Condensation heat transfer and pressure drop characteristics of R134a, R1234ze(E), R245fa and R1233zd(E) in a plate heat exchanger

The fundamental understanding of the thermal–hydraulic performance of working fluids during condensation is important for the optimal design of the condenser in various thermodynamic cycles. This paper is aimed at obtaining flow condensation heat transfer and pressure drop characteristics in a plate heat exchanger during the working conditions of the condenser of either organic Rankine cycle power systems or heat pump units. The selected working fluids are two hydrofluorocarbons, R134a and R245fa, as well as their hydrofluoroolefin replacements, R1234ze(E) and R1233zd(E). Measurements of heat transfer coefficients and pressure drops were carried out with varying saturation temperature, mass flux, and liquid Reynolds number, ranging from 30°C to 70°C, 16kg/m²s to 90kg/m²s and 65 to 877, respectively. Based on commonly used existing correlations, new heat transfer and pressure drop correlations were developed, including the effect of the surface tension. The experimental data indicate that different heat transfer mechanisms occur at low liquid Reynolds number with the different working fluids. The results suggest higher heat transfer coefficients and pressure drops for R1234ze(E) and R1233zd(E) than for R134a and R245fa at the same working conditions. The new correlations enable significantly better prediction accuracies for the experimental results in this study than existing correlations, indicating that the surface tension is a suitable parameter to consider in mini and micro-scale condensation heat transfer.

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