Towards Unification of Critical Heat Flux Prediction Models for Flow Boiling Based on the Liquid Film Dryout Mechanism

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Abstract

A unified critical heat flux prediction model for flow boiling in uniformly heated tubes is suggested based on liquid film dryout. The model successively calculates CHF for bubbly and annular flow with implication of flow regime transition criteria using single governing equation for the liquid film on a heated wall with regard to the mass transfer at the film interface. Assessment was conducted with large experimental data (9821) from KAIST CHF data bank and the model was proved to have reasonable prediction accuracy with the average error and RMS error of 0.8 % and 19.2 %, respectively. The error and parametric CHF trend analysis of the model revealed needs for the implication of slug flow and mass transfer terms in bubbly flow for a more reliable model.

Evaluation of High-Heat-Flux Subcooled Flow Boiling CHF Using Mechanistic Models

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Abstract

Among existing mechanistic models for critical heat flux (CHF) of subcooled flow boiling, the bubble crowding and liquid sublayer dryout models are receiving considerable attention for practical purpose. However, since these models are mainly based on the operating conditions of light water reactors (LWRs), they may not applicable to the boiling system for high-heat-flux applications. In this paper, the authors model and well-known mechanistic models were evaluated for the CHF under high-heat-flux subcooled flow boiling conditions. The CHF model previously developed by the authors was based on the mechanism of wall-attached bubble coalescence. Comparison of the predictions by the authors model against about 3100 subcooled water CHF data shows relatively good agreement over a wide range of parameter that covers the operating conditions of fusion reactor components. The evaluation results of various CHF models were discussed for comparison purpose.