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Construction and study of the load characteristics of the heat exchanger

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Abstract

The existing practice of designing heat exchangers is based on the application of an engineering method of calculation, the so-called graphical method. Therefore, the design principle of the method consists in solving a system of nonlinear equations describing the heat exchange between coolants composed of various organic substances toluene, benzene, using the method of successive approximations, and the number of approximations can be very large. Randomly given by a number of unknown quantities, namely the temperatures of the pipe walls and some structural dimensions of the apparatus, which are further specified when performing the calculations, are specified. A graph is plotted for the specific heat fluxes for both fluids from the assumed temperatures of the pipe wall, and the lines, the so-called load characteristics of the heat exchanger, are drawn through the points obtained. The analysis of the conditions of application of the load characteristics of the heat exchanger when calculating the surface of the apparatus for the three main types of heat exchange, implemented in heat exchangers: boilers, condensers, cooler-heaters in which heat transfer occurs between various organic liquids under various conditions of their work. It is shown that the load characteristics of heat exchangers are non-linear depending on the specific heat flux on the pipe wall temperature, and the curvature of the line deviations from the straight line depends on the type of heat exchange and the flow of coolants, the curvature of the lines is close to the straight line dependence in the laminar mode, significantly different from the straight line in the transition mode and turbulent regimes and is very different from the straight line dependence on heat exchange with a change in the state of aggregation of both fluids. A direct calculation of the surface of the apparatus has been proposed, a technique has been developed for determining the temperature of the pipe wall, selections of initial conditions for performing calculations, step-by-step changes in the magnitudes of the driving forces are recommended when performing approximations, which reduces the time spent on the calculation. The paper also analyzes the choice of changes in the magnitudes of the driving force of the heat transfer process for the number of approximations, shows the intervals of variation of this quantity at which the calculation error decreases. Direct determination of the surface of the device significantly increases the accuracy of the calculation of the surface.

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