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C1Or3B-07: Influences of distributed J-T effect on the performance of mixed-refrigerant Joule-Thomson refrigeration cycle

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In a Linde-Hampson cycle, the working fluid usually produces a throttling effect in the expansion element. However, when a mini-channel heat exchanger is applied to the cycle, the high-pressure flow can also generate a throttling effect in the narrow channels, known as the distributed J-T effect. The distributed J-T effect (or distributed pressure drop) is usually considered to have a negative impact on the cycle performance. However, it may be acceptable under special conditions. In this paper, the effect of the distributed J-T effect on the performance of mixed refrigerant Joule-Thomson (MRJT) refrigeration cycles is investigated. The exergy loss distribution of the cycle is investigated under different conditions: a fixed compressor inlet temperature, a fixed heat exchanger UA value, and a fixed minimum temperature difference of the heat exchanger. The effect of the distributed J-T effect on the cycle performance is also examined. It can be seen that the distributed J-T effect can be used to maintain high cycle performance under specific conditions, and the distributed J-T effect in a specific temperature region only affects the exergy loss in the lower temperature region than it. In addition, the maximum allowable pressure drop of the MRJT cycle is consistent with the isothermal throttling effect of the mixed refrigerant when the minimum heat exchanger temperature difference is defined. At the same time, only the exergy loss distribution between the heat exchanger and the throttle valve will be influenced by the distributed J-T effect at a constant compressor inlet temperature. The conclusions of this paper provide a reliable reference for exploiting the distributed J-T effect, especially for the design of compact miniature J-T coolers.

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