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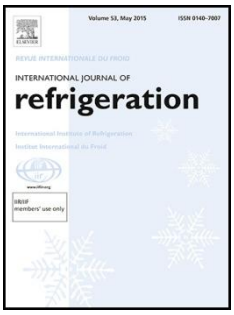

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COMPREHENSIVE CORRELATION FOR DISPERSED FLOW FILM BOILING HEAT TRANSFER IN MINI/MACRO TUBES

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HIGHLIGHTS

- Presents physically based correlation for dispersed flow film boiling in tubes.
- Verified with data from 38 sources for horizontal, vertical, mini and macro tubes.
- Data include 10 fluids and extreme range of pressure, flow rates, and diameters.
- Accuracy much better than of other correlations.

ABSTRACT

A general correlation for heat transfer during dispersed flow film boiling is presented which is applicable to horizontal and vertical tubes. It is based on the two-step model. It has been verified with data for 10 fluids in horizontal and vertical upflow. The fluids include refrigerants, hydrocarbons, cryogens, CO_2 and water. The range of data included diameters from 0.98 to 25.0 mm, reduced pressures from 0.0046 to 0.99, mass flux from 3.7 to 5176 kg $m^{-2}s^{-1}$, and qualities from 0.1 to 2.96. The 1481 data points from 38 sources are predicted with mean absolute deviation of 19.4 % . Several other correlations are also compared to the same data and found to have much larger deviations.

KEY WORDS: film boiling; heat transfer; correlation; tubes; minichannels

NOMENCLATURE

Bo	Boiling number = $q\ (G\ H_{fg})^{-1}$, (-)
C_{pf}	Specific heat of liquid at constant pressure, (J kg^{-1} K^{-1})
D	Inside diameter of tube, (m)
F_{dc}	Droplet cooling factor, (-)
F_{ent}	Entrance effect factor, (-)
Fr_L	Froude number for all mass flowing as liquid = $G^2\ (\rho_f^2 gD)^{-1}$, (-)
Fr_{TP}	Two=phase Froude number, defined by Eq. (28), (-)
G	Total mass flux (liquid + vapor), (kg $m^{-2}s^{-1}$)
g	Acceleration due to gravity, (m s^{-2})
h	Heat transfer coefficient, ($Wm^{-2}K^{-1}$)
h_g	Heat transfer coefficient of vapor, ($Wm^{-2}K^{-1}$)
H_{fg}	Latent heat of vaporization, (J kg^{-1})
H_g	Enthalpy of vapor at actual temperature, (J kg^{-1})
H_{gSAT}	Enthalpy of vapor at saturation temperature, (J kg^{-1})
h_{TP}	Two-phase boiling heat transfer coefficient defined by Eq. (16), ($Wm^{-2}K^{-1}$)
k	Thermal conductivity, (Wm^{-1} K^{-1})
K_{hor}	Factor defined by Eq. (24), (-)