HEAT EXCHANGE IN THICK HIGH-CONCENTRATED SOLUTION FILMS IN MODES OF DETERIORATION HEATING

Petrenko Valentin Petrovich, Pryadko M.O.
National University of Food Technologies, Department of Thermal Power Engineering and Refrigeration Engineering,
vul. Vladimirskaya 68, Kiev, 0160, Ukraine
petrenkovp@ukr.net

The goal of the work. To study the mechanism of crisis deterioration of heat transfer to dense, highly concentrated films of sugar solutions.

Results The results of modeling of the degraded heat transfer modes in the downward annular vapor-liquid streams of dense solutions during evaporating concentration in long vertical pipes are given. Unlike the crisis phenomena taking place during the evaporation of a water film, where the main cause of the heat exchange crisis is the violation of the integrity of the film, in the case of concentration of dense films along the length of the channel, there is a rapid increase in the viscosity and slowing of the film flow and, consequently, growth its thickness without breaking the integrity. The simulation of concentration and temperature fields has shown that the main reason for the fall of the heat flux along the heat exchange channel is the rapid increase in the physical-chemical temperature depression due to the increase of excess concentration on the interphase boundary of the film. The thickening of the film and the reduction of its thermal conductivity due to the increase in concentration plays a secondary role in the process of falling of the heat flow. It is shown that the experimental results of simulation of the modes of deterioration of heat transfer to highly concentrated films are shown only if the wave structure of the film is taken into account with the cyclic action of the large waves (influences) that periodically mix the films. The fall of the heat flow along the length of the evaporative channel occurs in the form of periodic saw-like functions with the frequency of passing large waves (influences) with the maximum of the heat flux at the moment of the passage of the wave and its rapid damping in the pause between the passage of two large waves. The function of changing the heat flow in the pause between the passage of two large waves repeats the nature of the change in the function of useful temperature head, as the main factor of the crisis mode of deterioration of heat transfer to dense high-concentration films.

Conclusions The heat transfer model, as the process of periodic, in accordance with the frequency of passing of large waves, the accumulation of excess concentration on the interphase boundary in the pause between the passage of two large waves and its alignment at the moment of passing a large wave with the corresponding cyclic change of useful temperature pressure, adequately reflects the regime of crisis deterioration of heat transfer to dense high concentration films of solutions.