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EFFICIENCY ANALYSIS OF HEAT PRODUCING UNIT AT VARIABLE OPERATING MODES WHILE BURNING ADDITIONAL FUEL IN HEAT RECOVERY BOILER

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Abstract

Background: Currently the usage of the fuel combustion chamber and additional heat exchanger behind the heat recovery boiler for the heating network water is theoretically proved. It is necessary to evaluate the effectiveness of such power generating unit at variable operating modes of a gas turbine.

Materials and methods: Development of dependency is made on the basis of technical documentation for combined-cycle gas turbine and the calculation of boilers.

Results: Based on the established mathematical dependences for nominal operation mode of combined cycle plant, which includes a heat recovery boiler with an additional gas-water heat exchanger and combustion chamber additional fuel formulas for evaluating the performance of power unit at variable modes are obtained. Based on the obtained equations the analysis of efficiency combined cycle plant at variable modes operating was performed.

Conclusions: The author concludes that the efficiency increases in the power unit with the optional gas-water heat exchanger and the combustion of additional fuel behind heat recovery boiler at variable modes operating is from 1.5 to 5.1%. The considered mathematical equations allow not only to define the mode and technical and economical characteristics of the object but also to predict the changes with regards to the source data concerning to the similar units, which utilize the heat from gases of the gas-turbine units.

Key words: combustion chamber of additional fuel, variable mode, the relative consumption of additional fuel, heat power.

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MODELING OF DEAERATION PROCESS IN BUBBLE STAGE WITH LIQUID FLOWS CIRCULATION

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Abstract

Background: Steam supply in bubbled liquid causes the appearance of circulating liquid flows, which at present are not considered in the description of deaeration process, but which can affect the size of steam bubbles, the area of interfacial surface and heat and mass transfer velocity. As a result, the circulation accounting of liquid flows is necessary for modeling of deaeration process.

Materials and methods: To consider the complicated movement of heat transfer agents in the layer and its influence on heat and mass transfer the authors use a new method, based on the Boltzmann kinetic equation.

Results: The mathematical model of water deaeration in bubbled liquid layer, based on the Boltzmann kinetic equation, is developed; parametric sensitivity of the model is investigated; the influence of circulating water flows on deaeration is shown.

Conclusions: The new approach to simulate the heat transfer agent movement and the heat-exchange process in bubbled liquid layer is proposed. The author prove that this method allows to increase the efficiency of deaeration process.

Key words: deaeration, bubble stage, heat and mass exchange, Boltzmann equation, interfacial surface.
References

INFLUENCE OF POWER AND RATED VOLTAGE OF WORKING POWER TRANSFORMERS ON OIL VOLUME IN MAIN INSULATION

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Abstract

Background: Nowadays there are no data in literature regarding the oil volume changes in basic insulation and its electrical strength statistical characteristics depending on nominal technical parameters of working power transformers. As a result, the research of the influence of power and rated voltage of working power transformers on oil volume in main isolation is very important.

Materials and methods: Using the data base of working power transformers technical parameters in a wide range of meanings the author analyzes the oil volume change in basic insulation depending on transformers capacity and nominal voltage, and also their damage rate while exploiting. To evaluate the change of electrical strength statistical characteristics of oil volume in basic insulation depending on its volume the author uses Gnedenko-Weibull's three-parameter distribution, which shows physical processes during oil testing.

Results: The author describes the correlation relationship between the oil volume in working power transformers in their basic insulation and their nominal capacities and voltages in a range of 25–1000000 kVA and 6–1150 kV. It is proved that when the transformers capacity rises in certain limits and voltage is fixed, the oil volume in main insulation is reaching 10–12, and if the transformer capacity is fixed, the oil volume with increasing of voltage class is reaching 3.5.

Conclusions: The received results are very important for the development of the specific exploitation limits to the basic insulation of the working power transformers.

Key words: Transformer, power, voltage, transformer oil, oil volume, electrical strength statistical characteristics.

