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Condensation Heat Transfer and Pressure Drop of R-134a Flowing inside Dimpled Tubes

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Abstract : A heat exchanger is one of the vital parts in a wide variety of applications. The tube with surface modification is generally referred to as an enhanced tube. With this, the thermal performance of the heat exchanger is improved. A dimpled tube is one of many kinds of enhanced tube. The heat transfer and pressure drop of two-phase flow inside dimpled tubes have received little attention in the literature, despite of having an important role in the development of refrigeration and air conditioning systems. As a result, the main aim of this study is to investigate the condensation heat transfer and pressure drop of refrigerant-134a flowing inside dimpled tubes. The test section is a counter-flow double-tube heat exchanger, which the refrigerant flows in the inner tube and water flows in the annulus. The inner tubes are one smooth tube and three dimpled tubes with different helical pitches. All test tubes are made from copper with an inside diameter of 8.1 mm and length of 1500 mm. The experiments are conducted over mass fluxes ranging from 300 to 500 kg/m^{2}s, heat flux ranging from 10 to 20 kW/m^2, and condensing temperature ranging from 40 to 50 ˚C. The results show that all dimpled tubes provide higher heat transfer coefficient and frictional pressure drop compared to the smooth tube. In addition, the heat transfer coefficient and frictional pressure drop increase with decreasing of helical pitch. It can be observed that the dimpled tube with lowest helical pitch yields the heat transfer enhancement in the range of 60-89% with the frictional pressure drop increase of 289-674% in comparison to the smooth tube.

Keywords : condensation, dimpled tube, heat transfer, pressure drop
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