

MECHANICAL AND THEORETICAL ENGINEERING

E. N. Eremin, G. N. Minnekhanov, R. G. Minnekhanov

The use of inoculating modification to increase durability of cast stainless steel blanks to intergranular corrosion

The problem of improving the quality of centrifugal pipes made of stainless steel is considered. It is proposed to tap ferro-titanium in a furnace under slag, after its deep deoxidation by REM-containing additive for receiving such pipes with high mechanical and service properties. Before tapping the melt from the furnace, the melt must be processed by nano-dispersed titanium carbonitride in the modifying briquette composition. Implementing the above conditions allows increasing the tensile strength of cast metal by 10–15 %, plasticity by 30–45 % with increasing resistance to intergranular corrosion (IGC) in the casting section.

Keywords: steel 08H18N9T, pipe blank, centrifugal casting, dispersed inoculator, nanodispersed particles, modified metal, mechanical properties of castings, intergranular corrosion.

D. I. Chernyavsky, D. D. Gapon

The application of laws of conservation of energy and momentum during trenchless horizontal laying of communications

An engineering technique is proposed for calculating the technical parameters of a pneumatic hammer for horizontal clogging of steel pipes into the foundation of roads for the laying of various communications – electrical cables, communication lines, sewerage, etc. The method is based on the use of equation of laws of conservation of energy and momentum. Examples of horizontal clogging of pipes in a compressible soil are considered. The concept of «additional mass» is introduced taking into account the friction force of the soil the pipe. This value is added to the weight of the pipe. This makes it possible to estimate the efficiency of the transport of kinetic energy from the hammer to the pipe as penetration of the pipe into the ground increases.

Keywords: impact theory, underground laying of communications, pneumatic hammer, mass of hammer, laws of conservation of energy and momentum.

A. V. Obryvalin, D. V. Muraviev, K. V. Averkov, A. A. Rauba

Simulation of process of slider formation on rolling surface of wagon wheel under laboratory conditions

The article presents the design of a device that makes it possible to investigate in the laboratory conditions the process of formation of a slider on the rolling surface of the wheel. A technique for studying the formation of thermomechanical damages on the rolling surface of a wheel of a freight car is proposed. The results of an experimental study of the motion of a wheel along a rail with the use of physical modeling are presented. An estimation of the change in the properties of the metal of the wheel in the region of thermomechanical damage with the use of metallographic analysis are performed. Conclusions and suggestions are made.

Keywords: wheel, slider, wear, repair, hardness, structure.

S. B. Skobelev, G. G. Bury

Analysis of effect of shock-acoustic treatment regimes on wear resistance of steel 45

The paper presents the results of experimental studies of the effect of shock-acoustic treatment regimes on the wear resistance of samples when tested in a friction pair steel 45 – Br AJ 9–4. The influence of the values of the total treatment factor on the microhardness and roughness of the treated surface is studied, and the dependence of the friction moment in the period of run-off on the values of the total processing factor is obtained. The rational values of the total treatment factor for steel 45 are determined, at which minimum wear of the samples during the run-in period is achieved.

Keywords: shock-acoustic treatment, wear resistance, frictional moment, surface roughness, microhardness, run-in, total processing factor.

V. A. Sokolov, N. B. Salykov, A.V. Sedikova

Development of equipment for welding pipes made of fluoroplast-4D

The description of the installation developed for overlap welding of tube shells of fluoroplast-4D used in the equipment of chemical and petrochemical industries is presented. The results of research of the technological process with application of bounding thermal expansion of internal and external mandrels, and also recommendations for the choice of welding modes are given.

Keywords: fluoroplast-4D, pipe shell, annular gap, thermal expansion, diffusion, strength.

