THE DEVELOPMENT OF ENERGY-SAVING OPERATION TECHNOLOGY OF THE BIODIESEL PLANT AS A PART OF THE COGENERATION SYSTEM (p. 4-10)

Eugene Chaikovskaya

The paper proposes the biodiesel plant operation technology that maintains oil heating in the heat exchanger, which is part of the biodiesel plant in measuring the outlet biodiesel temperature of the heat exchanger. The integrated system of evaluation of oil temperature changes based on the mathematical and logical simulation as a part of the cogeneration system enables making decisions to change the number of heat exchanger plates to maintain a constant biodiesel yield and timely change heated and fresh oil. On the example of the biodiesel plant EXON-500 with a production capacity of 12,000 liters/day this approach allows reducing the biodiesel production costs and the biodiesel plant payback period up to 30 %. 19.28 tons of oil equivalent per year are saved. With additional energy output of 66.5 MWh/year and sales at the "green tariff" in the range of, for example, 3.5–3.9 UAH/KWh, money income will be about 200 thousand UAH.

Keywords: technology, biodiesel plant, oil temperature, mathematical and logical simulation, cogeneration system.

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SIMULATION OF WORKING PROCESSES IN THE PYROLYSIS PLANT FOR WASTE RECYCLING (p. 11-20)

Rostislav Iskovych-Lototsky, Yaroslav Ivanchuk, Yaroslav Veselovsky

The results of theoretical research of thermo-physical processes as key working processes in the pyrolysis plant for waste recycling by numerical simulation are given. On the basis of the three-dimensional model of the pyrolysis plant for waste recycling, developed in the CAD-system with the KOMPAS-3D V16 software, in the CAE-system with the FlowVision software, using the finite element method, the temperature distribution and other hydrodynamic parameters of working areas and surfaces of the combustion chamber and the afterburning chamber are determined, which showed the presence of complete combustion of toxic or little toxic gases of combustion products. The areas of high temperatures for further insulation are identified.

The temperature distribution of surfaces of the cooling chamber of the pyrolysis plant for waste recycling proved the conformity of parameters of the output combustion products with the regulations of thermal pollution of the environment.

The temperature distribution along the heat-exchange unit walls allowed to estimate the efficiency of the heat-exchange unit in the municipal heating system and determine the prospects for future improvement and modernization.

Keywords: simulation, finite elements, temperature, combustion, heat exchange, recycling, turbulence, waste, velocity vector.

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CLASSIFICATION OF REGULATORY SUPPORT FOR EXTENSION OF LIFE OF MECHANICAL EQUIPMENT OF NUCLEAR POWER PLANTS (p. 21-28)

Nicholai Pakhalovich, Sergei Kucher, Yuri Levutzky, Sergey Malyshko, Marina Girya

The paper is concerned with the analysis of the existing regulatory support, its systematization and development of common classification criteria of regulations aimed at ensuring nuclear and radiation safety in dealing with life extension of thermal and mechanical equipment of the reactor facility of nuclear power plants. A brief description of operating conditions of thermal and mechanical equipment of the reactor facility and the algorithm of execution of works for service life extension are presented. The analysis of data on standardization of processes in the energy sector in Ukraine and abroad, including industry standards is performed. The results have shown that existing regulations require the creation of systematization, which makes it possible to develop common rules for selecting the physical parameters that characterize the technical condition of equipment considering its degradation, improve methodological support for reliable assessment of the technical condition of equipment; systematize the results of surveys and calculations for determining the predicted residual life. The structural formulation of classification criteria of regulatory support will improve the regulations to identify or expand technical specifications that define the equipment degradation processes to justify the method of evaluating its current technical condition and residual life, taking into account the requirements of safe operation of nuclear power plants.

Keywords: technical condition, thermal and mechanical equipment, residual life, safe operation, regulatory support.

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ANALYSIS OF THE SCHEMATICS OF THE COMPRESSION HEAT-DRIVEN REFRIGERATION MACHINE WITH R744 (p. 29-39)

Sergey Gayduk, Bogdan Grudka, Larisa Morozyuk

The classification group of heat-driven refrigeration machines includes compressor heat-driven refrigeration machines driven by a turbine that operates with the same refrigerant as the refrigeration machine.

Development of research of compressor heat-driven refrigeration machines is associated with the use of R744 (carbon dioxide) as a refrigerant. This, together with the design of new schemes and cycles and, consequently, the solution of energy saving and environmental security problems in refrigeration equipment has enhanced the utilization of heat of any temperature.

New scheme-cycle designs are developed based on heat recovery in direct and reverse refrigeration cycles by cross-

flow heat exchange between flows in cycles. To estimate the energy perfection of the decisions made, modern methods of thermodynamic analysis, energy and exergy are applied, which provided a simultaneous solution of energy saving problems.

It is shown that the energy (exergy) efficiency depends on the combination of the machine scheme and the refrigerant parameters (pressure and temperature) in gas heaters, and its values are determined by the temperature level of heat utilized. The exergy analysis defined the impact of irreversible losses in each element on the overall system efficiency, revealed the most critical elements, which should be regarded in the design of heat-driven machines in question.

Keywords: compressor heat-driven refrigeration machine, heat recovery, R744, thermodynamic analysis, exergy efficiency.

