A durable, high-capacity regenerable sorbent can remove CO2 from the breathing loop under a Martian atmosphere. The system design allows near-ambient temperature operation, needs only a small temperature swing, and sorbent regeneration takes place at or above 8 torr, eliminating the potential for Martian atmosphere to leak into the regeneration bed and into the breathing loop. The physical adsorbent can be used in a metabolic, heat-driven TSA system to remove CO2 from the breathing loop of the astronaut and reject it to the Martian atmosphere. Two (or more) alternating sorbent beds continuously scrub and reject CO2 from the spacesuit ventilation loop. The sorbent beds are cycled, alternately absorbing CO2 from the vent loop and rejecting the adsorbed material into the environment at a high CO2 partial pressure (above 8 torr). The system does not need to run the adsorber at cryogenic temperatures, and uses a much smaller temperature swing.

The sorbent removes CO2 via a weak chemical interaction. The interaction is strong enough to enable CO2 adsorption even at 3 to 7.6 torr. However, because the interaction between the surface adsorption sites and the CO2 is relatively weak, the heat input needed to regenerate the sorbent is much lower than that for chemical absorbents. The sorbent developed in this project could potentially find use in a large commercial market in the removal of CO2 emissions from coal-fired power plants, if regulations are put in place to curb carbon emissions from power plants.

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