ELECTRICAL ENGINEERING. POWER ENGINEERING

E. G. Andreeva, V. S. Plekhanova

The research of magnetic field, its power characteristics, properties of materials of electrical devices with unclosed magnetic system

The article is devoted to the research of magnetic fields and their power characteristics in electrotechnical devices with an unclosed magnetic system (magnetic core) of various design and function. The purpose of the research: the development of electrotechnical devices with various design of unclosed magnetic systems, their mathematical and simulation modeling, taking into account the magnetic properties of the materials used to improve the technical and economic and mass-dimensional indicators (energy efficiency). Research methods: Numerical solution of the magnetic field equations by the finite element method and simulation using ANSYS and ELCUT software products. The results of the investigation of the electrotechnical devices with an unclosed magnetic system of various design purposes, conducted for a long time, is the development of magnetic field concentrators and the creation of hybrid magnetic systems. Conclusion: the developed electrotechnical devices with unclosed magnetic core allow, due to its design and configuration of the magnetic field, to increase the power characteristics of the magnetic field, ponderomotive forces, technical and economic and operational properties of the devices.

Keywords: electrical device, the magnetic system (magnetic core), the magnetic field, the power characteristics of the magnetic field, numerical modeling, software product.

A. V. Bubnov, A. N. Chetverik

Improvement of dynamics of electric drive with phase synchronization, built on the basis of pulsed frequency-phase discriminator with extended functional possibilities

The electric drive with phase synchronization, widely used in thermal imaging and laser scanning systems due to the high dynamic characteristics in a wide range of adjustment of the angular velocity. The aim of the article is development of management method by an electromechanic with phase synchronization, realized on the basis of impulsive frequency-phase discriminator with the extended linear zone in the mode of phase comparison of entrance impulsive sequences. The method for controlling the electric drive with phase synchronization with the implementation of a control system based on a pulse frequency-phase discriminator with enhanced functionality has been improved. Schematic implementations of the logical comparison device with the extended linear zone of the IPFD in the phase comparison mode, which allow improving the dynamics of the electric drive in synchronization mode, are proposed.

Keywords: the electric drive with phase synchronization, synchronously-inphase electric drive, multifunctional logic comparator, discriminator, linear zone.

V. R. Vedruchenko, A. V. Shtib, I. I. Malakhov

On modeling problem of optimizing the environmental performance of ship power plant with reciprocating thermal engines as complex technical systems, taking into account operating costs and risk indices when operating on multi-grade fuels

On modeling the problem of optimizing the environmental performance of a ship power plant with reciprocating thermal engines as complex technical systems, taking into account operating costs and risk indices when operating on multi-grade fuels.

A mathematical model of the problem of optimizing the environmental performance indicators of technical complex systems is presented based on the criterion of minimum total costs. The developed optimization criterion allows to take into account both operational costs and accident risk indicators for the operation of complex systems. The efficiency of the developed models is confirmed by the results of the simulation.

Keywords: numerical simulation, ecology and economy of a complex heat and power system environmental compatibility of a complex technical system, accident risk indicators, operating costs, minimum cost criterion.

E. V. Ptitsyna, D. V. Ptitsyn, A. B. Kuvaldin

Mixed load operation in current-powered mode complex shape

The article presents the results of experimental studies of energy, technological parameters of the load in a steady state after switching in the network by the example of a mixed load with a power supply current of a complex shape connected to a power supply unit (on a physical model of an electric furnace of resistance to indirect and direct heating with dark infrared emitters and energy-saving light sources, and low-voltage electrode water heater and energy-saving light sources). The purpose of the work is to study the electrical modes of mixed load in the power supply unit (electrotechnological and lighting systems) to develop recommendations for the selection of effective modes of mixed load operation when feeding with a complex form of current for the development of automated control systems. It is established that the mixed load with power supply by the current of complex form continues to work in the effective mode after switching in the

network. To improve the efficiency of mixed load control, it is necessary to use two control channels: on the amplitude of the voltage (current) and on the frequency spectrum.

Keywords: electric furnace of direct and indirect heating resistance, the current is of complex shape, the low-voltage electrode water heater dark infrared emitter light source.

