Abstract

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Nucleate Boiling of Propane and R134a on Plain and Structured Mild Steel Tubes

Heat transfer by evaporation is used in many technical applications, enabling a compact and thereby economic design of heat exchangers. In spite to this importance and many research efforts the heat transfer coefficient can not be predicted by analytical correlations. Thus, empiric or semi-empiric correlations are used, calculating the heat transfer coefficient as function of pressure and heat flux. These correlations always need to be fitted to newly designed kinds of heating surfaces. Improvements in efficiency are achieved by enhanced heating surfaces with reentrant cavities forming sub surface tunnels. Inside these tunnels, special bubble formation mechanisms dominate the heat transfer.

This thesis deals with the heat transfer of propane and R134a boiling at plain and enhanced mild steel tubes. The bubble formation mechanisms are analyzed and identified in a broad range of pressure and heat flux. This enables the direct optimization of the surface structure. To predict the heat transfer coefficient of propane boiling at the enhanced surfaces, a semi-empiric correlation is presented and fitted to the measurement results. The correlation bases on common used correlations in the literature.

The comparison of both test fluids shows the ability of propane to be used as a replacement refrigerant for R134a, since propane shows same or higher heat transfer coefficient as R134a, in all bubble formation regimes.

Keywords:
Pool Boiling, Propane, R134a, enhanced finned surfaces, mild steel