PROJECT SUMMARY

Firm: Orbital Technologies Corporation
Contract No.: NNJ08JA59C
Project Title: Enhanced Brine Dewatering System (EBDS) II

Purpose of the research

The purpose of the Enhanced Brine Dewatering System (EBDS) is to provide an easily scalable means of recovering usable water from the waste products created by primary wastewater processors. Extended duration Lunar and Mars missions will require the conservation and recovery of water to allow for dramatic reduction of launch mass and stowage volumes. The Phase II EBDS development served four purposes: (1) Develop ersatz formulation to accurately represent wastewater brines; (2) Build subsystem and full system EBDS prototypes; (3) Evaluate the performance of the system prototypes, as well as the chemical and biological characteristics of the system end products; and (4) Determine the equivalent system mass (ESM) of a flight-like EBDS design.

Description of research carried out

The EBDS concept will recover water from brines by applying a thin layer of brine to a reusable substrate, evaporating the water out of the brine layer, condensing and collecting the water vapor, removing the dried solids from the substrate prior to reapplication of the brine, and collecting the dried solids after removal from the substrate. Before full system prototype development could begin, the salt collection function of the EBDS was prototyped and tested, and different methods of thermal transfer were analyzed. The likely composition of wastewater brine was investigated and several ersatz formulations for wastewater brine were developed, analyzed, and tested. Prototypes of the major EBDS subsystems were developed and integrated into a full system prototype. The alpha prototype was tested with ersatz solutions and authentic wastewater brines to evaluate performance, investigate areas for design improvement, and test the chemical and biological characteristics of the influent, dried waste solids, and product water. The EBDS beta prototype was developed based on lessons learned from the alpha prototype. The beta prototype was tested at ORBITEC and delivered to JSC. Mass, power, and volume values of the EBDS prototypes were used to perform an ESM analysis of a flight-like EBDS design.

Research findings or results

Preliminary development work in the Phase II provided the basis for the EBDS salt collection system design and showed that a vapor compression refrigeration system has a lower ESM than a thermoelectric thermal transfer system for the EBDS. Testing of the EBDS full system alpha prototype showed that the EBDS is an effective means of recovering water from wastewater brines, with very little chemical or biological contamination of the end product water. Development and testing with authentic wastewater brines and brine ersatzes showed that the EBDS method requires a small quantity of a drying agent to be added to the influent prior to processing to enable the EBDS to function properly. Testing of the second EBDS prototype showed an increased brine processing rate and reduced power consumption over the first prototype. The beta prototype processed 3.4 L/day of brine and recovered 88% of the water from the influent brine. The ESM analysis of a flight-like EBDS design showed that there is a significant ESM advantage for the EBDS over transporting additional water for a 6 month mission with three crew members, and the advantages increases with additional crew and mission duration.

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