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STATE OF TRASH-TO-GAS TECHNOLOGIES FOR FUTURE EXPLORATION MISSIONS

Abstract

Waste management systems for future long-duration crewed habitats are currently being developed by the NASA Advanced Exploration Systems Logistics Reduction project. If simply stored, waste items will continuously reduce crew habitable volume while making orbital maneuvers increasingly costly due to the accumulated waste mass. Valuable resources can also be recovered from various waste items. Since 2012, NASA has investigated the ability to gasify astronaut waste items via thermal degradation, a process coined Trash-to-Gas. Trash-to-Gas enables future long duration missions to either repurpose the gaseous products that are generated (ECLSS consumables, propellant) or to safely vent the gasified waste for mass and volume reduction benefits. Several Trash-to-Gas technologies have been explored, developed, and traded to better understand which processes may be preferable for certain mission scenarios and applications. This includes the development of the Orbital Syngas/Commodity Augmentation Reactor (OSCAR), which demonstrated sub-scale Trash-to-Gas operability in the microgravity environment, as well as the Advanced Organic Waste Gasifier (AOWG), which has demonstrated full-scale ground functionality for a crew of four. Other Trash-to-Gas research has investigated the use of pyrolysis, torrefaction, incineration, and plasma to thermally degrade various astronaut crew items. A historical overview of NASA Trash-to-Gas development, the current state of Trash-to-Gas, identified technical gaps, and how Trash-to-Gas technology may be infused into various future mission scenarios are presented and discussed.