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DEVELOPMENT OF THE MODEL OF FORCED-EXHAUST VENTILATION FOR PASSENGER CARRIAGES (p. 40-46)

Victor Busher, Viktoriya Yarmolovich

The behavior analysis of the model of forced-exhaust ventilation for the passenger compartment carriage, based on

the principle of similarity with electric circuits is performed. For quality indicators of the control object, the parameters of resistance and relative inductances determining the aerodynamic inertia of ducts and compartments are included in the model. The computations produced the charts of transients of air flows in individual compartments and the total flow. Their analysis suggests that despite the model formation only of the objects described by the first-order differential equations, the equivalent models of the carriage and individual compartments may be characterized by fractional order of differential equations. This allows us to offer a method of identifying the dynamic parameters of individual sections of the air duct and the compartment by fractional aperiodic links. Such links are a special case of the hyper-neuron. Their parameters are well defined using genetic algorithms. This reduced the order of equivalent transfer functions to 0.9...1.8 with a relative mean square error between the results of the ventilation system model transients and the solutions of fractional differential equations of no more than 0.14...1.23 %. The results indicate the feasibility of constructing a control system for the ventilation unit using the theory of fractional integral-differential controllers.

Keywords: forced-exhaust ventilation, model, fractional-differential controllers, genetic algorithms, parameters identification.

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EFFICIENCY IMPROVEMENT OF ORGANIZATIONAL-AND-TECHNOLOGICAL MANAGEMENT OF MUNICIPAL HEAT-POWER SYSTEMS (p. 46-52)

Boris Basok, Tatiana Yevtukhova

A new method of efficiency improvement of MHP systems by optimizing the structure and parameters of multi-

level organizational and technological management is proposed. The formalization of the method is implemented using the system of mapping of Cartesian products of the ordered sets of input variables and variables of control actions and feedbacks into output variables for each level of the management system. The problem of combination of organizational, technical and technological factors is solved using logical-mathematical functions, and interaction coordination of the MHP subsystems – by selecting the optimal degree of their organizational and functional independence within the limits determined by the above management tools. The possibilities of enhancing regional (city) programs of efficiency improvement of MHP systems by the interaction coordination of their participants taking into the account the size of investment sources received through the program and energy savings achieved are considered.

According to scenarios of profit maximization, minimization of losses of fuel and energy resources and minimization of CO_2 emissions, the problem of optimal control of the MHP system consisting of coal-fired boilers, gas-fired boilers, electric boilers, natural gas and biodiesel fuel cogeneration plants is solved. The simulation results, confirming the possibility of efficiency improvement of MHP systems by 20–40 % are presented.

Keywords: municipal heat-power system, organizational and technological management, multilevel management systems, interaction coordination, energy and economic efficiency.

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SIMULATION OF THE POWER SUPPLY SYSTEM WITH AN ACTIVE FILTER, CONTROLLED BY THE OPTIMIZATION ALGORITHM (p. 52-58)

Katherina Yagup

The presence of an inductive load in the grid gives rise to a reactive power, which adversely affects the quality of electric energy and operation of its consumers. The use of active filters with controlled switches allows one to reduce the phase shift of the grid current to almost zero.

The power supply system under study consists of three main units: a single-phase system with active-inductive load and active-inductive internal resistance of power sources, the active power filter and the filter control system using pulse width modulation.

The filter under consideration is a half-bridge inverter. It consists of two capacitors, two controlled switches - IGBT-transistors and the inductor, which smoothes the current supplied.

As a result of search engine optimization, it is necessary to find such values of parameters that compensate the reactive power and minimize the grid current strength. Optimization parameters are the difference of voltage across the capacitors of the half-bridge inverter in the initial and final points of simulation and the peak value of the sine-wave generator.

For this, a special visual model was developed by means of the MATLAB application package and the Simulink graphical simulation environment using search engine optimization. As a result of the computer simulation, the reactive power value was reduced to almost zero, the voltage across the capacitors stabilized, and the grid current strength was reduced to a possible value.

Keywords: power supply system, active power filter, reactive power, search engine optimization.

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MAINTAINING THE RATED LEVEL OF POWER SUPPLY RELIABILITY UNDER THE CONDITION OF DISTRIBUTED GENERATION IMPLEMENTATION (p. 58-63)

Saeed Banuzade Sakhragard, Vladimir Popov, Vadym Tkachenko, Andrii Zhuravlov, Denys Shpak

In order to minimize costs of power supply companies and potential investors, the study related to the formation of a strategy to ensure the rated level of power supply reliability in conditions of integration of distributed generation sources into electrical networks is carried out in the paper. The possibility of the logframe use to evaluate the integrated reliability indicators in the conditions of equipment of electrical networks with modern switching devices and presence of generating sources under different settings and locations is shown.

The experimental computations reveal that only a coordinated solution of the problems of electrical network partitioning in terms of reliability optimization and implementation of technical specifications to enable their "island" mode at the occurrence of distributed generation sources makes it possible to make the most cost-effective decisions.

The results can be directly used in the practical work of operational units and prospective development departments of energy supply companies, serve as an important component in the multicriteria evaluation of application options of distributed generation.

Keywords: overhead distribution network, distributed generation, power supply reliability, partitioning devices.

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