REGULARITIES OF THE SPATIAL DISTRIBUTION OF THE THERMOPHYSICAL PROPERTIES OF SUPERCRITICAL WATER AT ITS FLOW IN HEATED BARE TUBES

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The purpose of the work. Analysis based on CFD modeling of the spatial behavior of the physical properties of supercritical water at its ascending flow in vertical bare tubes.

Results. A complex of computational studies of the spatial pattern of changes in the physical properties of supercritical water (density, thermal conductivity, viscosity, specific heat, etc.) in a heated channel 4 m in length for the interval of heat flux density q supplied to the channel wall, 189 ... 287 kW/m^2. It is shown that the spatial distribution of the physical properties of supercritical water significantly depends on the laws of motion of the front of the pseudophase transition. It is established that the position of the specified front changes significantly with an increase in the heat flux q. Namely, for relatively large q values (q = 287 kW m^2), the front position on the tube axis corresponds to a longitudinal coordinate of 3.2 m. That is, in a significant section of the tube adjacent to its output section, the temperature of the supercritical water exceeds the temperature of the pseudo-phase transition. At relatively low q values (q = 189 kW/m^2), the coolant temperature is lower than the pseudo-phase transition temperature in the entire considered region except for narrow zones near the tube wall. According to the results of the analysis of the features of the physical properties distribution of supercritical water along the channel, it is shown that their behavior near the tube wall differs significantly from the nature of its change along the tube axis. In particular, an extreme change in the values of the thermophysical properties near the tube wall takes place in sections close to the entrance to the tube than on its axis. The regularities of changes in the plots of the physical properties of supercritical water along the tube radius in different cross sections of the channel are established and the influence of q on the indicated regularities is analyzed.

Conclusions. The regularities of distribution along the length and radius of the heated tube of the thermophysical properties of supercritical water are established and the effects of influence on the indicated distributions of the heat flux density, which is supplied to the tube wall, are revealed.