ABSTRACT AND REFERENCES

ENERGY-SAVING TECHNOLOGIES AND EQUIPMENT

THE METHOD OF MONITORING OF THERMODYNAMIC EFFICIENCY OF HEAT PUMP (p. 3-8)

Alexander Klepanda, Victoria Tarasova, Julia Berezhko

A technique for monitoring the heat pump, which allows for a limited amount of measured parameters exercise testing its thermodynamic efficiency in real time. Methodology includes three stages: the first stage - monitoring, involving only data logging and collection of information about the operation of the heat pump, the second stage - the processing of monitoring data, and the third stage - the analysis and diagnosis of the thermodynamic efficiency. The results of monitoring of the heat pump series Vicot VMN430L in the heating system of the administrative building is present. Monitoring system recorded the following parameters: temperature and humidity of the outside air temperature in the "direct" and "inverse" highways of the heating system, the power consumption of compressors , water flow in the condenser of the heat pump. Found that the model holds VMN430L low efficiency at low ambient temperatures that the current generation of chillers and heat pumps from other manufacturers is not so typical.

Keywords: heat pump, chiller, thermodynamic efficiency, conversion factor, exergy performance coefficient.

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THE SYNTHESIS OF SYSTEM OF AUTOMATIC CONTROL OF EQUIPMENT FOR MACHINING MATERIALS WITH HYDRAULIC DRIVE (p. 8-12)

Nataliya Sokolova

The issues of automatic control of equipment for machining materials with rotary hydraulic drive are considered in the paper. The main objective of this study is the development of a mathematical model and synthesis of the automatic control system of equipment.

The methodological basis of the research is a systems approach to modeling drives of process equipment using control theory methods.

Based on the accepted approach, the authors have developed the mathematical model of the equipment for machining materials with the rotary hydraulic drive as an object of automatic control and performed the synthesis of automatic control system, taking into account the stochastic perturbation and observation noise. Given that the stochastic excitation, applied to the control object, appears irrespective of the control signal, the synthesis of the automatic control system of equipment is executed taking into account additive noise. Therefore, solving the problem of stochastic optimal system with incomplete information about the state according to the separation method was divided into two: the problem of synthesizing optimal observer and deterministic problem of synthesizing optimal system.

The research results can be used in creating new and modernizing existing process equipment.

The results, presented in the work, can extend the functionality and efficiency of equipment for machining materials.

Keywords: hydraulic drive, mathematical model, transfer function, time constant, transfer factor, block diagram, stochastic perturbation, observation noise, automatic control system.

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IMPROVING THE EFFICIENCY OF STEAM-TURBINE PLANTS OF DIFFERENT CAPACITIES (p. 13-19)

Oleksandr Shubenko, Oleksandr Senetskyi, Olga Babenko

Important scientific and technical problem of increasing operational efficiency of steam-turbine plants by developing new technologies for solving problems of efficient distribution of thermal and electrical loads between turbines and network heaters of cogeneration turbines during the heating period is solved in the paper.

The scientific principles and methods for solving problems of both the analysis of power plant states, and their synthesis (optimization), taking into account a large number of factors, affecting the indicators of thermal circuit elements in their interaction, thus pro-

viding modeling of energy systems of different configurations with the ability to include new elements are developed.

Additional modules of mathematical model and software-computer complex for calculating thermal circuits to implement energy-saving measures are developed and introduced. Formulation and solution of the problem of determining rational operation modes of thermal circuits of low-capacity steam-turbine plants (confirmed by implementation acts) is first performed. For power units of industrial enterprises, expediency of building steam-turbine plants up the power steam boilers (confirmed by implementation acts) is shown. The optimum modes of heat output from cogeneration turbines T-100/120-130 and T-250/300-240 (confirmed by implementation acts) are determined.

The obtained results have shown the feasibility of solving the energy-saving optimization problems through generating additional electric power from CHP turbine plants. To solve this problem, new methods, which allow to propose measures on saving fuel and energy resources without additional capital investment, are used.

