An Experimental Study of the Liquid Entrainment from Swelled Two-Phase Mixture Surface in a Reactor Vessel

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Abstract

An experimental study of liquid entrainment by rapid surface swelling of a two-phase mixture in a vessel has been performed. To investigate the effects of air flow rate and initial water level on the liquid entrainment, a series of experiments have been performed using air and water as working fluids. A total of 64 experimental liquid entrainment rate data have been obtained for various combinations of test parameters (i.e., six different initial water levels and varying air flow rates from 300 to 1,200 lpm) using two test vessels of the same height and different inner diameters (D = 0.15 and 0.30m, respectively) for vertical bubbly and churn-turbulent flow conditions.

An empirical correlation for the liquid entrainment rate, E, has been developed in terms of the superficial velocity of air, the initial water level, the density of gas, the surface tension, and the gravity. This correlation shows a good agreement with the present experimental data within 30% over a wide range of flow parameters.

Implementation of 3-field model into TRAC

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ABSTRACT

TRAC-PF1 is modified to include the 3-field governing equations and physical model related to the droplet field. In deriving the present 3-field model, the droplet equation of motion used in the study of Varone and Rohsenow is used to calculate the relative velocity of the droplet and gas. The governing equations and physical models related to the droplet field are based on the 3-field model of COBRA-TF and the finite difference equations of these modified governing equations are derived in the form of TRAC-PF1. New solution matrix elements are derived and these are adopted to the solution step of TRAC-PF1.

The simulation results by the modified code are compared with these from Ishii' s equilibrium entrainment correlation. It is found out that the simulation results depend on inlet void fraction and pipe diameter. When inlet void fraction is 0.9 or higher and the pipe diameter is larger than 3cm, the simulation results approach Ishii' s correlation.