Researches ultrafiltration method using tubular membranes with a pore diameter ftorplasta 50 nm. The results showed that the membrane permeability is 0,025-0,035 m³ / (m²·h), and the yield of recovered oil is 80%.

Ultrafiltration membranes provide a consistently high quality of treatment of used motor oil, which not only reduce energy intensity of manufacturing industry, but also to reduce emissions of waste into the environment. Ultrafiltration separation processes depend on the properties of membranes, flows into them and driving forces. For these processes, the flow pattern is also important to the membrane by a shared medium and discharge of separation products on the opposite side. The principal difference between the traditional method of membrane filtration techniques - separation of the products in the stream, ie without separation of sediment deposition on the filtering materials, gradually working the porous sealing surface of the filter.

It should be noted that the oil recovery is possible to obtain base oils, the quality of fresh identical, the output of oil, depending on the quality of raw materials is 80-90%. Thus, the base oil can be regenerated for at least two times. It is possible to realize only with the application of new technologies.



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EQUIPMENT FOR THE MANUFACTURE OF ROAD CONSTRUCTION OF RIGID CONCRETE MIX

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Abstract. *This article describes a press for compacting concrete mix is implementing a new method of influencing a flat working of the sealing body on hard cement - sand mixture. This working body performs a spherical movement during compacting of the concrete mix. Such a scheme of action of the working body in the aggregate, it provides quality and effective seal hard mix even when using fine Sands.*

Keywords: *seal, product mix, concrete, stiffness, quality, strength, spherical, stamp, sand, vibration.*

The main task in the manufacture of products for road construction such as paving tile is technical re-equipment of existing and creation of new parcels for the purpose of improving the quality and increasing the production of paving slabs, increase productivity and improve working conditions, reduce the consumption of materials, fuel and energy costs and costs.

The process of manufacture of slabs involves the following operations: preparation of the mixture, compaction, aging products in the forms (on the ground or in the chamber of steaming) before the acquisition of at least 70% of design strength, the demoulding of products and finish-grout. The last operation mainly in enterprises is not carried out.

The recent increase in demand for paving is forcing many small businesses to adapt their existing cheap press for the production of paving slabs. Tiles produced on these presses, outwardly no different from the tiles produced on special equipment. However, experience shows that on key parameters and, above all, for frost it does not meet modern requirements.

For the production of paving slabs and other small road products are manufactured separately of the vibropress and lines.

Such of the vibropress, Riphean, the VIP-R, RMS already gained the trust of builders and businessmen. However, any design has its drawbacks and domestic manufacturers traveller constantly upgrading their equipment to successfully konkurentosposobnosti on the market. The main significant disadvantage of vibrocompression is the presence of vibration that requires action of vibration protection, ensuring the safety of the works, as well as the difficulty, and in some cases and the inability to obtain quality indicators when using fine sand (fineness modulus of, for example, about 1). In this environment, interest development, using new methods of working of the sealing bodies on a hard cement - sand mixture. So the Department SDM SSTU was designed and manufactured a prototype of a press with a flat working body (stamp), making a spherical movement during compacting of the concrete mix [1]. In this case, the stamp position is adapted to the density of the compacted mixture. Such a scheme of action of the working body has the



following features:

- continuity of application of the sealing load to the working body, i.e. no vibration;
- the pulsating nature of its impact on the sealing material;
- the growth of the specific pressure in the contact zone of the stamp with the mixture as seals;
- possibility of change of technological modes in a wide range;
- the unstressed nature of the work.

Together, this ensures quality and efficient packing of hard mixture even when using fine sand, fineness modulus of which is 1.2 .

To determine the effectiveness of compaction of the concrete mix flat working body (stamp), making a spherical movement, studies have been conducted, the results of which are presented in table 1 [2].

Table 1

The results of the compaction of the concrete mix in different ways

Packing method	The compressive strength (MPa) ----- Time seal mixture(c)	
	The stiffness of the mixture , c	
	320	100
Pressing $K_{np} = 26,3$ MPa	$\frac{16}{102}$	$\frac{15}{88}$
Vibrocompression ($A = 0,35$ mm; $n = 53$ c ⁻¹ ; $K_{np} = 0,005$ MPa)	$\frac{18}{80}$	$\frac{17.5}{47}$
Flat stamp with elements of adaptation ($K_{np} = 0,66$ MPa; $n = 50$ c ⁻¹)	$\frac{23.4}{13}$	–

Note: 1 The strength of concrete at 7 days age (cement grade M300), A – the amplitude of oscillation; n – speed; K_{np} – given the specific pressure. 2. In the numerator – the strength, the denominator of the seal.

The presented results show that with flat seal stamp with elements of adaptation to achieve a higher strength of concrete at lower sealing efforts than during Prototype press with adapting the flat die for the production of paving tiles has the following specifications

- the cycle time of molding, with 35 -40
- time seal mixture, with 13
- overall dimensions of the press, m
- length - width - height 2,5 – 1,5 – 1,5
- drive power, kW 5
- weight (without pump stations), t 1,2



Paving slabs (size 330 x 330 x 60) made of a concrete mixture with the following flow components for 1m³ of concrete:

- cement (M400) - 440 kg,
- sand (fineness modulus of 1,2) - 1760 kg,
- water 141 L.