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CHARACTERISTICS CALCULATION OF STEADY-STATE MODES OF ELECTRICAL POWER ENGINEERING SYSTEM WITH THE CONTROLLED DEVICE OF SERIES COMPENSATION

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Abstract

Background: The existing method of calculating the steady-state modes of the electrical power engineering system with the controlled device of series compensation should be constantly bound to the specific steady-state mode that is very inconvenient for researches and applying the controlled series compensation device with specific characteristics. It is important to carry out the characteristics calculation of the steady-state modes of the electrical power engineering system with the controlled device of series compensation without any links with the specific mode.

Materials and methods: The calculation of the steady-state modes of the electrical power engineering system with the controlled device of series compensation is carried out on the basis of the formed algebraic equations with using the Newton method. The verification of given results is controlled in "Energy" software package.

Results: The mathematical model is created and calculations of steady-state modes characteristics of the electrical power engineering system with the controlled device of series compensation are made without without any links with the specific mode, the initial data include characteristics of the controlled device of series compensation.

Conclusions: The developed software means allow to define changes of mode parameters at the set regulating device characteristic, to obtain controlled device characteristics for the solution to the problem of stability improvement, and to make steady-state modes calculations of electrical power engineering system with the controlled device of series compensation, altering the way of mode weighting at various calculation stages.

Key words: controlled device of series compensation, steady-state mode, mathematical model.

References

ELECTROMECHANICS

UDK 621.321

MAGNETORHEOLOGICAL DAMPER WITH PISTON MAGNETIC SYSTEM

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Abstract

Background: Magnetic liquid dampers have already been used in practice, but there is no fairly complete theory of the influence of magnetic fields and hydrodynamic processes on their power and dissipation parameters.

Materials and Methods: Simulation results of the electromagnetic field of the magnetic liquid damper in the ANSYS system and S.M. Targal’s hydrodynamic solutions are applied in the article.

Results: The authors consider the damper simulation with nanodispersed magnetic rheological liquids and piston magnetic system with the alternating poles and the magnetization reels. The authors find out that the damper properties and power characteristics of the device are defined by characteristics of the magnetic rheological liquids, intensity of the piston magnetic field, and the shift speed.

Conclusions: The proposed formulas can be used to estimate hydraulic parameters of dampers with magnetorheological liquid and the piston magnet system.

Key words: nanodispersed magnetorheological liquids, magnetic field, simulation, damper, magnetic liquid, piston magnetic system, shift speed, viscosity.

References


Abstract

Background: The actuality of the article is connected with the replacement problem of the toxic additions in the lubricating and cooling technological substances on less toxic and biodecomposable additions without losses of functional properties of these substances. At present time in scientific literature there is information about the possibility to apply the mesogenic cholesterol compounds as good additions. But the problem still requires the further research.

Materials and methods: The authors tested a large number of the lubricating and cooling technological substances structures with additions of cholesterol mesogenic compounds (MCC) while holes drilling.

Results: The authors carried out the experimental researches. The efficiency criterion of lubricity of the lubricating and cooling technological substances was suggested. The authors defined the most effective structures of the lubricating and cooling technological substances.

Conclusions: Implementation of the additions of cholesterol mesogenic compounds for the lubricating and cooling technological substances allows improving the lubricating ability of the structures and the quality of metal treatment.

Key words: metal treatment, drilling, surface quality, lubricant, cutting oil, lubricating fluid, additions, cholesterol compound, mesomorphism, tribology.

References

UDK 621.538

RESEARCH OF DISTRIBUTION OF MAGNETIC FIELD STRENGTH AND MAGNETIC FLOWS IN CLASSICAL MAGNETO-LIQUID SEALER

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Abstract

Background: Nowadays there are no data about detailed distribution of magnetic field in magneto-liquid sealers. As a result, it is important to carry out the research devoted to the distribution of the magnetic field strength and magnetic flows in classical magneto-liquid sealers.

Materials and methods: The research is performed on the basis of modeling the magnetic field by means of the method of finite elements. The author uses the differentiated finite element scheme of 1080000 triangular elements.

