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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