2015 ICES Conference

Abstract (DRAFT)

Correlation of Amine Swingbed On-Orbit CO2 Performance with a Hardware Independent Predictive Model

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The Amine Swingbed Payload is an experimental system deployed on the International Space Station (ISS) that includes a two-bed, vacuum regenerated, amine-based carbon dioxide (CO2) removal subsystem as the principal item under investigation. The amine-based subsystem, also described previously in various publications as CAMRAS 3, was originally designed, fabricated and tested by Hamilton Sundstrand Space Systems International, Inc. (HSSSI) and delivered to NASA in November 2008. The CAMRAS 3 unit was subsequently designed into a flight payload experiment in 2010 and 2011, with flight test integration activities accomplished on-orbit between January 2012 and March 2013. Payload activation was accomplished in May 2013 followed by a 1000 hour experimental period.

The experimental nature of the Payload and the interaction with the dynamic ISS environment present unique scientific and engineering challenges, in particular to the verification and validation of the expected Payload CO2 removal performance. A modeling and simulation approach that incorporates principles of chemical reaction engineering has been developed for the amine-based system to predict the dynamic cabin CO2 partial pressure with given inputs of sorbent bed size, process air flow, operating temperature, half-cycle time, CO2 generation rate, cabin volume and the magnitude of vacuum available. Simulation runs using the model to predict ambient CO2 concentrations show good correlation to on-orbit performance measurements and ISS dynamic concentrations for the assumed operating conditions. The dynamic predictive modelling could benefit operational planning to help ensure ISS CO2 concentrations are maintained below prescribed limits and for the Orion vehicle to simulate various operating conditions, scenarios and transients.