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Modeling the Adsorption of Mixed-Gases Based on Pure Gas Adsorption Properties

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Sorption-based Joule-Thomson (JT) cryocoolers often operate with pure gases. A sorption-based compressor has many benefits; however, it is limited by the pressure ratios it can provide. Using a mixed-refrigerant (MR) instead of a pure refrigerant in JT cryocoolers allows working at much lower pressures. Therefore, it is desired to use MRs in sorption-based cryocoolers in order to reduce one of its main limitations.

The adsorption of mixed gases is usually investigated under steady conditions, mainly for storage and separation processes. However, the process in a sorption compressor goes through various temperatures, pressures and adsorption concentrations; therefore, it differs from the common mixed gases adsorption applications. In order to simulate the sorption process in a compressor a numerical analysis for mixed gases is developed, based on pure gas adsorption characteristics. The pure gas adsorption properties have been measured for four gases (nitrogen, methane, ethane, and propane) with Norit-RB2 activated carbon. A single adsorption model is desired to describe the adsorption of all 4 gases. This model is further developed to a mixed-gas adsorption model. In future work more adsorbents will be tested with these four gases and the adsorption model will be verified against experimental results of mixed-gas adsorption measurements.

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