The quality of the tiles conform to the requirements of GOST.

Note that in the new press the seal is provided on the metal tray, which size of image the product is installed in the stack. Thus, dramatically reduces the required number of trays, and they don't fall into the steaming chamber.

For comparison of the new equipment with the most common, were calculated on the specific metal consumption and specific energy intensity the most used presses (PL.2)

Table 2

Comparative average data sealing equipment at the same performance

The name of parameters	Ed. measurements	The value of indicators			
		New technique	The vibropress		
			ИТ-11	Kvadr	Kondr
Performance	M ² /ч	11	11	36	5
Press weight	т	1,2	2	3,7	0,5
Power	кВт	5	5,5	12	4,4
Specific power consumption		2,2	2	3	1,1
Specific metal		9,2	5,5	9,7	10

Press under the brand name "Riphean", "Compact", "mastec" bundled lines and their average performance is close to that presented above.

A comparison of equipment on specific indicators, shows that the new machines are quite competitive with existing equipment and with proper organization of work can provide high efficiency.

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ANALYSIS OF METHODS FOR DIAGNOSIS OF OCCUPATIONAL DISEASES OF MACHINE CONSTRUCTION MACHINERY

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Abstract. The article discusses the main methods of carrying out the express diagnostkm development of general and occupational diseases in machine construction machines. Substantiates the benefits of using vegetative method of bio-resonance test.

Keywords: rapid diagnosis of common and occupational diseases of machine construction machines, vegetative method of bio-resonance test.

Significant role in preventing the development of General and professional diseases of workers of machine construction machines play the examinations. Preventive medical examinations in the same subject machine operators, managers of construction machines, car drivers, workers repair shops, etc..But often the specifics of work in the field and the distance from specialized diagnostic facilities allows full diagnose of body mechanic, so at this time is a topical study and implementation of methods of diagnostics of this professional group.

People, lives and works in the conditions of technogenic load (intoxication of living organisms due to environmental change, exposure to electromagnetic fields, radiation, electrosmog, energy impact and many more) that have a negative influence on the organism (Fig.1).



Fig. 1. Factors influencing human health

To monitor the functional state of the body of the operator, may be used in various diagnostic methods and means to obtain information about the condition of the body. Numerous studies have established that the functional state of internal organs is reflected in the form of specific changes at acupuncture points (specific points on the body associated with different internal organs).

For example, the auricle is connected through the Central nervous system to internal organs. Auriculodiagnostics – diagnosis of the condition of the body by the ear. The complexity and variety of sensitive innervation of the auricle makes it truly unique area on the surface of the human body. Just on the ear describes more than 200 points, the most often used about 60.



Fig. 2. Methods of Express-diagnostics of a person

The correct definition of the points of the ear is of great importance both for diagnosis and for therapeutic treatment.

For example, the diagnostic equipment "Peresvet-2009" allows diagnosis of folic, auricular diagnosis, diagnosis by Nakatani, equipment Biotest the same company allows diagnosis by Voll, VEGA-test. In that and other equipment used probes with replaceable tips, liners, set of plates, bowls, harness, electronic medical selector, the computer.

However, this equipment is of difficult access to biologically active point, which is located deep in the bowls of the sink on the leg curl and need a lot of time to spend on the procedure of diagnosis. If measured in the two ears of the time of diagnosis increases. The lack of accurate diagnosis of the nature of the disease. Any methodology auricular diagnostics allows one to accurately indicate the place of localization of the pathological process and the nature of its flow, but just to decipher the nature of the illness or clinical diagnosis, the ear is almost impossible. When auriculodiagnostics diagnostic unit "PERESVET", uses a large number of points on the ear. To work with the device PERESVET, requires a highly qualified medical specialist.

The functional state of the human body, it is possible to evaluate the characteristic points of the foot (Fig.2). So the foot has numerous reflex zones, correlated with the internal organs. When any internal organ or body part pathological changes occur or functional abnormalities in the reflex zones of the foot that correspond to these organs, symptoms of pathology. A sign capable of distinguishing healthy and diseased organs and their functioning – is the appearance of pain when pressing on the reflex area of the foot or eye swelling, blisters, and more.

Diagnosis in the footsteps of the person is carried out using equipment "PlantVisor and massage. The equipment is designed for screening, visual and full-scale computer analysis of the status and biomechanics of the musculoskeletal system, diagnosis and monitoring of orthopedic diseases and deformities (primarily of the spine and feet).

Mostly the diagnosis is done through the identification of sensitive areas on the feet that reflect the state of the organs. This diagnosis is made by experienced and professional physician.