Results: The author considers the main regularities of the distribution of magnetic field in magneto-liquid sealers: in the gap, on the magnetic system surface, in the cavity under the magnet. The author defines the distribution of the magnetic field strength in the gap, in the space near the magnetic system of the magneto-liquid sealer. The main magnetic flows of the magnetic system and their correlations are described. It is shown that the ends of the teeth of the pole attachments are able to perceive the pressure drop by 9.5% higher than the average. As a result of the simulation the author determines the detailed distribution of magnetic field strength of the magneto-liquid sealer.

Conclusions: The given results allow to design, test, operate, and fill the the magneto-liquid sealer.

Key words: magneto-liquid sealer, magnetic field, distribution of magnetic field strength, magnetic flows.

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VISCOMETER DESIGN FOR MAGNETIC LIQUIDS RESEARCH

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Abstract

**Background:** Due to the development of techniques and devices working with magnetic liquids, the problem to research the flow characteristics of magnetic structured nanoliquid media is very urgent. The creation of new constructions of the viscometers as well as modernisations of the known ones can help to solve the problem.

**Materials and methods:** Calculations of magnetic characteristics of the offered magnetic viscometer design are executed on the basis of the method of final elements.

**Results:** The author describes the specially developed design of magnetic viscometer which helps to research flow characteristics of magnetically dispersed environments named magnetic liquids (ML). The author considers the influence of external magnetic field strength on flow characteristics, magnetic properties of measuring surface of magnetic liquids parametres. The analysis of the received data is carried out.

**Conclusions:** The developed design of magnetic viscometer will allow to investigate properties of magnetic liquids environments in the magnetic field.

**Key words:** rheology, viscometer, magnetic structured media, magnetic liquid, magnetic field, ferromagnetic particles.

References


HEAT CALCULATION OF TRANSFORMERS WINDINGS AND CURRENT-LIMITING REACTORS BY MEANS OF ELECTRICAL EQUIVALENT CIRCUIT

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Abstract

**Background:** At present time heat calculation of transformers windings and current-limiting reactors of aluminum or copper tape are carried out by methodologies without taking into account the current crowding-out effect. So, there is great difference between calculated and experimental values of middle and maximum temperatures. The development of the exact mathematical model of transformer windings with taking into account the irregular current distribution on tape height is necessary.

**Materials and methods:** The authors use the thermal tests results of windings of current-limiting reactor 1600 A, 0.35 Ohm, as well as the thermal tests results of low-tension windings of dry-type transformers. The authors apply the method of heat circuits and method of electrical equivalent circuits while developing the model.

**Results:** The heat model of windings is developed. It considers the irregular current distribution on tape height. The authors provide the comparative analysis of the measurement results of temperature distribution in tape windings with calculation values.

**Conclusions:** The offered mathematical model can be used for increasing the calculation accuracy and designing efficiency of tape windings. It is proved that the temperature distribution in the tape windings can be defined with the high accuracy by means of calculations of the offered model.

**Key words:** tape winding, current displacement, heat transfer, heat circuits, heat convection coefficient.

References

COMPENSATION OF LOAD TORQUE HARMONIC DISTURBANCES IN FOLLOWING ELECTROMECHANICAL SYSTEMS AND ELEMENTS OF CONTROL STRUCTURAL OPTIMIZATION

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Abstract

Background: Polyharmonical load torque is a main feature of electromechanical systems. Load torque fluctuations and, hence, executive device speed fluctuations cause significant changes of the finished product quality measures. In electromechanical systems, which have conventional structures, considerable decrease in speed pulsations level by increasing the loop gain of the follow-up system can cause significant deterioration of control response quality and reduction of linear range of system operation.

Materials and methods: Simultaneous requirements satisfaction of control response and harmonic disturbance compensation are implemented by combining the principle of disturbance internal model with other principles of automatic control system design. These principles are cascade control, subordinate control with series correction, state control, polynomial output control, motion rates separation.

