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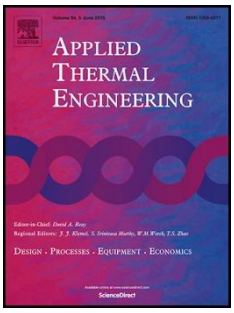

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Heat transfer correlations for CO_2 flowing condensation in a tube at low temperatures

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Abstract

A heat transfer model for CO_2 flowing condensation inside a horizontal, smooth tube at low temperatures is proposed. For the prediction of flow regime transition, criteria were developed by applying Soliman's modified Froude number to the observations of CO_2 condensation flow. The transition criteria were verified by the effects of mass flux, vapour quality and tube geometry on the corresponding experimental heat transfer coefficients, and then were applied to a CO_2 condensation databank, which was created from the published experimental data. All heat transfer data points were categorized into three flow regime groups; annular flow, wavy flow and stratified flow. Correlations for the distinguished flow regimes were developed based on theoretical analysis and the best fit procedure to the experimental data. The new model showed improved prediction ability compared to the existing models for CO_2 flowing condensation heat transfer in the macro scale tubes, and successfully predicted 217 experimental heat transfer data points with an average absolute deviation of 7.74%. The greatest deviation between the predicted and the experimental heat transfer coefficients was for the wavy flow transition zone inside microchannels.

Keywords

Flowing condensation, Carbon dioxide, Heat transfer correlation