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C3Po1D-02 [04]: Sorption compressor efficiencies of different designs

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Sorption compressors do not have moving parts and are suitable for driving Joule-Thomson cryocoolers. This allows a complete cryogenic cooling system with the absence of moving parts, which is attractive especially for space applications, as well as for other applications. Sorption compressors are thermally driven, meaning, they operate in heating and cooling cycles. The main drawback of sorption compressors is their low efficiency, relative to mechanical compressors. The compressor efficiency is defined as the PV power divided by the heat which is supplied to the compressor, it is limited by the Carnot efficiency, and practically it is significantly lower. In addition, we define a thermal efficiency of a compressor, by the heat which is transferred to the adsorbent divided by the total heat which is supplied to the compressor.
In the frame of our ongoing research on sorption applications we develop a numerical model for the heat and mass transfer in a sorption cell. The model allows investigating the performance of a variety of sorption cell configurations, including different geometries, dimensions, and materials. In the current paper we show preliminary results of sorption compressor efficiencies for different sorption cell designs. An investigation on the heater configuration, general dimensions, and different adsorbents is presented. The results show that a sorption cell configuration, which provides a maximum efficiency, is not necessarily the cell configuration which provides the maximum thermal efficiency.

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