Sabatier Catalyst Poisoning Investigation

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The Carbon Dioxide Reduction Assembly (CRA) on the International Space Station (ISS) has been operational since 2010. The CRA uses a Sabatier reactor to produce water and methane by reaction of the metabolic CO_2 scrubbed from the cabin air and the hydrogen byproduct from the water electrolysis system used for metabolic oxygen generation. Incorporating the CRA into the overall air revitalization system has facilitated life support system loop closure on the ISS reducing resupply logistics and thereby enhancing longer term missions.

The CRA utilizes CO_2 which has been adsorbed in a 5A molecular sieve within the Carbon Dioxide Removal Assembly, CDRA. There is a potential of compounds with molecular dimensions similar to, or less than CO_2 to also be adsorbed. In this fashion trace contaminants may be concentrated within the CDRA and subsequently desorbed with the CO_2 to the CRA. Currently, there is no provision to remove contaminants prior to entering the Sabatier catalyst bed. The risk associated with this is potential catalyst degradation due to trace organic contaminants in the CRA carbon dioxide feed acting as catalyst poisons. To better understand this risk, United Technologies Aerospace System (UTAS) has teamed with MSFC to investigate the impact of various trace contaminants on the CRA catalyst performance at relative ISS cabin air concentrations and at about 200/400 times of ISS concentrations, representative of the potential concentrating effect of the CDRA molecular sieve. This paper summarizes our initial assessment results.