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. This work was done by Gokhan Alptekin and Ambal Jayaraman of TDA Research for Marshall Space Flight Center. For more information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-32902-1.
not trap gases or cryogenic liquids and, consequently, does not pose cryopumping and cryoingestion problems.

This thermal management system can be applied in either an automated or manual spraying process with less sensitivity to process chemistry and environmental parameters than spray-on foam insulation (SOFI) products like a commercially produced polyurethane foam used on the Space Shuttle External Tank, while providing better insulation performance. The aerogel bead binder-sprayed panel, with a thermal conductivity of 20 to 25 mW/mK, outperformed the commercial foam by 30 to 40 percent in the 10 to 100 °C temperature range.

The aerogel compositions developed for this innovation withstand repeated cycles of high enthalpy shear flows of 20 to 100 Pa at temperatures tested up to 370 °C without losing mechanical integrity. Thermal management systems with versatile installation based on aerogel beads represent a significant opportunity for improving performance of systems for long-term cryogenic propellant storage or transfer for mechanisms operating in cryogenic temperature environments, space transportation, and propulsion systems.

This work was done by Danny Ou, Roxana Trifu, and Gregory Caggiano of Aspen Aerogels, Inc. for Marshall Space Flight Center. For more information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-32810-1.