Results: Comparative assessment of operating efficiency of control devices, synthesized by the combination of listed methods, is implemented. Assessment factors are response quality of load torque harmonic disturbances, acceptable variations range of inertia moment of system mechanical part, pulsations level of output speed signal when the noise is on its measuring channel, maximum value of signals time delay in power converter when the system is stable and the total degree of regulator dynamic blocks as well.

Conclusions: The obtained results enable to demonstrate the way the appointed quality factors are underlined when designer uses the combination of different principles of the system design. It allows to make the proper choice of the most efficient control structure.

Key words: electromechanical system, disturbance compensation, internal model principle, control structural optimization, selective invariance.

References

PARAMETRIC SYNTHESIS OF MULTIMOTOR ASYNCHRONOUS DRIVE WITH THYRISTOR CONVERTER OF VOLTAGE

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Abstract

Background: In existing systems of multimotor electric drive for synchronous rotation a considerable quantity of thyristor converters of voltage and asynchronous motors are applied. It complicates the mathematical description of the given electric drives.

Materials and methods: For parametric synthesis of multimotor asynchronous electric drive with thyristor voltage converters the author uses the mathematical model of the asynchronous motor within the scope of performance characteristics as well as the application program package MATLAB. The flow diagram of parametric synthesis algorithm is developed on the basis of the theory of Lyapunov’s direct method, scanning numerical method, and random numbers.

Results: The thyristor control systems of multimotor asynchronous electric drive which allow to support the rotation synchronism with great differences of loads of driving motors such as a card. The author draws up the flow diagram of parametric synthesis algorithm of multimotor asynchronous electric drive with thyristor voltage converters which helps to calculate the connection coefficients according to the differences of engines speed to provide synchronism of engine rotation at different loads on the shafts.

Conclusions: The calculated numerical values of the connection coefficients provide the synchronous rotation of all mechanisms and their multimotor asynchronous electric drives with thyristor voltage converters. It confirms with the given and completely matched curves of transitional processes of engine rotation speed.

Key words: multimotor electric drive, algorithm, parametric synthesis, connection coefficient, thyristor voltage converter.

References

METHODS OF MATHEMATICAL SIMULATION

UDK 621.311.22

MATHEMATICAL MODELING OF THERMAL POWER-PLANT PIPES STATE IN CREEPING CONDITIONS

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Abstract

Background: Reliability of the pipelines operating under creeping conditions depends on the defects in metal in the form of pores and microcracks, the intensity of which is determined by the development and the ever-increasing plastic deformation. The existing forecasting models use the average performance, which can vary widely even in the same type of elements working in the same conditions. For sound prediction the model that adequately reflects the accumulation of defects, and takes into account the individual characteristics of the elements, is necessary.

Materials and methods: Evaluation of the connection between the damaged structure and residual strain is based on the statistical analysis of the pipelines diagnostics results of live steam and hot reheats Ryazan GRES, made of steel 15H1M1F. The appearance probability of individual classed of microdamages is determined by the Bayes method.

Results: The mathematical model that calculates the most likely and gamma percentages of permanent deformation and the likelihood of damage metal pores and microcracks is developed. The parameters values of the distributions for classes of structure microdamages are provided.

Conclusions: The proposed mathematical model is recommended for predicting the state of the metal bends and calculating the remaining resource.

Key words: pipeline bends, creeping, residual deformation, damageability, prediction of condition.

References

UDK 004.94

MOVEMENT SIMULATION OF VISCOUS INCOMPRESSIBLE FLUID ON THE NVIDIA CUDA

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Abstract

Background: The movement simulation of viscous incompressible fluid has a great number of different areas of practical application in engineering (for example, simulation of feed water flow in heat power plant loop). The similar tasks are resource-intensive in calculation. The expensive highly productive cluster multiprocessor systems are used to solve the task. So, the problem of the movement simulation of viscous incompressible fluid without expensive calculating clusters is urgent.

Materials and methods: The authors suggest solving the problem of the movement simulation of viscous incompressible fluid using the calculations on graphics processors (GPU). The NVIDIA CUDA platform is chosen as a means to carry out the calculations. It allows to make general parallel calculations on graphics processors. Besides, the authors use the adapted computing circuit of the problem solving algorithm of the movement simulation of viscous incompressible fluid.

