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Parametric Trends of CHF and the Assessment of CHF Prediction Methods Based on Experimental Data at Low Pressure and Low Flow

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Abstract

Recently, a series of experiments on critical heat flux (CHF) under low pressure (< 9.5 bar) and low flow (G < 277 kg/m2s) condition have been accomplished in KAIST. As a result, a total of 513 CHF data for water flow in vertical round tubes were obtained at various stable conditions. Tests have been conducted in the following conditions: diameter of 6, 8, 10 and 12 mm; heated length of 0.3 ~ 1.77 m; pressure of 1.0 ~ 9.5 bar; mass flux of 20 ~ 277 kg/m2s; and inlet subcooling of 50 ~ 654 kJ/kg. Based on the data, parametric trends are examined from two different points of view: fixed inlet condition and fixed exit condition. Parametric trends are generally consistent with previous understandings but complex effects of system pressure and tube diameter are observed. Several empirical correlations and mechanistic model applicable to LPLF conditions are assessed with the measured data; the correlations of Baek et al.(1997) and Shah (1987), and the annular flow model of Katto (1984) show good prediction accuracy. Parametric trends of the prediction by these methods were compared with the CHF data to select most useful method for CHF analysis at low pressure and low flow.