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HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)
Human Exploration of Mars (2)

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ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM COMBINED TO TRASH-TO-GAS EXPERIMENT

Abstract

Future crewed missions to other planets or non-terrestrial bodies will require regenerative Life Support Systems (LSS) as well as recycling processes for mission waste. Constant resupply of many commodity materials will not be a feasible option for deep space missions, nor will storing trash on board a vehicle or at a lunar or Martian outpost, since the usable space will decline as the volume of waste increases. Deep space, long duration missions will rely on regenerative LSS and In-Situ Resource Utilization (ISRU) in order to sustain these missions and minimize waste volume build-up through recycling efforts. This paper will discuss a study that investigates the collaboration of two systems: a regenerative Environmental Controlled Life Support System (ECLSS) and a waste reactor for transforming trash into high value products such as methane gas for a green propellant, and water and oxygen for crew LSS.

A complete regenerative ECLSS on an extra-terrestrial outpost will likely include physico-chemical and biological technologies, such as bioreactors and greenhouse modules. Physico-chemical LSS do not enable food production and bio-regenerative LSS are not stable enough to be used alone in space. Mission waste that cannot be recycled into the regenerative ECLSS includes excess food, food packaging, clothing, tape, urine and fecal. This waste will be sent to a system for converting the trash into the high value products. Tests described in this paper were performed during the second Mars analog HI-SEAS (Hawaii Space Exploration and Analog Simulation) mission in which an ECLSS plant chamber was tested for food production during HI-SEAS and the non-edible and waste biomass, and other waste from the 120 day mission was accumulated and simulated in a reactor developed by KSC. This preliminary test paves the way towards full recycling for long duration deep space missions. The fact that it was tested on small-scale unit compared to what is currently done on large-scale Earth waste processing system brings the fully regenerative ECLSS-trash-to-gas technology closer to space adaptation.