



## OPTIMIZATION OF OPERATING LOAD PARAMETERS OF AMMONIA SYNTHESIS UNIT

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The problem of optimization of operating load parameters of ammonia synthesis unit was solved in the paper in the context of general problem of the need for improving the energy efficiency of domestic large-capacity units of AM-1360 series. The nature of changes in basic operation parameters of the synthesis unit, in particular changes in concentration of inert gases in the cycle, was analyzed allowing to establish a reserve of reduction of variable items of energy expenditures (consumption of natural gas, water and electricity) as objective optimization function which depends on the purge gas consumption. The parametric sensitivity of load vectors of purge gas and fresh hydronitric mixture to the vector of condensing temperature was studied by the method of mathematical modeling. This allowed concluding on the possibility of minimizing the objective function under the constraints typical for industrial operating conditions by the gradientless method, using the algorithm of one-dimensional seeking of function extreme in the plane of inert gases only. The indicators of energy consumption in case of deviation of inert gases concentration from the optimal level were quantitatively determined. The presented method of developing the mathematical model and optimization algorithm can be adapted to industrial environment for various series of units, taking into account the features of technological design of the systems of compression, condensation, as well as utilization of purge and tank gases.

**Keywords:** ammonia production, energy consumption, synthesis unit, mathematical modeling, optimization.

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## JUSTIFICATION OF LIMITING WEAR OF TILLAGE TOOLS BLADES

page 8–10

In modern ecological agricultural technologies primary attention is paid to the use of tillage equipment. It is necessary to follow the agrotechnical requirements in order to obtain good harvest. Rapid wear of tillage working bodies is a significant obstacle to the quality of soil cultivation. Therefore, the actual problem is to determine the limiting wear of tillage tools.

The results of experimental studies on determining the allowable wear of hoe blades are given. Multifactor field and laboratory experiments were conducted, which studied the influence of hoe blades wear on the uniform functioning of hoes in depths, quality of weeding, energy performance and defined physical and mechanical properties of weed roots. Based on them, it was found that wear from operating time of 62–76 km of path length does not affect the quality and performance indicators, and operating time of about 100 km in selected field conditions can be considered as acceptable limiting wear of hoe blades.

**Keywords:** tillage, hoes, tillage equipment, limiting wear of tools.

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## CRYOSCOPIC EXAMINATIONS OF YEAST-LEAVENED DOUGH WITH HERBAL RAW MATERIALS

page 10–14

The production of frozen semi-finished products made of dough is constantly increasing every year. Examinations of structural state and biological activity of water in dough and their changing under various conditions of storage and treatment play a great role in solving practical problems concerning the increase of the quality and safety of frozen semi-finished products, as well as in creating conditions of healthy lifestyle.

Based on this, the appropriateness of adding potato, put through various modes of preliminary preparation, to the formulation of frozen dough products for improving rheological properties of dough and extending the storage life of semi-finished products was suggested and experimentally substantiated. The influence of the above mentioned techniques on basic thermophysical properties of yeast-leavened dough was studied, namely the change of moisture crystallization and melting range in the investigated samples, chilled moisture content and dough behavior while freezing. Herewith, it was experimentally proved that excluding the proof phase of dough products before freezing allows minimizing all possible enzymatic, microbiological and oxidizing processes in dough.

In addition, rationality and efficiency of using low-temperature treatment of yeast-leavened dough semi-finished products for extending their storage life was scientifically grounded and proved.

**Keywords:** freezing, low-temperature calorimeter, herbal raw materials, yeast-leavened dough, cold storage.

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### RESEARCH OF SPARINGLY ALLOYED TITANIUM ALLOY WITH GIVEN CHEMICAL COMPOSITION

page 14–17

The study of the structure and mechanical properties of sparingly alloyed sintered titanium alloy Ti-0,25O-1,5Fe, obtained by hydride powder metallurgy of titanium using spongy titanium as a raw material with a specified composition of alloying elements O and Fe, was conducted. The sintering of samples was conducted at the temperature of 1310 °C, based upon the results of our own research, as well as the sintering modes of industrial sintered titanium alloy 2M2A: heating in vacuum furnace with a speed of 20 °C/min to a temperature of 1310 °C and shutter speed of 4 hours. At the temperature 500 °C a shutter speed of 1 hour was carried out to prevent cracking of the material as a result of heavy hydrogen emission. Titanium sponge of fractions from 0 to 2 mm was treated with vibrating screening and sieving at the installation with the receipt of titanium sponge powder of fraction from 0,08 to 0,45 mm with a given content of oxygen and iron. The studied titanium sponge powder, compared with the requirements of the normative document, after its processing and allocation in separate fraction, contained alloying elements O and Fe at a level acceptable to the desired composition of alloying (O – 0,25 % (mass.), Fe – 1,5 % (mass.)), by the content of other impurities it corresponded to the highest grades of titanium sponge. Titanium sponge with a specified composition of alloying elements (O – 0,25 % (mass.), Fe – 1,5 % (mass.)) was obtained. On its basis sparingly alloyed sintered Ti alloy Ti-0,25O-1,5Fe was developed having a high level of mechanical properties:  $\sigma_B$  – 630 MPa,  $\delta$  – 7 % and  $\psi$  – 28 %. The conclusions were made about the economic attractiveness of use of titanium sponge with a given chemical composition as a raw material for the production of sparingly alloyed sintered titanium alloys.

