SBIR/STTR
Small Business Innovation Research / Small Business Technology Transfer

NASA SBIR 2018 Phase I Solicitation

H3.02 Waste Management and Resource Recovery

Lead Center: JSC

Participating Center(s): ARC, GRC, KSC, MSFC

Technology Area: TA6 Human Health, Life Support and Habitation Systems

There are two areas of focus in this subtopic:

Collection and Recovery of High TOC Water from Feces and Trash

Wet trash contains ~25% and feces contains ~75% water by mass that is currently not recovered on ISS. Currently wet trash and feces are collected and stored in relatively impermeable containers for short term storage (1-3 months) and disposed of in departing logistics vehicles. There have been crew comments about odor generation during storage. Trash and fecal material must be stabilized for Mars transit and surface missions. Drying and thermal processing of trash can reduce odor generation and prevent microbial proliferation. Past Heat Melt Compactor (HMC) technology development has indicated >80 volatile compounds elute from trash and recovered water can exceed 3,500 ppm total organic carbon (TOC). Innovations are requested for technologies that can recover water from a gas stream with a wide range of volatile gas contaminants for long periods. Technologies must be able to recover >80% of the gas stream water content. Captured water should have minimal free gas and should be below 2% by volume for eventual delivery to a waste water tank. Purification of the water is not requested. Technologies must be able to accommodate a wide range of condensable and non-condensable mass flow rates as trash/fecal processing systems dry and process the material. Water recovery from a variety of processes (i.e., HMC, Trash to Gas, freeze drying) should be accommodated directly or with an assumed regenerative heat exchanger to recover energy prior to phase separation. Process gas temperatures will range from -80Â° C to 200Â° C and 6-110 kPa absolute. Condensable gas will range from 0-100% by volume with a maximum water flow rate of 15 g/min. Air cooling using cabin air 18-30Â° C is preferred but water cooling is acceptable. Systems must be capable of microgravity operation over a 6-month transit to Mars, an 18-month dormancy period, and 6-month operation on return to Earth with minimal crew maintenance. It is highly desirable that maintenance items consider fabrication by on-demand manufacturing (i.e., additive manufacturing and post finishing). Technologies must consider accumulation of organics and microbial proliferation between normal waste processing cycles and extended dormancy and any change in performance should be characterized. Technologies shall demonstrate comparison to previous SOA condensing heat exchangers.

Low Consumable Low Residual Waste Gasification

Past trash gasification technologies focused on producing gases (methane, water, oxygen, or CO_2) for secondary purposes using supplemental oxygen, water, or other consumables. The current request focuses on the minimal total mass (combined consumables and residual mass). Recent trash storage vs processing trade studies have indicated trash jettison during the transit results in the lowest total vehicle mass.Â It is possible to reduce overall vehicle mass by ~6% (10,800 kg) via trash jettison. Approximately 70% of the savings is due to reduced chemical propulsion fuel and tankage for orbit departures and insertions.Â Innovations are requested for technologies that can convert trash to gas suitable for venting to the space craft exterior for the purpose of reducing vehicle mass. Technologies must be capable of processing the wide range of crew logistical trash and metabolic waste.Â Processing technologies must decompose at least a portion of the hydrocarbon waste. Technologies that only recover water are not requested. Residuals material plus processing consumables (lost gas, oxygen, water, and carrier gases) must be less than 10% of the starting trash material.Â Processes must be capable of serial waste loading, processing, and residual removal without complete shutdown. Systems must be capable of microgravity operation over a 6-month transit to Mars, an 18-month dormancy period, and 6-month operation on return to Earth with minimal crew maintenance.Â It is highly desirable that maintenance items consider fabrication by on-demand manufacturing (i.e., additive manufacturing and post finishing). Technologies must consider containment of high pressure/temperature/hazardous gases for crew safety and operational robustness.Â Characterization of produced gases is required with emphasis on identification of condensable gases and acid/caustic gases that can adversely affect exterior glass and metallic vehicle surfaces. Technologies shall demonstrate comparison to previous state-of-the-art Trash to Gas (TtG) systems.Â If water is recovered (desirable but not required) chemical contaminants within the recovered water should be characterized.