A method for detection of diseases through the foot massage allows you to



detect the disease, when it has not crossed the stage of the disease, when there is the slightest deviation in the functioning of any area of the body. You receive the opportunity to initially separate the problem and the healthy parts of the body and to proceed to further treatment.

The equipment and method can indicate only the presence or absence of disease of any internal organ or body part or abnormality of some function, but can not accurately determine the disease and a particular sore spot.

To diagnose changes in the body, it is possible by the iris (Iridology), since the eye is a derivative of the nervous system and thus reflects the status and functioning of the body. Iridology is a method of investigating the condition of the body on the iris of the eye. Each organ has its localization on the iris, projection zone, where in visceral centers of the brain sends information about your trouble. These signals and contribute to, primarily, the appearance of the iris iridological signs that help to diagnose many diseases. Thus, the iris of the eye is the mirror of health".

Recently increased interest in the use of data iridological examinations for appointment and further application of color impulse therapy and antistress color correction.

Iridodiagnosis complex "ETCHING-ID" allows exploring the patient's eye to detect changes in the human body. The equipment includes three-coordinate table with facial set-up, the camera for photographing, the binocular attachment, interface unit, an input unit, an overhead projector, a work place with a PC, the optional color monitor.

This equipment is large, does not allow measurement in the field, but in the same way iridology sees iris-not the diagnosis, and the process occurring in the tissues of an organ (circulatory disorders, degenerative changes, etc.).

To diagnose the body's acupuncture points is possible using the Method of R. Voll. It is known that the various organs and body systems related to specific areas of the skin, called acupuncture points. These points immediately if you have any abnormalities in the body systems and organs, due to the so-called meridional ties, begin to react to these changes, and, at the stage of functional disorders before the advent of organic changes. This reaction in the acupuncture points is manifested as changes in cellular composition, magnetic field, temperature, electrical resistance, the rate of biochemical reactions.

Diagnosis of the body's acupuncture points is possible using a galvanometer and a method of Richard Voll, using diagnostic device "HARMONY". Measuring the electric skin resistance in certain acupuncture points, identify changes in the body at the stage of functional disorders. By Foll method used 250 -500 biologically active points (BAP) on the hands and the feet, which makes the measurement method long-term and time-consuming.

Recently, the latest developments of medicine is widespread use of Vegetative resonance test (VRT), which was developed in Germany by a doctor Shimel in 1978, for the rapid diagnosis of human. It is based on methods of electro-diagnostics, and testing of drugs on R. Voll and bioelectronic functional diagnostics by V. Schmidt and H. Pflaum. However, if for solving problems of diagnostics and medical testing in the method of R. Voll used 250 -500 biologically active points (BAP), autonomic



test uses only one reproducible BAHT.

Method of vegetative bioresonance test is based on the resonant interaction between the wave processes in the body and drug test. More than 15 years of research of Dr. Schimmel and his followers have turned this method is an extremely effective diagnostic tool, primarily through the development and use of specific frequencies for testing, and measuring extremely small currents.

Vegetative resonance test allows you to identify various abnormalities in the organs and systems of the body: to identify geopathic and radiation loads, to determine the presence of benign and malignant tumors and predisposition to tumors, to detect in human helminths, fungi, protozoa, bacteria, viruses, which is the cause of serious chronic diseases, to know the level of intoxication of the organism, to detect hidden allergies and to find specific allergen to determine the lack of microelements and vitamins in the body, to assess the mental state and physical overload of the person, to find out your biological age index, constitutional ideal biological index that identifies natural health level, adaptation reserves of the body. It is important to note that this method of assisted reproduction has been successfully used to diagnose people who are unable to speak or are unconscious.

Vegetative resonance test (VRT) is carried out using devices D-104 + ALL Pharma or Professional that includes: probes, electrodes, selector blocks, medical blocks and much more, allowing full-scale to assess the condition of an organism at any stage of life. It is possible with a medical unit on the appliance Professional to work in an ambulance (to relieve acute symptoms). It is important to note that the diagnostician uses one reproducible biologically active point, which reduces a large amount of time on the diagnosis, the equipment is compact and diagnoses in the field.

Thus, vegetative resonance test and equipment working with the use of art allows to obtain reliable answers to such questions as: is There a pathology? In which organ? What is the cause of the disease?

All of the above listed methods of Express-diagnostics with the use of technical means, quite complex in technical terms, do not cover the whole functionality of the body require a certain number of measurements from different points of the human body.

Thus, vegetative resonance test and equipment working on a method of assisted reproduction is the most progressive in order to fully Express diagnostics of living systems, as in a short period of time accurately and efficiently to identify certain abnormalities in the body of the soldier at the earliest stages in the conditions of technogenic load, when the service is used only one biological active point for full diagnosis of the body.

Clinical trials of the method of assisted reproduction and diagnostic devices showed that diagnosis and develop appropriate treatment with subsequent recovery of 99.8% of all examined patients [1-7]. Consequently, vegetative resonance test and the equipment that uses this method is effective and promising method of Express diagnostics of occupational diseases of machine construction machines.

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