World Academy of Science, Engineering and Technology
International Journal of Mechanical and Mechatronics Engineering
Vol:9, No:11, 2015

An Experimental Study on the Effects of Aspect Ratio of a Rectangular Microchannel on the Two-Phase Frictional Pressure Drop

Authors : J. A. Louw Coetzee, Josua P. Meyer

Abstract : The thermodynamic properties of different refrigerants in combination with the variation in geometrical properties (hydraulic diameter, aspect ratio, and inclination angle) of a rectangular microchannel determine the two-phase frictional pressure gradient. The effect of aspect ratio on frictional pressure drop had not been investigated enough during adiabatic two-phase flow and condensation in rectangular microchannels. This experimental study was concerned with measurement of the frictional pressure gradient in a rectangular microchannel, with hydraulic diameter of 900 µm. The aspect ratio of this microchannel was varied over a range that stretched from 0.3 to 3 in order to capture the effect of aspect ratio variation. A commonly used refrigerant, R134a, was used in the tests that spanned over a mass flux range of 100 to 1000 kg m-2 s-1 as well as the whole vapour quality range. This study formed part of a refrigerant condensation experiment and was therefore conducted at a saturation temperature of 40 °C. The study found that there was little influence of the aspect ratio on the frictional pressure drop at the test conditions. The data was compared to some of the well known micro- and macro-channel two-phase pressure drop correlations. Most of the separated flow correlations predicted the pressure drop data well at mass fluxes larger than 400 kg m-2 s-1 and vapour qualities above 0.2.

Keywords : aspect ratio, microchannel, two-phase, pressure gradient
Conference Title : ICTHT 2015 : International Conference on Thermophysics and Heat Transfer
Conference Location : London, United Kingdom
Conference Dates : November 27-28, 2015