V. V. Kharlamov, A. V. Sklyar, D. I. Popov, A. V. Eroshenko

Mathematical model of induction motor containing slot harmonics effect in magnetic field and various types defects presence

The article presents mathematical model of induction motor taking into account the appearance of the slot harmonics in the air gap magnetic field induction. This model can be used in the development of stator current spectrum analysis methods. There are presented the results of low power induction motor mathematical modeling with various types faults. The conclusion is made about spectrum-current analysis possibility to determine the induction motor rotor speed in the presence of defects.

Keywords: induction motor, mathematical model, air gap, engine defects, slot harmonics.

P. A. Batrakov, D. G. Mumladze

Investigation of combustion patterns in furnace type chemical reactor with non-stoichiometric combustion of fuel in the Ansys CFX software package

The paper considers the calculation of the combustion chamber of a chemical reactor in the software complex Ansys CFX, which allows to determine the thermal characteristics, as well as the concentration of CO, CO₂ at the output with different air flow coefficients. The paper presents the computational model, the initial conditions, and describes the calculation algorithm and the formation of the diffusion scheme. Verification of the methodology for adequacy when comparing the numerical model in ANSYS CFX with the literature data, which showed a maximum discrepancy of 6,92 %. Calculations shows that the operating mode of the reactor will be observed for $\alpha < 1$.

Keywords: Chemical reactor, combustion chamber, non-stoichiometry, air flow coefficient.

V. P. Beloglazov, L. V. Mostovenko

To the question of «relaminirization»

The purpose of the publication is to identify the trapping features in an inertia-vacuum ash collector. The inertia-vacuum ash collector (IVAC) is an inertial type ash collecting device having a purification degree of gases over 95 %. The relevance of the article is confirmed by the state program of energy development, which is interested in the modernization of ash collecting devices in connection with the lowering of the maximum allowable concentration limit for ash emitted by power plants into the air. The tasks considered in the article include the description of the process of relaminirization, the presentation of its occurrence, the calculation of the corresponding values to confirm its presence during the ash removal process in the IVAC. The results are companion calculations, which are accompanied by conclusions.

Keywords: relaminirization process, ash collection, flow regime, inertial-vacuum ash collector, laden flow, innovation.

D. V. Borisenko, I. V. Prisukhina, S. A. Lunev

Machine state classification of electric track circuit by means of logistic regression

Electric track circuits are widely used on railways as sensors providing position of a train and information about physical integrity of rails. A modern railway monitoring system is required to have automatic data analysis capabilities. For a track circuit this functionality can be implemented as automatic state classification. To perform this task, we developed an algorithm based on logistic regression. In this article we describe basic principles of the algorithm and machine learning techniques that are applied.

Keywords: railway signaling, electric track circuit, machine learning, classification, logistic regression.

A. G. Mikhailov, O. V. Vdovin, E. N. Slobodina

Heat exchange processes in volume of fire-tube boiler with non-water heat transfer fluid

The article suggests the solution of problems related to the intensification of heat transfer from the high-temperature organic heat transfer fluid. The main advantages of high-temperature heat transfer fluid are given. Heat transfer processes by heat conduction and convection are considered. The criterial equation describing heat exchange in the volume of a high-temperature organic heat transfer fluid under natural convection is presented. The description of a nanofluid and its main characteristics are given. Present models of calculating the basic thermophysical properties of a nanofluid (density, heat capacity, viscosity, and thermal conductivity) are presented. Based on the results of the calculated experiment, graphs of the dependence of density, heat capacity, viscosity, thermal conductivity, Grashof number and heat transfer coefficient of ditolylmethane and nanofluids based on it (ditolylmethane + Cu (1%) and ditolylmethane + Cu (5%)) on temperature are plotted.

Keywords: high temperature heat transfer fluid, fire-tube boiler, nanofluid, thermal conductivity, coefficient of heat transfer, non-water heat transfer fluid.

