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C1Po2D-06 [06]: Optimum Design of Cryogenic Plate-Fin Heat Exchangers Based on Volume Minimization

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To reduce the volume of hydrogen or helium cryogenic refrigerator and liquefaction, we need the minimum volume to achieve the efficiency and the pressure loss of the plate-fin heat exchangers given by the process. For this purpose, this paper presented a new comprehensive performance factor S = J^3*As^2/(f*V^2), which means ε/(Δp·V_{eff}) or ε/(w_{pump}*V_{eff}). Based on the performance factor, a new optimization method for cryogenic heat exchanger, optimization design method for cryogenic plate fin heat exchanger based on volume minimization, was proposed in this paper. Using this method, the authors of this paper optimized the heat exchangers in the L40 helium liquefaction developed by the technical institute of physics and chemistry of the Chinese academy of sciences and design a 250W@4.5K refrigerator. In the case of meeting the requirements of the process, the volume of the heat exchangers in the L40 helium was reduced by half. Under the condition of almost the same volume of cold box and heat exchangers, the liquefaction rate of 250W@4.5K is almost 50% higher than that of L40. This method has a certain theoretical guiding significance for the development of a large cryogenic system.

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