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Condensation Heat Transfer and Pressure Drop Characteristics of Alternative Refrigerant Flowing Through Flat Tubes with Various Aspect Raios

ABSTRACT

Abstract

The condensation heat transfer and pressure drop characteristics of R134a flowing in a circular tube and 3 flattened copper tubes are investigated. The flattened tubes were made from round tubes with a 3.5 mm inner diameter. The tested tube configurations were as follows: a circular tube with a 3.5 mm inner diameter; flattened tube with a 0.72 aspect ratio (FT1); flattened tube with a 3.5 aspect ratio (FT2); and flattened tube with a 7.2 aspect ratio (FT3). The experimental ranges covered a mass flux of 300–900 kg/m^{2}s, heat flux of 10–50 kW/m^2, inlet quality of 0.1–0.9, and saturation pressure of 8–12 bars. The flow pattern map was initially investigated by comparing it with existing well-known flow pattern maps. Except for some of the results obtained from FT1, most of the experimental data for all of the tested tubes fell into the categories of semiannular and annular flow patterns. For heat transfer, the condensation heat transfer coefficient increased with increasing mass flux, heat flux, and vapor quality. The heat transfer coefficients of the flattened tubes were higher than that of the circular tube, around 5–10%, 10–50%, and 200–400% for FT1, FT2, and FT3, respectively. The existing correlations for predicting the heat transfer coefficient were not successful for the flattened tubes. The new correlation was proposed for practical applications. For pressure drop, the frictional pressure gradient increased with increasing mass flux and heat flux and slightly increases with decreasing of saturation pressure.

Keywords: Condensation, Heat transfer coefficient, Pressure gradient, Flattened Tube, R134a.