D. I. Popov

Mathematical modeling of physical processes in test complexes of electric machines

The article is devoted to the study of the issue of creating energy-efficient test complexes designed for testing induction motors and DC motors by the method of mutual load. For the considered schemes, mathematical models are made, allowing to study static and dynamic modes of operation both in the test and load machines, and in the elements of the frequency converter. The practical value of the obtained mathematical models is that they can be used in the design process of new test complexes to determine the necessary parameters of the equipment at the known parameters of the tested motors, as well as to simulate transition process in the electrical circuits of the test scheme in order to virtual check of possible algorithms for setting the load.

Keywords: test complex, electric machine, load tests, mathematical model, frequency converter.

E. M. Rezanov

The increase of technical and economic efficiency of operation of thermal oil boilers

The advantages of thermal operation of thermal oil boilers are considered. An algorithm is proposed for determining the optimum air heating temperature required for burning fuel in boilers of

petrochemical production, proceeding from the minimum of the total discounted costs for a recuperative device and burned fuel.

The expediency of using the developed algorithm is substantiated, which makes it possible to reduce fuel consumption and increase the efficiency of a thermal oil boiler unit.

Keywords: efficiency, costs, air, heat transfer, fuel, boiler unit, temperature.

A. Yu. Finichenko, A. A. Tartachev

Selection of optimum parameters of system of solar collector on basis of climatic data for chosen location

Charge climatic daily data for the annual period is made for the set location, primary analysis of the obtained data and detailed visualization of position of the Sun within a year, the choice of optimum technical parameters of system of a solar collector on the basis of climatic data for the chosen location (Omsk). The technique of selection of a solar collector is given.

Keywords: solar collector, energy saving, thermal energy, climate, heliosystem, heating, hot water supply.

F. A. Losev, V. V. Sushkov

Technique and algorithms for induction electromotive loading node stability assessment of oil fields at three-phase unbalance voltage sag

The main aim of the research is stability assessment of induction electromotive loading node at to three-phase unbalance voltage sag. The authors developed a technique and algorithms of loading node stability assessment on the basis of mathematical model of an induction motor, the transformer and the line for a positive-sequence network and a negative sequence network. The modeling results showed that voltage increase in a negative sequence leads to decrease a stability reserve of induction electromotive loading node.

Keywords: induction electromotive loading node, three-phase unbalance voltage sag, dynamic stability, stability reserve.

E. S. Flek

Development and analysis of physical and mathematical models of combustion of single drops of coal-water fuel in furnaces of boiler plants

In the article there is considered one of directions of increase of efficiency of use of coal – burning coal-water fuel (CWF). There is developed a physical and mathematical models of the combustion of droplets of CWF with division of the process into a sequence of repetitive stages of evaporation and burning out of the solid phase. The formula for calculating the time of burnout of a single drop of CWF on the basis of the Sreznevsky equation is obtained. The results of calculation of time of burning of a drop depending on a radius of a drop and a moisture content are presented.

Keywords: coal-water fuel, ignition, combustion, evaporation, physical model, mathematical model.

**A. O. Shepelev, S. S. Girshin, V. N. Goryunov, O. A. Sidorov, K. V. Khatsevskiy,
E. Yu. Shepeleva**

Mathematical modeling of electric regime of closed supply network taking into account temperature dependence of active resistances

In this paper, there is considered the problem of calculating the mode of an electrical network with two-way feed, taking into account the temperature dependence of the active resistances. The purpose of the article is to analyze the modes of an electrical grid with and without consideration of the mutual influence of electro-thermal processes. The simultaneous solution of the equations of electric and thermal regimes is realized on the basis of temperature correction in the formation of the Jacobi matrix at each iteration of the solution of the nodal stress equations. Taking into account the temperature dependence of the active resistances allows us to clarify the parameters of the regime of the electric power system. Based on the results obtained, it follows that when taking thermal processes into account, the currents, voltage deviations and power losses in the network are substantially refined. The greatest degree of refinement takes place when calculating the losses of active power.