Keywords: energy efficiency, turbine plant, optimization, thermal circuit, power unit, network heater, operation mode, thermal load, electric capacity.

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ANALYSIS OF THE INFLUENCE OF METHODS FOR CONTROLLING POWER UNIT WITH A PRESSURIZED WATER REACTOR FOR AXIAL OFFSET (p. 19-27)

Timur Fosch, Maksim Maksimov, Mark Nikolskiy

The paper deals with analyzing the influence of the methods for controlling power unit with the VVER-1000 power unit in a maneuverable mode on a quantitative measure of stability, namely on the size of axial offset. Automated systems for controlling power units with the VVER-1000 reactor in maneuvering with such control programs as: with a constant average temperature of the coolant in the first loop, with a constant pressure in the second loop, with a sliding pressure in the second loop, with a constant water temperature at the input to AKZ of the reactor, were described. Also, the graphs of the reactor axial offset variations in a maneuverable mode from 100 % to 80 % and vice versa were made and presented. It was found that in stationary automated control systems of power units with the VVER-1000 reactor, the axial offset is unstable and may lead to a decrease in stability and reliability of the reactor. The improved automated control systems allow maintaining sufficiently the axial offset constants and the necessary parameters of the control program on the whole range of power unit maneuvering.

Keywords: automated control system, program control, axial offset, maneuverable mode, VVER-1000.

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STATIC THYRISTOR COMPENSATOR WITH FORCED COMMUTATION AND ISOLATED NEUTRAL AND SCHEME OF ITS CONTROLLING (p. 28-37)

Mykola Petukhov, Sergiy Litkovets

In this work the configuration, principle of operation of static thyristor compensator with forced commutation and isolated neutral are considered, the integral indicators of its energy process and speed of operation for two management strategies of reactive power are determined. It is established, that the value of reactive power of compensator in the case of its voltage by the supply of rectangular shape is almost a linear function of the angle control of commuting thyristors for the considered management strategies, and the increase of the angle control of thyristor causes the decrease of the value of specific active power consumption, which is the criterion of economic efficiency of the compensator as a source of reactive power. At the defined values of angle control thyristors the value of specific active power consumption is less than the value of the basic variant of the same name, which corresponds sinusoidal supply of compensator that allows realizing power effective technologies management modes of its work. The designed the scheme of control of static thyristor compensator provides the proper speed of operation for reacting to rapid changes of reactive power, independent control of phase reactors of two adjacent phases, needed algorithm of switching commuting thyristors and microprocessor control of all elements of the system in real time to reduce the value of the specific active power consumption and, thus, to realize the concept of a global management energy processes in compensator.

Keywords: static thyristor compensator, forced commutation, global management, speed of operation.

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THERMODYNAMIC ANALYSIS OF HEAT-ENERGIZED REFRIGERATION MACHINE WITH CARBON DIOXIDE (p. 36-44)

Larisa Morosuk, Tatiana Morosuk, Sergey Gayduk

The stages of creating a circuit-cycle design of a heat-energized refrigeration machine using carbon dioxide as a working fluid are considered in the paper. The purpose of the machine development is to get cold using a low-temperature heat of enterprises, as a way of saving energy and material resources. The thermodynamic analysis for generating a machine circuit using the "cycle method", the energy and exergy analysis of parts and the machine in general, in a wide range of temperatures and pressure in the gas heater, was conducted. The analysis showed that the machine can work in a wide range of the heating source and different pressures in the gas heater, but their change affects the effectiveness of other machine parts, which affects the exergy efficiency of the machine and its parts. The obtained results of the analysis are useful for further implementation of the machine, namely modeling, design and selection of machine parts for the maximum efficiency.

Keywords: thermodynamic analysis, exergy efficiency, exergy, fuel, product, destruction, carbon dioxide, heat-energized refrigeration machine.

