

Virtual Design Of A Four-Bed Molecular Sieve For Exploration

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Abstract

Aboard the International Space Station, carbon dioxide is removed from the atmosphere using a four-bed adsorptive separation process, referred to generally as a 4-Bed Molecular Sieve (4BMS). Experience with the current 4BMS design in space has led to a list of areas for improvement for a next-generation design, which is currently in development at NASA. Some of the major design improvements include using a different sorbent for CO₂ and changing the sizes of the beds. Because 4BMS is a complex system and testing of new configurations is time-consuming and expensive, COMSOL modelling is being used to help guide the design. In this work, simulations of six new 4BMS configurations have been performed using a one-dimensional COMSOL model. The preliminary results show that reductions in desiccant bed size and sorbent bed size when compared to the International Space Station configuration are feasible while still yielding a process that handles at least 4.0 kg/day CO₂. The results also show that changes to the CO₂ sorbent are likewise feasible. Decreasing the bed sizes was found to have very little negative effect on the adsorption process; breakthrough of CO₂ in the sorbent bed was observed for two of the configurations, but a small degree of CO₂ breakthrough is acceptable, and water breakthrough in the desiccant beds was not observed. Both configurations for which CO₂ breakthrough was observed still yield relatively high CO₂ efficiency, and future investigations will focus on bed size in order to find the optimum configuration.

Figures used in the abstract

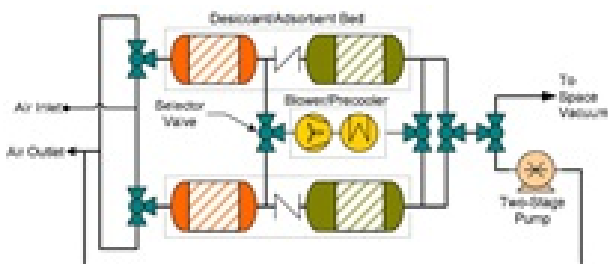


Figure 1 : A simplified schematic of a 4BMS system.