HEAT EXCHANGE AT BOILING IN THE FIELD OF ELECTRIC FORCES

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Aim. In the resent years a growing interest is observed related to the studies of the heat and mass exchange processes during boiling in electrohydrodynamic (EHD) flows. However, since a clear understanding of the mechanisms of the action of EHD flows is not available, the regularities of the boiling process and heat exchange in an electric field remain underinvestigated.

Results. In this communication the results of experimental studies are presented related to the heat exchange at boiling under the action of electric filed and electrohydrodynamic flow generated by a high-voltage perforated electrode. The influence of the external electric field strength and interelectrode gap on the main characteristics of the heat transfer at boiling and the development of the process was investigated. Hexane with a boiling temperature of 68.7°C, a relative dielectric permittivity of $\varepsilon/\varepsilon_o = 1.88$, and a conductivity of $\sigma = 10$ pS/m is chosen as a working liquid. A horizontal stainless steel cylindrical tube 80 mm long with an outer diameter of 4 mm heated by a direct current was used as a heat-liberating element. The high voltage electrode is made in the form of an isolated copper wire 1.5 mm in diameter with transverse notches facing the heating surface. The electrode is placed over the heating surface parallel to it. The interelectrode space amounted to 1.5, 1.85, 2.0, 3.0, and 4.2 mm. The electric voltage was changed abruptly up to 20 kV.

The experimental dependences of the heat transfer coefficient vs. the heat flow density q at various values of the field strength show that for greater q values the formation of vapor bubbles and boiling of the liquid are more intensive; the heat transfer intensity is also greater, and it increases with the increasing of the field strength. The higher values of the heat transfer coefficient at the same values of the heat flux density correspond to the higher values of the field strength. At the moderate densities of the heat flux the influence of the field on the heat transfer intensity is more pronounced; the influence of the field decreases when the q increases. The distance between the heating surface and high-voltage electrode for which the heat transfer intensity is maximal was determined experimentally.

Conclusion. On the basis of our investigations we conclude that the EHD method is efficient for intensification of heat transfer at boiling and can be used for the development of closed electrohydrodynamic systems of active regulation, cooling systems, and thermal regulation in heat exchange apparatuses.