**Keywords:** titanium alloy, titanium sponge, alloying, sintering, chemical composition, impurities, microstructure.

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### A DEVICE FOR CENTRELESS MECHANICAL OPERATION OF CYLINDRICAL PRODUCTS MADE FROM POLYMERIC COMPOSITE MATERIAL (PCM)

page 17–21

During the past 10 years composite materials production has reached high volumes, among them composites made of polymeric materials take the significant place. As large number of the most popular products, made from PCM of different purpose has a cylindrical shape, there are high demands to the quality of their elements, their deviation from norms take place during processing. In the article there a device for centreless mechanical operation is considered. When using it the effectiveness of making products from PCM can be increased, especially in case of labour productivity and getting the more quality of treated surface, that can be reached by means of cutting force balancing and rotational moments, acting on the die in cutting zone and large quantity of cutting elements that have differently directed cutting edges.

**Keywords:** cylindrical products, polymeric composite material, centreless mechanical operation.

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**RELIABILITY CONTROL IN VIEW OF PRODUCTION PROCESS STABILITY**

page 22–24

The data on the effect of measurement error on the probability of decision making on the products acceptance under statistical instability of the production process are given. It is shown that the objectivity of quality control depends on the accuracy of measuring devices, as well as the reproducibility of production process, characterized by the reproducibility indexes. This causes erroneous rejection of some effective items, the actual values of the controlled parameter of which lie in the tolerance zone.

By the example of production of ceramic brick three variants were shown, which are characterized by different values of reproducibility indexes. The probability of errors of the first and second kind was calculated, which indicate the probability of the situation when the controlled item is effective, but it will be erroneously considered to be defective, and when the controlled item is defective, but it can be wrongly considered to be effective. It is established that the probability of the error of the first and second kind increases as the production process reproducibility reduces.

**Keywords:** probability, control, reliability, type I error, statistics.

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**OPTIMIZATION OF DESIGN AND TECHNOLOGICAL PARAMETERS FOR MILK SEPARATOR**

page 24–28

The results of the analysis of known publications and a practical experience have used for the formulation of the research purpose.

The purpose of the research is the optimization of design and technological parameters of the separator. Standard techniques, matrix planning and statistical processing of the results of the experiment were used to test the theoretical assumptions. The frequency of the rotation of the drum, the efficiency of the liquid separation in the combined separator. The experimental results show the impact of the studied factors on the performance of the separator for the separation of the working fluid into components, and the time required to reach the operating speed. The performance of the separator depends on the number and the diameter of the nozzles. The optimal parameters are: the diameter of the nozzle d...5 mm, the number of nozzles – 2, the system pressure – 0,11 MPa, the acceleration time 2,0...2,5 minutes.

**Keywords:** milk, separator, separation of milk, cream, separator purifier.

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**THEORETICAL SUBSTANTIATION OF OPTIMIZING THE CONTROL MODES OF ENERGY FLOWS OF POWER SUPPLY OF ELECTRICALLY HEATED FLOOR HEATERS**

page 28–33

The paper gives the results of theoretical studies on the optimization of control modes of energy flows of power supply of heaters of multi-tiered electrical heat storage systems of underfloor heating of livestock production facilities. The modes of heaters power supply both from traditional and alternative, or renewable energy sources in a three-tiered heating structure that provides the given standards of thermal regime of the microclimate in technologically active zone, namely the surface of electrically heated floor and the air at a given height of production facility, were considered.

The optimal functional control modes of energy flows of traditional and alternative, or renewable energy sources, as well as the energy ratio for the corresponding heating modes of electrically heated structure were substantiated. Approximate analytical problem solutions allow compact submission of current information on the state of thermal regime that makes it possible to implement a control system of thermal processes of facilities on the microprocessor base using universal tools.

**Keywords:** energy saving, energy flow, automation, microclimate, algorithm.

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### IMPROVING THE CAR TRAFFIC VOLUME TRANSPORTATION BY STREAMLINING THE ROUTES

page 33–35

Streamlining the organization system of car traffic volumes at the level of railway network allows optimizing the sub-units operation and accelerating the car turnover. It is achieved by establishing rational interaction of train stations and adjacent areas.

