Heat Transfer and Pressure Drop During Hydrocarbon Refrigerant Condensation Inside a Brazed Plate Heat Exchanger

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This paper presents the experimental heat transfer coefficients and pressure drop measured during HC-600a (Isobutane), HC-290 (Propane) and HC-1270 (Propylene) saturated vapour condensation inside a small commercial brazed plate heat exchanger (BPHE): the effects of refrigerant mass flux, saturation temperature (pressure) and fluid properties are investigated. The heat transfer coefficients show weak sensitivity to saturation temperature (pressure) and great sensitivity to refrigerant mass flux and fluid properties. A transition point between gravity controlled and forced convection condensation has been found for a refrigerant mass flux around 15-18 kg/m^{2}s. At low refrigerant mass flux (G_r < 15-18 kg/m^{2}s) the heat transfer coefficients are not dependent on mass flux and are well predicted by the Nusselt (1916) analysis for vertical surface: the condensation process is gravity controlled. For higher refrigerant mass flux (G_r > 15-18 kg/m^{2}s) the heat transfer coefficients depend on mass flux and are well predicted by the Akers et al. (1959) equation: forced convection condensation occurs. In the forced convection condensation region the heat transfer coefficients show a 35-40% enhancement for a 60% increase of the refrigerant mass flux. HC-1270 shows heat transfer coefficients 5% higher than HC-600a and 10-15% higher than HC-290. The frictional pressure drop shows a linear dependence on the kinetic energy per unit volume of the refrigerant flow and therefore a quadratic dependence on mass flux.