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THE MATHEMATICAL MODEL OF NON-CERTIFIED FUEL COMBUSTION (p. 44-51)

Maksim Maksimov, Vadim Lozhechnikov, Tatiana Dobrovolskaya, Andrey Bondarenko

The process of uncertified fuel combustion with a variable calorific value of gas at a petroleum refinery for generating steam is considered in the paper. The main purpose of the paper is to develop a mathematical model of three steam boilers, working for one steam pipe, for combustion of gas fuels of varying composition. Effective combustion of the uncertified fuel will allow reducing not only CO_2 emissions to the environment, but also reducing the consumption of natural gas. In the proposed model, the incremental equations were considered to linearize them. The given mathematical model allows obtaining a predetermined steam rate for the gases under consideration. This model is applicable to gas fuel with a variable calorific value in a petroleum refinery. The next step for solving the problem is to automate the process of boiler control.

Keywords: mathematical model, uncertified gas, calorific value of gas, steam boiler, common steam pipe.

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THE POWER BALANCE OF THE DC TRACTION SUBSTATION AT THE DIFFERENT LEVELS OF THE VOLTAGE UNBALANCE OF THE EXTERNAL POWER SUPPLY SYSTEM (p. 52-57)

Dmitry Bosiy, Denis Zemskiy

This article contains the research of DC traction substation power balance and the components of the apparent power for the DC and the AC circuits in the normal and the unbalanced modes. The ratio of higher harmonics of DC voltage which depends on the external voltage unbalance is used for the quantitative estimation of the external network influence on the rectifier.

The cause of the research lies in need of the energy saving with regard to the power quality which needs power balance evaluation. Many authors suppose that in the DC traction system the conversion process from the three-phase energy to the DC energy is symmetrical but in fact the voltage unbalance creates additional difficulties for the power supply devices and might be considered.

The result of research is in determination of the fact that changing voltage unbalance doesn't change the three-phase and the DC power factors. While the voltages unbalance is reallocating the power in phases of the rectifier the power factor is increasing in the phase with lower voltage and decreasing in the other phases.

The importance of the given result is in the method of voltage unbalance definition with the higher harmonics ratio that allows the accurate calculation only by the values of DC harmonic magnitudes. In practice the given method allows to avoid the measurement of the primary networks parameters in the control systems. The created physical model may be useful for the further research of the DC traction substation in parts of creating and tuning the devices of the power quality improvement.

Keywords: electric power, balance, traction substation, harmonics ratio, power factor.

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PLANT BIOMASS AS ORGANIC FUEL (p. 57-61)

Alexei Osmak, Alexander Seregin

Application of biomass for generating heat and electric energy is substantiated. The basic reasons for using organic materials as renewable energy sources are described. The examples of industrial use of energy, produced from biomass in the EU countries are given.

Suitability of various types of biomass (sunflower, buckwheat and oats husk) for further thermo-chemical conversion to produce alternative fuel is experimentally investigated.

When generalizing the physical and technical characteristics of different types of biomass, the results of studying a number of agricultural waste, as well as foreign authors' data were used.

The results of the technical analysis (moisture content, ash content, calorific value) of several analytical samples of agricultural waste are given.

The elemental composition of some types of plant material is studied, thus allowing to state that the mentioned agricultural waste is highly reactive fuel with high volatile-matter yield.

The mineral composition of organic waste: oxides of silicon (40...87 %), iron (0.2...7.7 %), calcium (0.6...30.6 %) and potassium (6.2...20 %), which has no significant effect on the heating surface contamination is investigated.

The data on the elemental composition of peat, its calorific value, as well as on the products of peat decomposition at different temperatures (350, 400, 450, 520 °C) are submitted.

Based on the content of ash, water-insoluble substances, lignin, hemicellulose and cellulose, wood composition depending on the breed is determined.

Keywords: thermo-chemical conversion, plant biomass, alternative fuel, agricultural waste, gasification.

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