Results: The article contains the way for simulating the movement of viscous incompressible fluid with using of calculations on graphics processors (GPU) that helps to reduce the computing system costs, save the high speed of calculations and their accuracy. The authors demonstrate the calculation acceleration in 85 times according to the operation in the central processor.

Conclusions: The authors carry out the calculations of the movement of viscous incompressible fluid on NVIDIA CUDA platform and it helps to accelerate the calculations in comparison with the program which can calculate only in central processor. The application of graphics processors allows to simulate the movement of viscous incompressible fluid without expensive calculating clusters. The costs of necessary equipment are less in 80–100 times.

Key words: numerical simulation, countercurrent derivative, parallel programming, NVIDIA CUDA.

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COMPUTER SCIENCE AND INFORMATION TECHNOLOGIES

UDK 004.6

AUTOMATION OF POWER CONSUMPTION RATIONING AND LIMITS IN BUDGETARY SPHERE OF THE REGION

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Abstract

Background: Fuel and power resources costs growth and, as a result, tariff rates growth make it necessary to assume measures aimed to increase energy consumption efficiency in all industry sectors. According to the law in the non-private sector considerable economy of fuel and power is to be achieved. Energy saving and energy efficiency enhancement co-ordination and their accomplishment by state-financed activities monitoring are up to relevant government authorities of the Russian Federation territorial units. In view of a large amount of information it’s reasonable to apply informational decision support tools for power consumption limits.

Materials and methods: Systems analysis of fuel and power resources consumption by non-private sector activities and power-consumption typology research aimed at reasonable average standards consideration became a basis for the developed methods for rating and limiting of non-private sector activities power consumption.

Results: An informational decision support technology which allows regional government authorities, public offices and public unitary enterprises to settle valid power resources consumption limits for achieving the savings rate ascertained by statute.

Conclusions: The implemented analytical service allows to determine power consumption limits taking into account an assessment of each activity FPR specific consumption deviation from the specified average standard for a relevant consuming cluster. Annual power consumption analysis allows to consider power resources expenditure reduction in the covered field.

Key words: Energy saving, budgetary sphere of region, power consumption rating and limiting, decision making support, informational analytic system.

References


APPLICATION OF STATISTICAL METHODS FOR PRIOR INFORMATION PROCESSING

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Abstract

Background: Statistical methods are widely used. The usage of a priori processing allows reducing a number of observations to design models.

Materials and methods: The author used the correlation analysis. The article also considers the informative determination method of independent features, based on the comparison of the probability characteristics.

Results: The author suggests the method of prior processing based on the correlation analysis. For the selection of input features the informative determination method of independent features is considered. As an example, the implementation of the methodology is discussed.

Conclusions: The method of prior processing is aimed not only at selecting the relevant variables, but also at testing the links between input variables. It allows to decrease a number of the required observations.

Key words: statistical methods, regression model, final figure, independent factor, mathematical expectation, variance, correlation, significance of coefficients, informational signs.

References

CERTIFICATION OF ISPU QUALITY MANAGEMENT SYSTEM IN ACCORDANCE WITH THE EFQM MODEL CRITERIA

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Abstract

Background: In the conditions of educational system reformation and the tendency to higher educational institutions amount reduction the problems of quality management in higher professional education arise with growing urgency. A certified quality management system of a university is one of the factors ensuring its competitiveness. The assessment of organization activities in accordance with the EFQM model criteria is a convenient certification tool implying objective research of quality management system condition.

Materials and methods: During certification in accordance with the EFQM model criteria, a combination of the following methods is used: questionnaire polls, self-assessment, conference meetings, benchmarking, and validation procedure.

Results: EFQM model levels are considered, certificate reception procedure is characterised, ISPU experience in model application and certification in accordance with the «Recognised for Excellence» level is described.

Conclusions: ISPU quality management system certification in accordance with the EFQM model criteria gives the university a splendid opportunity to establish more fruitful contacts and develop cooperation with European partners, initiate and take part in joint European projects, and strengthen ISPU leading status in the sphere of ensuring quality management among Russian universities.