The tasks of streamlining the transportation routes are related to the NP-complex problems of combinatorial optimization, which can be solved using the heuristic methods. They do not guarantee an optimal solution, but allow quickly get a solution of appropriate quality and they are the basis for further intellectualization of the transportation process.

To create competitive conditions in the service system, there is a need for providing a flexible response of the transportation process technology concerning the users' requirements to the quality of traffic with guaranteed performance. To this end, it was proposed to select the optimal routes based on the heuristic method of simulated annealing.

**Keywords:** route selection, transportation streamlining, simulated annealing method.

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### INCREASING THE EFFICIENCY OF COMPUTER-AIDED MODEL DIAGNOSTICS USING ARTIFICIAL NEURAL NETWORK

page 36–39

The method for automated objective early diagnostics of latent type 2 diabetes (D2) of an examined patient based on computer-aided model processing of his/her oral glucose tolerance test (OGTT) results using artificial neural network (ANN) was suggested. It is known that D2, accompanied by deadly late vascular and neurological complications, is a widespread disease, especially in developed countries, and constitutes a serious medical and social problem. Nowadays, the most precise diagnostics of latent D2 is the expert diagnosis of experienced endocrinologist on glycaemic results of the OGTT. However, it has a subjective nature and cannot be used for conducting mass health examinations, the need for which has increased lately.

Thus, the problem of developing the method of automated objective early D2 diagnostics based on computer-aided processing of the patient's glycaemic results of the OGTT with differentiation of diagnosed conditions is urgent. Possible applications of both artificial neural networks and mathematical modeling were demonstrated in literature. Thus, it was found that each of the methods of computer-aided diagnostic processing of OGTT results has significantly less sensibility in detecting latent diabetes, comparing to the doctor's. The paper shows that the combined application of computer modeling and ANN in processing the patient's glycaemic results allows approximating the sensibility of automated objective early D2 detection to the expert endocrinologist's diagnosis.

**Keywords:** mathematical model, artificial neural network, diabetes.

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**THEORETICAL ANALYSIS OF ELECTROMAGNETIC FIELD INSIDE THE EGGS OF A GRAINE OF MULBERRY SILKWORM**

page 39–41

This article conducts research on the distribution of the electromagnetic field inside the silkworm eggs, which are being presented in the form of a homogeneous sphere with dimensions comparable to the wavelength of the acting field EHF. Researches on the distribution of information EMF within silkworm eggs are necessary to determine the parameters of the field (frequency, power density, exposure) that increase the yield and quality of silkworm cocoons. Given the above, analysis in this article is based on a methodical planning to solve the problem of determining the electromagnetic field inside biological objects. Among methods that were used for that main one is gradual approximation which was applied to the real data situations resulting in transition to cases that could be solved by known techniques and approaches allowing to discover new data. Given the electrical properties in particular the permittivity of silkworm eggs a classical approach was used to calculate the structure of the electromagnetic field inside the biological homogeneous objects which being exposed to external electromagnetic fields. Because the shape of silkworm eggs can be compared approximately to the shape with a regular geometry, the problem of diffracting electromagnetic fields on them has been reduced to the problem of diffraction by a sphere.

**Keywords:** extremely high frequency range, silkworm eggs, internal electromagnetic field.

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**EXTREME ALGORITHMS OF SOLVING THE COEFFICIENT PROBLEMS WITH HIGH ORDER OF ACCURACY**

page 42–45

To study the thermal properties of materials by inverse methods, an appropriate class of mathematical models was derived. The procedure of processing of mathematical models is reduced to an extreme setting that allowed the development of efficient algorithms for solving coefficient problems of an arbitrary order of accuracy. The results of test problems solution based on the proposed approach were given.

Additional conditions were considered that allow the division of the studied problem into two – temperature and streaming. The first one gives the opportunity to solve the coefficient problem within the specified range of temperature change with the control parameter in the form of thermal diffusivity (model), the second – in the form of thermal conductivity and heat capacity (model 2). The study of mathematical models 1 and 2 was performed using the method of lines. Thus, the model 1 (for example, algebraic or functional) and model 2 (gradient) allow solving the coefficient problem in the extreme setting.

An application package for solving the coefficient problems of heat conduction using mathematical modeling was developed taking into account the requirements of object-oriented programming. The modeling procedure was implemented based on the application of a multiprocessor computation system. The application package is designed to process thermal experiments by inverse methods.

**Keywords:** coefficient problems, extreme setting, mathematical model, thermal conductivity, heat transfer.

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