ABSTRACT AND REFERENCES

ENERGY-SAVING TECHNOLOGIES AND EQUIPMENT

THE SEARCH ALGORITHM FOR OPTIMAL RELIABILITY INCREASING SYSTEM PARAMETERS IN 10 KV BRANCHED DISTRIBUTION NETWORKS (p. 4–10)

Sergiy Tymchuk, Mykhailo Sirotenko

To increase the reliability of power supply to consumers in 10 kV distribution networks, various devices are used, such as pointers of damaged areas, line isolators, automatic partitioning devices and automatic transfer switches. Optimization of the arrangement of reliability increasing means is an urgent task. However, existing computational methods either do not consider the possibility of installing several types of devices in the network at once, or require performing a large number of iterations when searching for the optimal layout.

To solve this problem, it is proposed to apply an algorithm that uses the features of the object of research, namely the property of optimal layout of RIM in the distribution network with the priority of one of the criteria for i points occupied by devices, always include the optimal layout of RIM with the priority of the same criterion for (i-1) points.

Using the proposed algorithm allowed to carry out the computational study of the impact of PTL parameters on the structure of the optimal reliability increasing system and the effect of its installation. The experiment showed that the arrangement of RIM will significantly reduce the expected damage from annual undersupply of electric power, as well as the average time to search for the damaged area in both redundant and non-redundant branched distribution networks.

The importance of the results lies in the fact that the efficiency of installation of the line isolator together with the pointer of the damaged area that has the ability to transmit information on the damaged area to the control point, compared to other RIM installed in 10 kV non-redundant networks was first shown.

Keywords: distribution electric network, reliability, partitioning, efficiency, optimization, algorithm.

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STUDY OF THE PROCESS OF MANAGEMENT OF THE OPERATING MODES OF ELECTRIC NETWORKS IN MODERN CONDITIONS (p. 11–18)

Vladimir Bondarenko, Nikolay Cheremisin, Veronika Cherkashyna

To improve the process of management of operating modes of electric networks in modern conditions, the following tasks were solved. Technical and economic model of OL, taking into account the incompleteness of the initial information, which is characterized by changes in analytical connection of investments with the wire section to optimize the parametric series of wire sections was improved. The criterion of technical and economic distinctiveness of the OL options taking into account the discreteness of the scale of wire sections in forming the parametric series, which is a prerequisite for the OL unification and reduces the effect of network heterogeneity was formed. To optimize the process of management of electric power transmission, the principle of economic similarity in the problems of improving the OL structure based on unification, which provides a twofold extension of the object life until the first reconstruction at the minimum technological losses was elaborated. Some development aspects of OL as the active-adaptive objects of EN under the SmartGrid platform to regulate the process of management of electric power transmission in real time were presented.

Keywords: management of operating modes of electric networks, electric power transmission, SmartGrid, balancing market.

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ANALYSIS OF EXPERIMENTAL DATA ON AERODYNAMIC DRAG OF FLAT-OVAL TUBE BUNDLES (p. 19–24)

Eugene Pis'mennyi, Vadim Kondratyuk, Alexandr Terekh, Alexandr Rudenko, Alexandr Baranyuk

The paper deals with experimental research of aerodynamic drag and synthesis of data for virtually unstudied staggered bundles of flat-oval tubes at transverse air flow around. Experiments were conducted in an open-circuit rectangular cross-section wind tunnel in the range of Reynolds numbers from 2000 to 30000. In the processing and analysis of experimental data and dependences of the Euler numbers on the Reynolds numbers of flat-oval tube bundles, much attention was paid to factors which may influence the aerodynamic drag. During the experiments, several factors were identified: operation factor - flow rate W, geometrical factors – back and long pitches between tubes, the ratio of longitudinal and transverse dimensions of the tube (profile elongation) d_2/d_1. Based on the data obtained, generalized relationships for calculating the aerodynamic drag of staggered bundles of flat-oval tubes in a wide range of operation parameters and geometrical characteristics of tubes and bundles were developed.

Keywords: flat-oval tube, staggered bundle, aerodynamic drag, influence, calculation, generalized relationships.

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DEVELOPMENT OF NEW PARTIAL STEAM DISTRIBUTION METHOD FOR PROVIDING PARTIAL OPERATING MODES OF POWERFUL STEAM TURBINES (p. 24–28)

Andrey Rusanov, Anna Kosianova, Dmitry Kosianov

A new approach to the partial steam distribution - radial steam distribution was presented. On its basis, a prototype of the control compartment for steam turbine K-325-23, 5 without the surge chamber, designed to provide partial operating modes of the turbine was developed. A theoretical scheme of the control stage with radial steam admission to annular chambers was proposed. Flow visualization and integral characteristics of the developed flowing part were given, and analysis of features of the physical processes occurring in the radial steam admission was performed.

It was found that using radial partial steam distribution provides the necessary parameters of the partial operating modes of the steam turbine. Effect of radial partiality on gas-dynamic efficiency parameters appears to a greater extent in the control stage and to a substantially lesser extent in the second and third stages.

Keywords: steam turbine, control stage, radial partiality, steam distribution, spatial turbulent flow.

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DEVELOPMENT AND ANALYSIS OF NEURAL NETWORKS TO PREDICT THE EFFICIENCY PARAMETERS OF REGENERATOR CHECKER OF GLASS FURNACE (p. 29–33)

Artem Migura, Aleksndr Koshelnik

The basic modern types of checkers and refractory materials for regenerative heat exchangers of glass furnaces were described. Operating features of using refractory materials of the checker depending on the purpose and the height of the regenerator design were given.

