ABSTRACT AND REFERENCES

ENERGY-SAVING TECHNOLOGIES AND EQUIPMENT

EXPLORING SENSITIVITY OF MATHEMATICAL MODEL FOR THE SYSTEM OF VOLTAGE SYMMETRIZATION (p. 4-8)

Vitaliy Gnilitsky, Alexander Polishchuk, Ruslan Petrosyan

Contemporary control systems of symmetrization devices widely use microprocessor devices, the algorithms of work of which are based on mathematical models of voltage symmetrization. Moreover, important elements of control systems of such systems are the sensors of electrical magnitudes on whose error the error of calculation of parameters of symmetrization devices depends. For a correct choice of sensors of electric magnitudes, it is necessary to solve the inverse problem of sensitivity of mathematical model of the appropriate control systems. Therefore, the development of methods that study sensitivity of mathematical models of symmetrization devices control systems is a rather relevant task for electric power industry.

We examined existing methods of determining sensitivity of mathematical models. The algorithm for solving the inverse problem of sensitivity for mathematical models, presented in the form of a "black box", is proposed. It is revealed that the error in accuracy of sensors of electric magnitudes, which are necessary for practical implementation of the system of voltage symmetrization based on the examined model, must not exceed 0.5 %. Contemporary sensors of electric magnitudes and network analyzers, the measurement errors of which for the real values of voltages and currents do not exceed 0.2 %, for the shift angles between phase voltages and coefficients of powers do not exceed 0.5 %, are fully applicable for the development of such a system of voltage symmetrization.

The resulting algorithm may be used when studying other mathematical models of the voltages and currents symmetrization systems, represented in the form of a "black box". Results of such research might be applied to assess the accuracy of sensors of electric magnitudes of the voltages and currents symmetrization systems, the mathematical models of which are examined.

This work is the result of continuing research, part of which is described in other papers of authors.

Keywords: reactive power, voltage symmetrization, asymmetry, mathematical model, sensitivity.

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RESEARCH INTO THE INFLUENCE OF CLIMATIC FACTORS ON THE LOSSES OF ELECTRIC ENERGY IN OVERHEAD POWER TRANSMISSION LINES (p. 9-19)

Vladimir Bakulevskiy

The problem of improving the accuracy in the calculations of technical energy losses in the overhead transmission lines of voltage 6–35 kV was examined by taking into account climatic factors. The influence of climatic factors on the losses of electricity in the overhead transmission lines of voltage 6–35 kV was explored. We improved the model of thermal processes in the PTL wires through a fuller account of meteofactors. The approaches to calculating the losses of active power in PTL were analyzed and examined. We substantiated expediency of applying the approach in which the losses are calculated taking into account the average monthly air temperature. It was investigated, calculated and proposed to include, in the basic equation of thermal balance for the PTL wires, the heat transfer coefficients that take into account the impact of precipitation (rain, snow). We improved the basic equation of thermal balance for sustained thermal mode for the PTL wires with regard to the proposed approach to the selection of temperature and calculated heat transfer coefficients at atmospheric precipitation on the surface of the wires. The expression is proposed for determining technical energy losses in the overhead PTL of voltage 6–35 kV. We designed a model of neural network for forecasting and calculating technical energy losses in the overhead power transmission lines of voltage 6–35 kV, which has advantages in comparison with traditional models and will make it possible to reduce error when calculating and forecasting load electric power losses in PTL.

Results of the study may be useful for forecasting and calculation of energy losses in the overhead PTL of voltage 6–35 kV in power supply and designing organizations.

Keywords: neural networks, electric power losses, overhead power transmission lines, climatic factors.

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APPLICATION OF GRAPHIC APPARATUS OF C-CURVES FOR THE ANALYSIS AND OPTIMIZATION OF SUPERCRITICAL CYCLES OF THERMOTRANSFORMERS (p. 20-25)

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The method of the generalized analysis and optimization of supercritical cycles, allowing the directed search of the most rational flow diagrams of RM and HP at the stage of predesign development, taking into account the structural and topological features of their equipment was proposed.

It is, in fact, unique because it is based on a synthesis of modern methods of thermodynamics, system engineering, and graphic optimization techniques. The main advantage of the method consists in the visual presentation of the results that greatly facilitates the flow diagram selection process in the design of the refrigeration unit, making it formalized and controlled.

Introduction of the criterion of complexity to the thermoeconomic analysis allowed identifying a rational complication limit of the flow diagram of the refrigerating machine when the introduction of additional equipment in the flow diagram structure in order to reduce the internal irreversibility in a cycle does not lead to the expected efficiency improvement of the unit.

It is proposed to use the graphic apparatus of C-curves to determine the minimum cost of the design and operation of the system over the entire lifecycle.

Introduction of the replacement cost factor to the economic analysis allowed using not the cost of reference fuel on the world market as the variable parameter in the optimization, but the estimated operation time of the unit. This made it possible to make a choice not only in favor of cheap and structurally simple but also complicated two-stage flow diagrams. Such an approach shall promote the introduction of efficient expensive technologies of thermotransformation in practice since in this case the contribution of the capital component is offset.

