NASA SBIR 2018 Phase I Solicitation

H3.01 Process Technologies for Water Recycling in Space

Lead Center: MSFC

Participating Center(s): ARC, GRC, JPL, JSC, KSC

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

Water Processors for Planetary Surface Systems

NASA seeks concepts for the development of water systems on a planetary surface that take advantage of the partial gravity on Mars or the lunar surface while implementing robust technologies with minimal consumables. The technologies should focus on the following potential waste streams: urine, humidity condensate, Sabatier product water, waste hygiene, and waste laundry water. Consideration should be given to planetary protection, for both forward and backward contamination. Technologies must be compatible with a delivery schedule to Mars (6-12-month transit) in which the system will be dormant, operational periods exceeding 500 days, followed by dormancy periods between uses for 2 or more years.

Total Organic Carbon Analyzer for Exploration Missions

Over the past 10+ years, we've learned the importance of real-time on-board monitoring of total organic carbon (TOC) in product water from the ISS wastewater recycling system (Water Processor Assembly - WPA). TOC along with conductivity provides a means to predict when multi-filtration beds require replacement. This data allows controllers and engineers to monitor both impending break through and recovery of upsets in water quality once appropriate remedial action is taken. Having measurement of TOC helps to optimize the life of consumable WPA elements. The hardware for monitoring TOC on the ISS is called the "Total Organic Carbon Analyzer" or TOCA. The Size, Weight and Power (SWaP) of TOCA is as follows: 67 L, 34 kg, and 64 W. Water recycling and therefore a TOCA will be required on future long duration gateway/deep space missions. The ISS TOCA design is simply too large for exploration vehicles and habitats. Any design effort toward an advanced TOCA should reduce the SWaP of the ISS TOCA by at least an order of magnitude. New technology development is sought in measuring TOC and conductivity in a miniaturized, automated system that can be plumbed into the WPA. Ideally, the TOCA requires no hazardous reagents, has long-term calibration stability, and requires very little crew time to operate and maintain. TOCA functionality is one of the critical water monitoring needs for future spacecraft based on the requirements assessment. Studies are currently being performed to explore alternative oxidation and detection techniques, as well as system simplifications and repackaging to shrink its size. In-line measurement is desired as a capability above the SOA, but it is not critical.

Silver-based Microbial Check Valve

NASA has interest in in-line microbial check valve (MCV) technologies for spacecraft potable water systems. The MCV should add 300 to 500 ug/L of silver to the water at a flow rate of 0.1 to 0.15 L/min to maintain the microbial control of the system in accordance with typical spacecraft potable water specifications. In addition, the device should be able to operate at ambient temperature, pH ranges between 4.5 - 9.0, and system pressures up to 30 psig. In addition, the MCV should prevent the passage and/or grow through of microbes across the MCV device when there is no flow. The MCV device should be capable of easy installation and be maintainable. The devices should also be small, robust, lightweight, and have minimal power and consumable mass requirements. In addition, candidate technologies should be microgravity compatible, have no adverse effects on the potability of the drinking water system, and not require removal of the imparted biocide prior to crew consumption. Of particular interest are microbial check valve technologies that are either silver-based and/or fully compatible with ionic silver disinfection strategies. Finally, MCV technologies should also be capable of providing continuous, stable and autonomous operation, and be fully functional following periods of long-term system dormancy – up to 1 year.