Keywords: electric regime, the temperature dependence, Newton method, active resistance.

**INSTRUMENT ENGINEERING, METROLOGY
AND INFORMATION MEASURING EQUIPMENT AND SYSTEMS**

Yu. M. Veshkurtsev

New generation modem for future data transmission systems. Part 1

New methods of signal modulation and demodulation implemented at the level of invention in the modem structure are considered. Theoretically there are investigated and statistical modeling confirmed noise immunity of the modem when working in the channel without interference.

Keywords: characteristic modulation, demodulation, the noise immunity of the modem, error probability, estimation, characteristic function.

V. A. Zakharenko, Ya. R. Veprikova, D. Yu. Kropachev

Pyrometer for temperature measurement of melts

The paper describes a new approach to melt temperature measurements using fiber-optic pyrometer. An analytical review of methods and means of measuring the temperature of high-temperature melts is done. Operational characteristics of materials of covers for contact thermometry are given. It presents calculations and experimental results on the justification of the spectral characteristics of materials of the crucible emitter type model of blackbody. There is shown the design of the crucible. The results of full-scale tests of the proposed pyrometer for measuring the melt temperature in a quenching furnace at Omsk enterprise of JSC «Omsktransmash» are presented.

Keywords: absolutely black body, the temperature of the melt, the coefficient of blackness, the crucible, the pyrometer sighting tube.

R. B. Burlakov

Determination of contact resistivity of ohmic contacts to semiconductor plates by the method Cox-Strack

Modified variant of the method Cox-Strack, which allows to reduce an amount of frontal contacts on the test sample before 2 and simultaneously exclude an operation of the extrapolation of schedules at the determination of the specific contact resistance ρ_K , is considered. There is shown that contribution of the contact resistance R_K in the impedance R_T of the test structure takes greater values, when diameter of the frontal contact lies in the interval 40–1040 micrometer, that promote more efficient process of supervision resistivity of ohmic contacts to semiconductor plates.

Keywords: ohmic contacts, semiconductor plate, measurement of contact resistance, method Cox-Strack, optimization of measurements.

V. F. Kovalevskiy, S. B. Skobelev, G. G. Bury

Application of electrohydraulic effect for stripping from terminals of plastic parts

The paper reviews the methods for cleaning plastic parts. The physics of the electrohydraulic effect processor L. A. Yutkin is considered. The design of the pilot plant, as well as the interchangeable devices used to remove the flare from the terminals of the plastic parts, is presented. The results of experimental studies of the application of the electrohydraulic effect for the removal of a cover are presented. During the processing, the thick layer of stripping is completely removed from the leads in 1–2 minutes. On the conclusions of the details there are small areas covered with a layer of a few micrometers thick.

Keywords: conclusions of plastic parts, electrohydraulic effect, breakdown, cleaning device, spark discharge, hardening.

E. V. Leun

Questions of constructing probe active control devices for product sizes

The article presents probe active control devices (ACD) of the size of products, describes the composition, versions, principle and modes of operation. The measurements are carried out by two-coordinate vibration oscillations of the tip along a closed path with a section of co-directional motion and mechanical contact of the lc with the surface of the moving product. The tip moves v_{tip} with a slight lag from products v_{det} with a small relative velocity $\Delta v = v_{tip} - v_{det} \approx 0$, thus implementing a moving feeling, like a needle profilometer or a cantilever, measuring its position in two coordinates l_x and l_y . The measurements consist of a sequence of such feelings.

The article discusses the issues of the functionality, continuity and accuracy of probe ACD measurements.

Keywords: active control, the size of the product, scanner, vibromotor, piezomotors, probe microscopy, tip.