Key words: quality management system, certification, excellence model, benchmarking.

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IDENTIFICATION AND ECONOMIC ASSESSMENT OF ENERGY SAVING POTENTIAL IN TEXTILE INDUSTRY

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Abstract

Background: The textile industry is one of the energy-intensive sectors of Ivanovo Region with a considerable energy saving potential. Energy resources efficiency is the main task for the textile enterprises.

Materials and Methods: The development of the calculation method of energy saving potential in textile industry is based on the structure analysis and dynamics of energy resources consumption.

Results: The energy-effectiveness indicators and energy saving coefficients are calculated. The approbation results of methods on the finishing and spinning&weaving factories of medium capacity are given. The authors prove the necessity of using the innovative developing model by textile branch.

Conclusions: The developed algorithm allows to estimate the quantity of possible economy of heat energy and electricity.

Key words: textile industry, power efficiency, typical energy saving projects, structure and dynamics of energy consumption, energy-efficiency ratio, calculation method, energy saving potential.

References

CONTROL OF ELECTRIC POWER QUALITY IN ELECTRIC POWER SUPPLY SYSTEMS OF METALLURGICAL ENTERPRISES IN MARKET CONDITIONS

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Abstract

Background: In market conditions the main factors which can define the production competitiveness remain quality and price. Hence, one of the most complex tasks during the production of the metallurgical enterprises is guaranteeing the quality.

Materials and methods: To research the control system of production of the metallurgical enterprise the method of the system analysis is applied.

Results: The control system of quality of the electric power in systems of power supply of the metallurgical enterprises in market conditions is given, as well as principles, technology and the main quality management processes of the electric power are developed.

Conclusions: The quality control system of the electric power at the metallurgical enterprises in the market conditions is developed. It allows to increase the competitiveness between enterprises as well as the quality of production.

Key words: Quality of the electric power, unsinusoidality, asymmetry, fluctuation, voltage, current, management technology, process approach, market, metallurgical enterprise.

References

CONTROL SYSTEM OF ELECTRIC COLLECTING ROLLER TABLE OF HOT ROLLING BROAD-STRIP MILL

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Abstract

Background: The current control method of electric collecting roller table of hot rolling broad-strip mill provides the required voltage in the strip due to the difference between the strip speed and the roller speed. This leads to the increased wear of rollbarrels and great replacement costs. As a result, the problem of efficiency increasing of the electric collecting roller table of hot rolling broad-strip mill is highly important.

Materials and methods: The experimental assessment of the influence of the speed difference for rollers barrels wear of roller table is carried out on the example of 2000 hot rolling broad-strip mill.

Results: The authors suggest the calculation method for the required torque electric collecting roller table with the technological features of the rolling cycles of hot strips. The article contains the control method for electric collecting roller table, which provides the required torque within the specified speed range in order to reduce the wear of barrels rolls. The block diagram for controlling the electric collecting roller table, which implements the proposed control method, is also developed.

Conclusions: The offered control method of the electric collecting roller table allows to decrease the broad-strip mill intensivity. The obtained results can be applied to improve the efficiency of the collecting roller table of hot rolling broad-strip mill by increasing the equipment service life period.

Key words: electric collecting roller table, wear of roll barrels, calculating load torque of electric drive, control system, block diagram.

References


UDK 62-83:004

DEVELOPMENT AND IMPLEMENTATION OF AUTOMATED ELECTRIC DRIVES AND CONTROL SYSTEMS OF TECHNOLOGICAL PARAMETERS OF HOT ROLLING BROAD-STRIP MILL

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Abstract

Background: The author pays special attention to the problems of control systems improvement of technological parameters of broad-strip mill, as well as automated control systems of speed, tension and thickness. However, because of the implementation of foreign-made equipment at iron and steel plants, the products to improve the automated electric drives and control systems at the Russian enterprises are developed limitedly. Another factor is the implementation of industrial controllers. The mentioned factors cause the importance of studying speed modes of electric drives.

