

DIRECT CONTACT HEAT TRANSFER TO
PORIZING DROP IN IMMISCIBLE LIQUIDS

BY

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SUBMITTED
LFILMENT OF REQUIREMENTS OF THE DEGREE OF
DOCTOR OF PHILOSOPHY

TO THE
INDIAN INSTITUTE OF TECHNOLOGY, DELHI

MARCH, 1981

ACKNOWLEDGEMENT

The author wishes to acknowledge gratefully the guidance and advice given by Professor P. D. Grover, Head of the Department, throughout the course of this work.

The author is indebted to Professor R. Kumar, Department of Chemical Engineering, I.I.Sc. Bangalore, for his useful suggestions.

Thanks are due to faculty members and fellow research scholars for their help and encouragement.

Co-operation by staff members and the institute photographer Mr. Sukhdev Singh is duly acknowledged with thanks.

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Delhi
March, 1981.

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 cine-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 interface 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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