Abstract

Extensive survey of open literature showed that experimental correlations and theoretical models for the accurate prediction of liquid height at the onset of gas entrainment through small branches have gained considerable importance. This is because of its relevance to the various industrial applications such as in Pressurised Heavy Water Reactor (PHWR). During postulated Loss-Of-Coolant-Accident (LOCA) occurring in PHWR, the heavy water, which transport heat from the PHWR, is lost resulting in overheating of the PHWR and can cause damage, or perhaps can melt down the reactor core.

A few investigators have studied the onset of gas entrainment for the single discharge and dual discharge through small branches mounted on the vertical wall or circular surface. However, no information exists presently on the entire single or multiple discharges when branches are mounted on the circular surface in full compliance with the header-feeder geometry of the PHWR. For different branch combinations of dual discharge or more, the information is completely lacking. This deficiency of information is addressed in the present investigation by carrying out experiments.

The experimental set up was designed and fabricated to generate extensive experimental data for the liquid height at the onset of gas entrainment for single and multiple discharges mounted on circular surface with different branch combinations

from stratified region. The five small branches of 9.0 mm diameter were mounted on the circular header of 58.7 mm diameter at an angle of 0^0, 45^0, 90^0, 135^0, and 180^0 with the horizontal in clockwise direction. The dimensions of header and branches were geometrically similar to the header-feeder system of PHWR. The experimental data were generated in five groups; each group corresponds to particular discharge condition. Group no. 1 contains the data for single discharge, group no. 2 corresponds to dual discharge condition, group no. 3 corresponds to triple discharge condition, group no. 4 corresponds to quadruple discharge condition, and group no. 5 corresponds to quintuple discharge condition. The test matrix was designed to include the data of group nos. 1 to 5. In group no.1, total five sets were investigated containing two side branches, two inclined branches, and a bottom branch. In group no. 2 and group no. 3, total ten sets of different branch combinations were investigated. In group no. 4 total five sets of different branch combinations were investigated, while in group no. 5 one set of all the five branches was investigated. The experiments were conducted under the condition of equal Froude number for the branch lines. In each of the five groups, the liquid heights at the onset of gas entrainment were measured within the range of Froude number from 6.4 to 27.5. For each branch combinations, empirical correlations were developed for dimensionless liquid height at the onset of gas entrainment in terms of Froude number. The set of correlations developed during present study may be used for validation of existing thermal-hydraulic codes of PHWR.