Materials and methods: Methods of mathematical modeling of the interconnected electromechanical systems and experience trial on an acting mill are used.

Results: The complex of the developed and introduced scientific and technical solutions to the problem of perfection of automatic electric drives and regulating systems of technological parameters of broad-strip mills of a hot rolling is observed at gauges spreading rolling strips. Scientifically well-founded power saving up automatic electric drives, algorithms and management systems of the interconnected electromechanical systems of the broad-strip mill of hot rolling are developed.

Conclusions: The offered products provide accuracy raising of thickness regulation and strip tension, as well as stimulate the decrease of the losses of electric energy without application of any compensating arrangements. The flat rolled products manufacturing extends the opportunities of the present and new-build flat rolled devices, increases the economic production efficiency, its resources and energy savings, increase competitive ability.

Key words: rolling mill, electromechanical systems, technological parameters, control system, energy saving electric drive.

References


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ELECTRIC DRIVE CONTROL SYSTEM OF PULLING ROLLERS OF BLANKS CONTINUOUS CASTING MACHINE

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Abstract

Background: Nowadays, calculation and moment distribution of an ingot pulling for electric drives of pulling rollers are a paramount task for ensuring quality of the ingots.

Materials and methods: The authors use the developed mathematical model of resistance efforts calculation to the ingot pulling.

Results: The control system of the electric drive of the pulling rollers with implementation of the pulling moments distribution demanded on technological conditions is offered.

Conclusions: It is established that the offered model of efforts calculation can be used for the usage of the regulation system of pulling rollers.

Key words: automatic control system, electric drive, continuous casting machine
TECHNOLOGICAL DEMAND AND EFFICIENCY ASSESSMENT OF IMPLEMENTATION OF VARIABLE-FREQUENCY ELECTRIC DRIVES ON THERMAL POWER PLANTS

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Abstract

Background: The industrial implementation of variable-frequency electric drives on additional mechanisms of any thermal power station requires the technical and economic analysis. Thus, the features of the technological process and the equipment configuration should be considered attentively.

Materials and methods: The authors carry out the analysis of the technological demand of the controlled electric drive on the Heat Power Station of open joint-stock company «Magnitogorsk iron-and-steel works» in accordance with the basic criteria of the estimation of implementation technical efficiency.

Results: It is shown that with economy of electric energy the basic stimulating motives are the technological demand and automation possibility. The feasibility report is given, the implementation sequence of variable-frequency electric drives is offered at stage-by-stage redesigning of the Heat Power Station equipment.

Conclusions: Apart from the energy savings the main stimulating motives of frequency regulation systems implementation are the improvement of technological process and more accurate adherence to technical modes, as well as the improvement of working conditions and reliability improvement of heat-water supply of the population.

Keywords: heat and power plant, variable-frequency electric drive, implementation, technological demand, efficiency, sequence of upgrading.

References

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PERSPECTIVES OF ASYNCHRONOUS MOTORS APPLICATION WITH INDIVIDUAL COMPENSATION OF REACTIVE POWER IN INDUSTRIAL ELECTRIC DRIVES

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Abstract

Background: Nowadays, the traditional asynchronous motors with non-high energy data are used in industrial electrical drives. Improving the energy efficiency of asynchronous electric drives is relevant technical and economic problem in all industries. To solve this problem the asynchronous motors with individual reactive power compensation are developed, researched, manufactured and tested in practice.

Materials and methods: The authors used the results of the practical tests and mathematical modeling. The results were processed using the probability theory and mathematical statistics according to correlation and regression analyses.

Results: The authors describe the comparative analysis of the specific differences between energy saving asynchronous motors and traditional asynchronous motors. The test results of the energy saving asynchronous motors with individual reactive power compensation are given.

Conclusions: Calculations and experiments conducted on real electric drives that are based on energy saving asynchronous motors allow to confirm that the transformer load factor decreases by 13%, the losses of electrical power supply systems and electric drives are reduced by 19%, the total capacity economy is 310–750 kW per year. Drives based on the proposed asynchronous motors with individual reactive power compensation are energy saving. Based on energy-saving asynchronous motors the controlled electric drives with thyristor converter can be developed.

