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C2Po1E-01: Numerical investigation on the performance of a new type of perforated-serrated fin for plate-fin heat exchanger in helium cryogenic system

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In order to improve the heat transfer and pressure drop performance of plate-fin heat exchanger in helium cryogenic system, a new type of perforated-serrated fin is proposed by combining traditional serrated and perforated fins. A series of numerical simulations are carried out with well-validated 3D models. Because the flow in the channel should be in a turbulent state, the RNG k-ε turbulence model is used which can simulate the strong strain flow with higher accuracy. The numerical model of flow and heat transfer in the fin channels takes into account the influence of low temperature conditions with variable physical properties by NIST-Real-Gas-Model invoking the properties of helium. Meanwhile, three performance evaluation criteria Colburn factor j, friction factor f and JF-factor are used to qualitatively compare their pressure drop, heat transfer performance and thermo-hydraulic performance. The results show that the heat transfer performance of new perforated-serrated fins is better. Colburn factor j of the new fins increases by 10.74%˜21.40% compared with serrated fin. The flow performance of the perforated-serrated fin is slightly worse, but the overall thermo-hydraulic performance is better, especially at low Reynold number. In addition, the effects of various structural parameters on the thermohydraulic characteristics of the perforated-serrated is obtained. The present work might be very helpful to enhance the performance of heat transfer in the fin channels and also guide the optimum design of plate-fin heat exchangers in helium cryogenic system.

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