To solve the inverse problem of predicting the regenerator parameters and classifying the refractory material of the checker depending on the coolant temperature at the checker flue outlet, the methods of neural network programming were applied, and a neural network based on multi-layer perceptron was created. The structure of this neural network was analyzed, the patterns of using different types of activation functions to solve various prediction problems were identified.

The advantages of neural network models for the successful solution of prediction problems and classification of parameters of regenerative heat exchangers compared to existing finite-difference methods used for solving non-stationary problems of complex heat transfer in the checker were revealed.

Keywords: glass furnace, regenerator, checker, refractory, prediction, neural networks, activation function.

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STUDY OF CORROSION RATE AND DEPOSIT ACCUMULATION UNDER CIRCULATING WATER CONCENTRATION IN INDUSTRIAL APPLICATIONS (p. 34–40)

Vadim Chichenin, Victor Kishnevskiy, Anastasiia Hrytsaienko, Svyatoslav Savych, Iryna Shuliak

The methods of investigating and the results of testing the corrosion rate and deposit accumulation on control samples of various metals in two similar industrial circulating cooling systems (CCS) with specified water chemistry were presented. As the make-up water, biologically treated municipal and industrial wastewater with a high content of anions of strong acids were used in systems.

The results of the influence of phosphate inhibitors on the processes of deposit accumulation and corrosion rate at different concentration coefficients in the circulating cooling system were given. Introducing phosphate inhibitors to the make-up water, consisting of the biologically treated wastewater, subjected to liming allows to reduce the deposition rate on the heat transfer surface of heat exchangers to a value of 0.05 $g/m^2 \cdot h$.

Results of comparison of deposit accumulation and corrosion rate values on heated and unheated samples in the studied environments were provided. It was shown that the deposition rate on heated samples in comparable thermal-hydraulic conditions is several dozen times higher.

The main factor affecting the value of deposit accumulation on samples from Art. 20 is the value of corrosion rate of the sample.

To obtain reliable and reproducible results, laboratory and industrial tests of corrosion rate and deposit accumulation should be carried out for 1,000 hours or more in comparable thermal-hydraulic conditions on large-scale models of CCS at a given quality of circulating water.

Keywords: corrosion, deposits, circulating cooling system, circulating water, inhibition.

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ANALYSIS OF HEAT TRANSFER PROCESSES IN CURVILINEAR MICROCHANNELS FILLED WITH A VISCOUS INCOMPRESSIBLE FLUID (p. 41–49)

Alexandre Gourjii, Oleksii Shaldenko

The problem of convection-diffusion heat conduction from the external environment to the curvilinear channel with a system of inserts filled with a homogeneous viscous fluid in the approximation of small Reynolds numbers is considered. A major stimulus for the research was the need for a controlled and managed heat transfer process that occurs on crystals of microprocessors and other microelectronic devices while a permanent complication of these devices and aspiration for miniaturization. The main idea of the local increase of heat flows in microchannels is associated with the possibility of forming quasi-stationary localized vortex structures in the areas adjacent to the inserts and the corners of the channel due to external pressure applied.

Mathematical formulation of the problem is described by the system of the second-order differential equations with partial derivatives in a conservative form and appropriate initial and boundary conditions. The problem is solved numerically on a uniform grid using a simple explicit upwind differencing method for solving parabolic equations (Navier-Stokes equations, heat conduction convection-diffusion equations) and the method of successive over-relaxation for solving elliptic equations (Poisson equations for the stream function and Poisson equations for pressure).

The numerical model was tested on a two-dimensional problem of homogeneous viscous fluid flow in the rectilinear channel and on a one-dimensional problem of heat conduction in a solid medium. The data of numerical experiments are in good agreement with the analytical solutions and the data published in the scientific literature.

Studies have shown that increased coolant velocity leads to higher heat flow across borders due to the formation of localized vortex structures in the corner areas of the channel. It was found that heat flows increase when introducing a system of inserts of different heights for the fluid flows with Reynolds numbers Re>30... 40. The level of heat transfer in the curvilinear channel with inserts for a given fluid velocity can be increased to 60 % compared with the channel without inserts by increasing the pressure difference applied to the channel input and output.

The obtained dependences and estimates of levels of heat flows can provide some support to designers and engineers in the microelectronics industry, other interested experts in the field of fluid mechanics and heating engineering.

Keywords: convection-diffusion heat transfer, numerical solution, viscous fluid, microchannel with inserts.

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EXPERIMENTAL STUDY OF HEAT AND MASS TRANSFER COEFFICIENTS AT HEAT RECOVERY OF STEAM-GAS FLOW IN THE TORCH OF DROPS OF MECHANICAL NOZZLE (p. 50–59)

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The paper deals with the experimental study of heat and mass transfer processes in contact heat-recovery drop-type units using mechanical centrifugal nozzle as a fluid sprayer.

The intensity of heat and mass transfer in contact gas-drop unit with the centrifugal nozzle at the waste-heat recovery of power units was experimentally determined. The studies were carried out in a range of excessive water nozzle pressure (0.2–0.6) MPa and the steam volume fraction of the steam-gas mixture at the inlet of the unit from 0,08 to 0,35. According to the results of experimental studies, heat and mass transfer coefficients that were attributed to the real surface of the drops were determined.

The results of experimental studies of heat and mass transfer coefficients were compared with a single drop. It was found that the heat transfer intensity for drops of the fluid with the steam-gas flow is higher than for a single drop and lower for the mass transfer. Generalizing dependences for heat and mass transfer processes for the torch of the spray cone drops were obtained.

Keywords: contact heat-recovery unit, centrifugal nozzle, heat and mass transfer coefficient, mass transfer coefficient, steam volume fraction.

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