It is proposed to use the total equivalent warming impact factor to analyze the environmental indicators of flow diagrams of different complexity using the apparatus of C-curves.

Keywords: exergy destruction, thermoeconomic analysis, supercritical cycle, C-curves.

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ANALYTICAL STUDY OF THE PROCESSES OF THERMAL CONDUCTIVITY AT HIGH INTENSITY HEATING (p. 26-31)

Natalia Kolesnychenko, Natalya Volgusheva, Iryna Boshkova

The analytical study of the processes of thermal conductivity at high intensity heating of dense bodies, similar to clay and plastic materials, was conducted. The conditions of applicability for the hyperbolic and parabolic equation of thermal conductivity for the composition of mathematical models of high intensity heating were explored. It was found that for the small Fourier numbers, the solution of hyperbolic equation of thermal conductivity makes it possible to determine thickness of the thermal layer and its change over time. Based on the example of manufacturing technical ceramics, it was demonstrated that the possible heating rates are considerably below the boundary rate, within which the velocity of heat propagation may be accepted as infinitely high. The conclusion was drawn that in the course of construction of mathematical models for the processes of thermal treatment in the technologies for the production of technical ceramics and the products similar to them in the intensity of heating, it is rational to take the thermal conductivity equation of parabolic type as the basis. The analytical solution, which makes it possible to calculate temperature field of the semi-restricted array under conditions of microwave heating, was obtained on the basis of the equation of thermal conductivity with internal heat sources, taking into consideration heat exchange with the environment. Results of computational experiment testify to the correctness of the proposed dependency.

Keywords: thermal conductivity, parabolic type, hyperbolic type, velocity of heat propagation, microwave heating.

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OBTAINING ANISOTROPIC HEXAFERRITES FOR THE BASE LAYERS OF MICROSTRIP SHF DEVICES BY THE RADIATION-THERMAL SINTERING (p. 32-39)

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The technology of obtaining anisotropic polycrystalline hexagonal ferrites by the thermal radiation sintering is developed. Using the thermal radiation sintering, we obtained the samples of anisotropic polycrystalline hexaferrites $BaFe_{12}O_{19}$, $BaFe_{12-x}Al_xO_{19}$ (with the Ni, Ti, Mn additives), $SrFe_{12}O_{19}$ and $SrFe_{12-x}Al_xO_{19}$ (with the Ca, Si additives) for the base layers of the microstrip ferrite untying instruments of the short-wave part of the millimeter wavelength range. The essence of the RTS technology is the obtaining, by the method of classical ceramic technology, by pressing in the strong magnetic field, of raw billets with their consequent sintering in the beam of fast electrons. The use of different compositions and alloying additives makes it possible to control the electromagnetic and magnetic properties of hexaferrites.

The advantages of the RTS technology consist in high energy efficiency, high values of operating characteristics of the obtained material and low duration of the process of sintering.

It was established that the RTS technology may prove to be an alternative technology when obtaining the high-quality polycrystalline hexaferrites M of elementary and complex substituted compositions.

Owing to the low energy- and time costs, high values of the performance parameters, the RTS technology of anisotropic hexaferrites may find wide application when obtaining permanent anisotropic magnets and various miniature SHF-devices.

Keywords: hexagonal ferrite, radiation-thermal sintering, pressing, magnetic field, texture

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IMPROVEMENT OF TECHNOLOGICAL-MATHEMATICAL MODEL FOR THE MEDIUM-TERM PREDICTION OF THE WORK OF A GAS CONDENSATE FIELD (p. 40-48)

Mykhailo Kutia, Mykhailo Fyk, Oleg Kravchenko, Stefan Palis, Ilya Fyk

Authors proposed analytical and algorithmic additions to the mathematical model of the prediction of the work of a gas-condensate field in the gas regime. The developed technique of improved calculations of the gas-dynamic parameters was verified by the actual history of a number of real fields in Ukraine. It demonstrated good results by accuracy in the course of medium-term prediction, which is important for estimating the efficiency of the measures for the intensification of well production. The new analytical construction of the systems of equations of the plane-radial inflow of gas to the well bottom and transport of gas by the vertical column allowed us to make the algorithm of iterative calculations more universal. The universality consists, in particular, in the possibility to predict the results of thermobaric changes in the gas flow and changes in the design parameters of a well after technological measures for the intensification of well production. The unique difference is the possibility of rapid evaluation of the prediction of intensification of a well with the interference into both the productive layer and the downhole equipment. Authors emphasized the need for a similar further improvement of the technological-mathematical model taking into account the new technologies of intensification, including innovative technological schemes of constructing the downhole equipment, equipment for the column of wells, wellhead equipment, multi-bottom and multi-row systems of extraction, extraction of gas with injection into the layer of special chemical agents.

The certain properties of the adaption correction of parameters made it possible to use the program realization of the developed technological-mathematical model at the Ukrainian-Swedish gas-extraction company TOV "Karpatygaz".

Keywords: gas-condensate field, intensification of inflow, Gas-field development indicators, mathematical model, gas-dynamic calculation.

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