Channel structure influence on the thermal-hydraulic performance of zigzag supercritical CO₂ PCHE

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Supercritical Carbon Dioxide Printed Circuit Heat Exchanger (SCO₂ PCHE) is a very promising flat plate heat exchanger, which is considered to be the feasible candidate in the generation IV reactor. Based on the PCHE model of Tokyo Institute of Technology, CFD method was used to measure the two fin angles which were 32.5° and 40.0° of the zigzag channel, the simulation showed a good agreement with the experiment results in local heat transfer, Nusselt number and friction factor.

Then the effects of 5°-60° fin angles and 1-6mm channel width on the heat transfer performance and flow characteristics of SCO₂ PCHE were studied. The increase in diameter increases the heat transfer performance and significantly increases the friction factor, while the effect of diameter is just the opposite. It is found that the 2mm channel diameter and 20°-45° fin angles are the optimal choices to enhance the heat transfer with less pressure drop reduction. And 6 types of fin length, which are 2mm, 3mm, 6mm, 9mm, 18mm and 27mm were compared. It showed that the small length has good thermal-hydraulic performance, and 3mm fin length is the optimal choice in the simulation conditions.

The work has important reference value for the SCO₂ PCHE design, development and research.

Keywords: supercritical carbon dioxide; printed circuit heat exchanger; channel width; fin angle; fin length