

Rapid Cycle Amine (RCA 2.0) System Development

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The Rapid Cycle Amine (RCA) system is a low power assembly capable of simultaneously removing carbon dioxide (CO₂) and humidity from an influent air stream and subsequent regeneration when exposed to a vacuum source. Two solid amine sorbent beds are alternated between an uptake mode and a regeneration mode. During the uptake mode, the sorbent is exposed to an air stream (ventilation loop) to adsorb CO₂ and water vapor, while during the regeneration mode, the sorbent rejects the adsorbed CO₂ and water vapor to a vacuum source. The two beds operate such that while one bed is in the uptake mode, the other is in the regeneration mode, thus continuously providing an on-service sorbent bed by which CO₂ and humidity may be removed. A novel valve assembly provides a simple means of diverting the process air flow through the uptake bed while simultaneously directing the vacuum source to the regeneration bed. Additionally, the valve assembly is designed to allow for switching between uptake and regeneration modes with only one moving part while minimizing gas volume losses to the vacuum source by means of an internal pressure equalization step during actuation. The process can be controlled by a compact, low power controller design with several modes of operation available to the user.

Together with NASA, United Technologies Corporation Aerospace Systems has been developing RCA 2.0 based on performance and design feedback on several sorbent bed test articles and valve design concepts. A final design was selected in November 2011 and fabricated and assembled between March and August 2012, with delivery to NASA-JSC in September 2012. This paper will provide an overview on the RCA system design and results of pre-delivery testing.

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