Key words: asynchronous motor, reactive power, electric drive.

References


AUTOMATED ELECTRIC DRIVES OF DRAWING MILLS ACCORDING TO THE «FREQUENCY CONVERTER– ASYNCHRONOUS MOTOR» SYSTEM

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Abstract

Background: The equipment analysis of metal industry demonstrated that the main electric drives systems has more than 80 % of wear, the low energy efficiency and reliability, high operational costs and the low power coefficient. Thus, the urgent scientific and technical tasks are increasing the labor productivity and decreasing the energy losses in metal industry, but their solution is connected with rebuilding or replacement of electrical drives systems.

Materials and methods: The structure scheme of the combined control system consisting of microprocessor-based systems of the field oriented control with rotor flux stabilization and continuous electromechanical unit is developed for the research of related electric drives system of drawing mills in MATLAB Simulink platform.

Results: The experiments results based on the mathematical model of the automated electric drive operation in starting-breaking modes are presented. The various alternatives of forming electric drive system in industrial application is offered.

Conclusions: The application of dynamic correction signal, flexible feedback of spring torque of coiling machine and controlled offset of main drive make it possible to considerably reduce elastic vibration of wire during its progress and stabilize wire tension.

Key words: drawing mill, frequency converter, asynchronous motor, field vector control, mathematical model.

References


ELECTROMECHANICAL REVERSE SCANNING DEVICE ADJUSTER

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Abstract

Background: At present time in design of accurate reversible electromechanical scanner great attention is devoted to the characteristics of the control object and control system quality. At the same time, the quality of the operation of reversible scanner is determined, first of all, within the input assignment, which formation is often neglected. This leads us to the necessity of the input assignment ways forming search.

Materials and methods: During the research MatLab simulation package was used, where the corresponding mathematical models were designed and mathematical modeling was held.

Results: The paper presents a synthesis and a mathematical model for reverse scanning device adjuster in Simulink system of MatLab package. The obtained model takes into account the requirements set point to the acceleration, velocity and position of the work item.

Conclusions: Formed in the described manner input assignment can get the exact value of the speed and position of the scanning element in the work area.

Key words: input assignment, reverse scanning device, adjuster.

References

REVERSIBLE ELECTROMECHANICAL SCANNER DEVICE CONTROL SYSTEM

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Abstract

Background: Currently in systems with small required operating element deflection angle from the zero position the reverse electromechanical scanning devices with a limited angle of rotation are used. These devices have high inertia and additional requirements for control systems quality.

Materials and methods: During the research MatLab simulation package was used, where the corresponding mathematical models were designed and mathematical modeling was held.

Results: The paper presents a synthesis and a mathematical model for reverse scanning device adjuster in Simulink system of MatLab package. The results of modal controller and combined management control system simulation are presented.

Conclusions: Modal regulator system has less sensitivity to changes in the parameters of the control object. The combined system, at the same time, has zero speed error and position in the work area.

Key words: Reversible electromechanical scanner device, control system, mathematical simulation.

References

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REGULATED ELECTRODRIVE FOR PUMP SET OF THE FIRST RAISE WATER SUPPLY STATION

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Abstract

Background: Technical and economic efficiency of electric drive for pumps stations second lift was recognized. In the technical literature is almost not considered the feasibility of controlled electric pumps for the first lift. However, this issue is relevant, given the widespread use of the first lift station, equipped with high-power pumping units.

Materials and methods: Experimental studies were carried out on the existing pumping station first lift. To analyze the modes used computer simulation techniques.

Results: A comparison of three methods of capacity control pumping station first head: discrete control – switching-off pumps, throttle and speed changes through variable speed drive pumps.

Conclusion: It is demonstrated that regulated electrodrive supplies technical and economic advantager for pump sets of the first lifting.

Key words: pump set, regulated electrodrive, water treatment plant, the mathematical model.

References