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C2Or2C-04: Experimental validation and refinement of mixture optimization for mixed gas Joule-Thomson cycle

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An initial prototype of a mixed gas Joule-Thomson (JT) cryocooler was constructed and installed in a test facility to experimentally validate and refine a computational tool developed to optimize the gas mixture composition for a Joule-Thomson cycle with specific operating parameters. The mixture optimization model determines an optimal three-component mixture based on the analysis of the maximum value of the minimum isothermal enthalpy change that occurs over a temperature range coupled with an evaluation of the percent of the heat exchanger that exists in a two-phase range. The initial prototype of the JT cryocooler was installed in a test facility capable of providing a range of gas composition, mass flow rate, and pressures. The JT cryocooler has been operated while charged with several gas mixtures over a range of operating pressures. The mass flow rate, temperature at the outlet of the JT valve, and cooling load were compared to the expected values based on the mixture optimization model. Results were used to refine the model, particularly the heat exchanger performance, and gain confidence in its ability to steer future experimental iterations.

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