Contribution ID: **114** Type: **Contributed Oral Presentation**

Thermodynamic optimization of mixed refrigerant Joule Thomson systems constrained by heat transfer considerations

Wednesday 1 July 2015 11:45 (15 minutes)

Mixed refrigerant (MR) working fluids can significantly increase the cooling capacity of a Joule Thomson (JT) cycle. The optimization of MRJT systems has been the subject of substantial research. However, most optimization techniques do not model the recuperator in sufficient detail. For example, the recuperator is usually assumed to have a heat transfer coefficient does not vary with the mixture. Ongoing work at the University of Wisconsin-Madison has shown that the heat transfer coefficients for two-phase flow are approximately three times greater than for a single phase mixture when the mixture is between 15% and 85% quality . As a result, a system that specifies a MR without considering the impact of two phase flow may require an extremely large recuperator or not achieve the performance predicted by the model. To ensure optimal performance of the JT cycle, the MR should be selected such it is entirely two-phase within the recuperator. To determine the optimal MR composition, a parametric study was conducted on a thermodynamically ideal cycle. The results of the parametric study are graphically presented on a contour plot in the parameter space consisting of the extremes of the qualities within the recuperator. The contours show constant values of the normalized refrigeration power. This 'map'of the JT cycle shows the effect of MR composition on the cycle performance and can be used to select the MR that provides a high cooling load while also constraining the recuperator to be two phase. The predicted best MR composition can be used as a starting point for experimentally determining the best MR. To confirm that the map is generally useful, similar studies are carried out in order to compare the effect of changing the number of components, the charge pressures, the temperature range, and using synthetic vs hydrocarbon mixtures .

Author: Mr HINZE, Jacob (University of Wisconsin-Madison)

Co-authors: Mr NELLIS, Gregory (University of Wisconsin-Madison); Mr KLEIN, Sanford (University of Wisconsin-Madison)

Presenter: Mr HINZE, Jacob (University of Wisconsin-Madison)

Session Classification: C3OrC - Mixed Gases

Track Classification: CEC-12 - Fluid Mechanics, Heat Transfer, and Cryogen Properties