E. V. Leun, V. I. Leun

Features of contacting of transparent and high-strength measuring tips of active control devices of sizes with products during process of their grinding

The article is devoted to the analysis of the load capacity of measuring tips of active control devices (ACD) with the size of the products in their mechanical contact. The value of the depth of

indentation of the measuring tips into the product is calculated, which leads to the formation of measurement error. Transparent and high-strength materials for the manufacture of measuring tips are considered.

The mode of mechanical interaction for experimental studies of the features of contact between the sapphire tip and the high-speed steel cutter is determined and the value of the specific energy in this contact is calculated. It is shown that the resulting loads, having a ≈ 40 fold safety margin and corresponding to the quasi-plasticity regime, do not lead to brittle fracture.

Keywords: active control, contact measurements, non-contact measurements, product size, corundum, sapphire, tip.

E. V. Nikolaeva, M. Yu. Nikolaev, A. S. Molodtsov, N. E. Pimneva, M. V. Kazakov
Measurement of toothed helical gears and worm gears on coordinate-measuring machine

A new method of measuring parts of complex geometric shape on the coordinate measuring machine KIM-1000 of the Russian company «Lapik» has been developed and implemented. The new method allows to determine the basic parameters of helical gears, wheels and worm gear pairs with high accuracy up to 1 μm . Control and measurement of parts is possible not only with a screw, but also with a threaded and intermittent surface. The obtained experimental method of measurement on the coordinate-measuring machine allows to exclude all the variety of low-productive hand tools and equipment, improve accuracy and efficiency. And the introduction of automatic measurement on the coordinate measuring machine allows to exclude a number of subjective errors of the operator.

Keywords: coordinate measuring machines, gears, worm wheels, propellers, threaded parts, experimental method of measurement.

P. I. Puzyrev, S. A. Zavyalov, V. V. Erokhin, V. Yu. Shein
Low-rate modem for transmission of small data in medium frequency range for Arctic

In this paper, we consider the implementation of a low-rate modem for the transmission of small data, such as short text messages, distress messages, commands, notifications, coordinates, etc. The modem uses orthogonal 64-position frequency shift keying characterized by a lower probability of bit error, the possibility of non-coherent demodulation and a constant envelope. The structure of the modem is designed for implementation in software and for the implementation in languages of the description of equipment for SDR systems. The procedure of primary time synchronization, detection, frame synchronization and demodulation is considered. The use of a low-rate modem will expand the radio coverage area in the Arctic, where there are no cellular networks.

Keywords: modem, multiple frequency shift keying, detector.

N. A. Semenyuk, Yu. V. Kuznetsova, Vad. I. Surikov, Val. I. Surikov, A. A. Teploukhov
Application of vanadium dioxide in acoustic logging devices

The study of the elemental composition of samples of vanadium dioxide is used as a thermal sensor in logging complexes after a series of 0, 15, 30, 50 thermal cycles. The influence of thermal Cycling on the elemental composition of the surface of vanadium dioxide and the electrical properties of VO₂ in the vicinity of the phase transition is studied. There is change in the electrical properties of the material in the phase transition metal–semiconductor. It is revealed that the value of the

electrical resistivity jump at the phase transition is significantly less for the sample, after a series of 50 thermal cycles compared with the original sample.

Keywords: vanadium dioxide, phase transition metal-insulator, electrical properties, Schottky defects, elemental composition.

INFORMATION TECHNOLOGY

V. N. Zadorozhnyi, E. B. Yudin, V. A. Badryzlov

Vertex degree distributions of growing graphs: calculation methods using error control

Methods for calculating final distributions of vertex degrees in growing graphs with a nonlinear rule of preferred binding are developed. The problem of calculation errors control is solved. Formulas for determining the key properties of calculated distributions are developed. Examples of calculation with error control are given.

Keywords: random graphs with nonlinear preferential attachment rule, vertex degree distribution, numerical methods.

