DIRECT CONTACT HEAT TRANSFER TO PORIZING DROP IN IMMISCIBLE LIQUIDS

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ABSTRACT

Direct contact heat transfer between single drops of n-pentane vaporizing in a series of 0,30,65 and 98 percent (by volume) glycerol-distilled water solutions has been studied using ciné-photography. The experiments have been carried out varying initial diameter from 1.0 to 3.5 mm and the temperature difference between the two immiscible liquids from 1.0 to 13.9°C using a new nucleation technique. The nucleation technique is based on surface properties of teflon and avoids the drop from getting superheated.

It has been shown that under conditions of thermal equilibrium a thin film of residual liquid should exist over the entire inside surface of the vaporizing drop due to the effect of surface forces and not because of sloshing of the residual liquid, as visualized by Simpson and Co-workers. However, the residual liquid film would vaporize leaving behind a vapour-liquid interface near the front stagnation point under the temperature driving force.

A semi-analytical expression for instantaneous heat transfer co-efficient as a function of vaporization ratio has been developed assuming significant heat transfer through thin portion of the liquid-liquid interfac where inside resistance is negligible. It has been verified experimentally and found to agree with vaporization as well as condensation data of Sideman and Co-workers.

Another semi-analytical expression has been developed for the total vaporization time. This expression is in better agreement with experimental results of Sideman and Co-workers than those predicted by their analytical expression.

The instantaneous heat transfer co-efficient related to the overall area of the vaporizing drop has been found to increase rather sharply upto about 10 per cent vaporization and then decrease moderately over the remaining vaporization process. It has also been found to decrease with increasing initial diameter and/or the temperature difference.

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