ABSTRACT

This thesis introduces a complex test rig for flow boiling experiments with highly viscous mixtures of silicon oil (Polydimethylsiloxane) and n-pentane in downward flow. To date, no reliable correlations for the calculation of heat transfer and pressure drop of highly viscous 2-phase flows in evaporator pipes are available. Apart form this, options for establishing new or improving existing correlations are very limited due to the lack of reliable experimental data. The new test rig was therefore designed to generate an experimental data base, which can be used for the development of new correlations. As a special feature of the rig an annulus test section heated electrically from inside has to be mentioned. Multiple sensors are mounted to measure temperature and pressure along the test section, and it is also possible to measure the temperature on different radial positions in the annulus. The 2-phase flow can be observed in wide areas of the test section.

Based on experimental results available to date it can be shown that besides mass flow, solvent concentration, heat flux and wall temperature, the viscosity of the fluid particularly determines the occurrence of different heat transfer mechanisms along the test section. In addition flash volatilisation, a heat and mass transfer mechanism which does not play a role in flow boiling of fluids with low viscosity, increases significantly at high viscosities. The extreme radial temperature gradients observed experimentally are also caused by viscosity and represent a special challenge for formulating a new heat transfer correlation. Furthermore pressure and temperature oscillations were observed along the test section for silicon oils with high viscosity and concomitant high n-pentane concentrations. These oscillations, yet not been documented in this form, will be an object of further research.