V. G. Khomchenko, I. M. Zuga, A. N. Kuzhel, A. O. Stroyev

Local relief approximation with deterministic methods for optimizing production facilities layout on rough terrain

Relief approximation is proposed in the vicinity of the facility location at the current computational iteration using the Lagrange's interpolating polynomial. Formulas are given for the operative transport at each coordinates iteration of a proportional geodetic grid in the local coordinates of 16 fixed points required during the optimization process. Localization of the relief vicinity is performed algorithmically depending on the current values of the geometric image center coordinates of the certain facility foundation.

Via an example of a real territory relief the comparative assessment of the accepted local approximation with the results of the software product AutoCad Civil 3D is given.

Keywords: rough terrain relief, local approximation, production facilities layouts, Lagrange's interpolating polynomial.

I. M. Zuga, V. G. Khomchenko, A. N. Kuzhel, A. O. Stroyev

Mathematical model for designing optimized layouts of production facilities on cross-country terrain

This article contains information on the obtained model of accounting the production facilities location in an area with a cross-country terrain. Two criteria are proposed for the search for an optimal interposition of technological products source facilities and receiver facilities, taking into account the height difference. A characteristic of the source facility is introduced. Examples of the way for filling tables with communication costs levels in the vertical direction and the tables with the characteristic of the source facility are given.

Keywords: cross-country terrain, production facilities, layouts, optimized synthesis.

S. V. Fedorov

Decrease in errors at solution of problems of heat conductivity by finite element method

The method of the choice of a step on time at the solution of non-stationary problems of heat conductivity is presented in the article. Comparison with the analytical decision is made. The algorithm of the choice of a step in the automatic mode is offered. Application of this technique allows to reduce significantly expenses of machine time for carrying out calculation of the non-stationary temperature field without error in accuracy.

The specified technique is realized in the Temper-3D program used for performance of heat technical calculations of the protecting designs.

Keywords: finite element method (FEM), heat technical calculation of FEM, «Temper-3d», validation of EN ISO 1021, automatic generation of final and element network.

R. A. Khakimov

Identification of mathematical model of diesel fuel hydrotreatment process for creation system optimization of group of technological units of oil refinery plant

The article deals with the dynamic optimization of complex technological processes on the example of the process of hydrotreating of diesel fuel. The purpose of the study is to create a system of optimization of a group of technological installations in real time. The relevance of the study is determined by the fact that the existing optimal control systems solve the problem of local optimization of one process, rather than the problem of global optimization of oil refinery chains. There is also a problem of lack of integration solutions between the optimal planning systems and control systems of technological installations. As an integration system, it is proposed to use the system of optimization of a group of technological installations in accordance with the hierarchy of refinery management systems, discussed in this article. In the framework of the study, the identification of the technological process to obtain a mathematical model of several plants of different capacity using regression analysis methods of historical data. The model has been evaluated with statistical estimates and meets the requirements of accuracy and adequacy. As a result of the study, a mathematical model of hydrotreatment is developed to solve the problem of minimizing energy consumption while respecting product quality restrictions. The quality of the obtained model confirms that the creation of a system for optimization of a group of technological units in real time is possible, and the model can be used in dynamic optimization of the production chain of diesel fuel.

Keywords: advanced process control systems, mathematical modeling of process of hydro treatment of diesel fuel, identifications of technological process, regression analysis, optimization of group of installations.

A. S. Serobabov, E. V. Chebanenko, L. A. Denisova, T. S. Krolevets

Early disease detection expert system development: primary machining software applications and dependences

The article observes descriptive statistics tools for the biomedical information processing, clinical trials data on the nonalcoholic fatty liver disease (NAFLD). The primary machining software package structure which characterizes patienthood including the laboratory studies results, comorbidity, patient's physiological parameters is elaborated. The interconnections map of the patienthood diagnostics was retrieved, which enables to detect the dependences between the liver disease markers for the early disease detection expert system development.

Keywords: descriptive statistics, expert system, early diagnosis, non-alcoholic liver disease, correlation analysis.