Proceedings of the Korean Nuclear Society Spring Meeting
Pohang, Korea, May 1999

Characteristics of pressure oscillation induced by direct contact condensation of steam discharged through sparger in a pool of subcooled water

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ABSTRACT

A experimental study was carried out to present the characteristics of pressure oscillations generated from the steam-water direct contact condensation(DCC). Steam is discharged through an I-type spargers whose pitch over diameter(P/D) ratios vary from 2 to 5. Dynamic pressure was measured at the quench tank side wall by using a piezo-electric type pressure sensor. The test conditions were restricted to condensation oscillation. The amplitude and frequency of the dynamic pressure resulting from the DCC of the steam jets discharging into subcooled water has been measured as a function of steam mass flux and water temperature. Steam is discharged in a horizontal direction through eight different kinds of I-type spargers placed in the middle of a quench tank, which contains subcooled water at various temperatures. Eight different spargers with a hole diameter of 5mm were used under the various test conditions of the steam mass flux in the range of 70 ~ 215 kg/m^2-s and the pool water temperature in the range of 30 ~ 95°C. In the present study, two different types of hole-patterned-sparger were used, i.e. staggered and parallel type spargers.

It is observed from the test results that the trends of dynamic pressure in the case of using a multi-hole discharging device(sparger) are very similar to those using a single-hole discharging device(nozzle) in spite of the fact that the amplitude shows quite different values. The dynamic pressure tends to increase with pool temperature at the beginning. The amplitude reached a peak at a pool temperature around 50 ~ 80°C depending on the kinds of spargers and the steam mass flux and then the amplitude decreased rapidly before the pool water reached saturation temperature. The peak amplitude tends to increase slightly with an increasing P/D ratio with the same types of spargers. The amplitude at the low steam mass flux reached its peak when the pool temperature is about 50 °C, but this temperature increases with the steam mass flux, the amplitude peak at the relatively high mass flux was found at around 80 °C. The frequency of pressure oscillation is also analyzed by using the fast Fourier transformation technique from the original data. The results show that the dominant frequency increases with the subcooling temperature of water, the P/D ratio of sparger and the steam mass flux. The dominant frequencies lie in the range of 120 ~ 760Hz.