

Experimental study of the thermo-hydraulic performance of 3-stream plate-fin heat exchanger

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The performance of a 3-stream plate-fin heat exchanger in a helium refrigerator plant having a modified Claude cycle is crucial to achieve required refrigeration power. This heat exchanger is placed between 2 warmer turbines of the helium refrigerator plant, which is being developed at IPR, Gandhinagar, India. This 3-stream plate-fin heat exchanger has been designed using serrated fins of Al-alloy (Al3003) for 2 hot helium streams of flow rates ~ 13 g/s and ~ 17 g/s and cold helium stream of 30 g/s with cold end at ~ 15 K and hot end at ~ 27 K. The fabricated 3-stream heat exchanger has been tested down to 80 K in a test bed before using it in the plant. In this test bed, a helium circulator and LN₂-precooling heat exchanger along with this 3-stream heat exchanger were used. In the 3-stream heat exchanger, the temperature at the cold end was ~ 80 K and at the hot end, ~ 300 K. A simple test set-up has been made without a vacuum chamber and using insulation like nitrile rubber and MLI. In this test setup, thermo-hydraulic performances were measured successfully and found to be quite close to the designed value. The thermo-hydraulic performances have been compared with that of AspenTech software results and design results. The test setup and results will be discussed in detail in this paper.

Keyword: 3-stream, plate-fin, heat exchanger, Helium, Cryogenics, Test setup

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