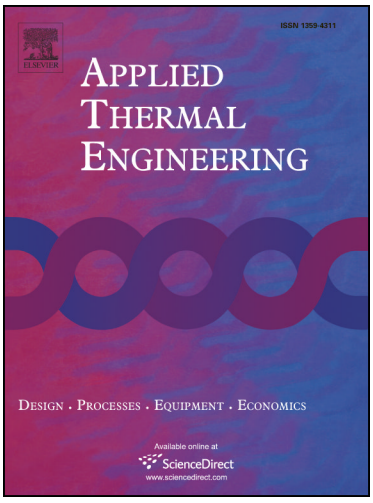

Research Paper

Numerical investigation on heat transfer and flow characteristics of supercritical nitrogen in a straight channel of printed circuit heat exchanger

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Numerical investigation on heat transfer and flow characteristics of supercritical nitrogen in a straight channel of printed circuit heat exchanger

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Abstract:

PCHE (Printed Circuit Heat Exchanger) is a promising candidate for vaporizer in volume-limited vaporization processes, and the thermal-hydraulic performance of crossflow PCHE for liquefied gas vaporization has been investigated under different conditions. In this study, we herein focused on the heat transfer and flow characteristics of supercritical nitrogen in the PCHE cold channel, so the same flow through a single channel of PCHE cold side was numerically treated. Numerical simulation was performed using FLUENT. The mass flow rate was 0.000493 kg/s, corresponding to the turbulence flow regimes. The SST model with enhanced wall treatment method was utilized by comparing with the experimental data. The thermal properties of supercritical nitrogen at different pressures were studied by using piecewise polynomial functions of temperature. After validation of the method, the influences of nitrogen inlet pressure and mass flux on the heat transfer and flow characteristics were discussed in detail. Then the Nusselt number and Fanning friction factor were proposed using numerical data for the Reynolds number from 19379 to 40171.The experimental data were utilized to validate the correlation of Fanning friction factor. The Nusselt number calculated by the proposed Nusselt number was validated with the numerical data and the developed empirical correlations for the experimental condition. In addition, the overall heat transfer coefficient was obtained by two methods. The indirect method, which predicted the overall heat transfer coefficient by using the proposed Nusslet number correlation,