Safe Consumable Water and Wastewater

Name of Technology:
Disinfectants for Consumable Water and Wastewater

Participating NASA Centers:
JSC (Lead); ARC, GRC, KSC, MSFC

Technological Area:
X3.02 Water Processing and Waste Management Systems

Vision for the Technology:
For crews to live on Mars and the moon, water is a critical essential for life. Water technologies, processes, and methodologies must address long term storage and the need for recycling wastewater, including water brines (e.g. urine), clothes washing, feces, etc.

Ideally, the system(s) would have a disinfectant that maintains disinfection residual in water and wastewater recycling systems, which can be consumed safely by crew. The same system would be needed on both spacecraft and space bases to add to recycled water or refresh stored water.

These processes are needed to collect, store, recycle, and disinfect water for reuse as both drinking and hygiene water during long term missions and/or long periods of dormancy. Additional requirements include safe operability in micro- and partial-gravity environments, ambient and reduced-pressure environments, low-system volume, mass, and power, minimal use of expendables (e.g. chemicals, materials, etc.), high reliability, and ease of maintenance.

Challenges:
The United States uses on the International Space Station (ISS) Iodine for disinfection, but it must be removed prior to crew consumption. The Russians use Silver (Ag), but it has been shown to plate out of solution. Furthermore, the two biocides are incompatible and cannot be used together.

Research is going in the evaluation of the following technologies: UV, silver, coatings for storage tanks, microbial check valves, as well as design architecture changes (recirculation, and system redesigns) to validate feasibility.

Long term water storage and the need for recycling wastewater are essential for useable water for survival. Techniques are needed to eliminate biofilms and microbial contamination within water storage and components, such as pipes, tanks, check valves, etc.

NASA Seeks to Meet the Following Specs:

Success will be measured by demonstration of

1) Long-term maintenance of water systems with bacterial count <50 CFU/mL
2) Microbial control against 100 targeted microbes
3) Coliform, fungal count, and parasitic protozoa counts at 0 per 100 mL.

Overview of Student Project:
NASA seeks innovative technologies and processes to provide clean drinking water from long-term water storage and wastewater recycling. These disinfectant processes need to store water and to disinfect (recycle) wastewater for reuse as both drinking and hygiene water during long term missions and/or long periods of dormancy.

Innovative Areas Student Projects Can Address:
A. Water Storage Disinfectant

B. Wastewater Disinfectant
C. Water and Wastewater Disinfectant Technologies/Systems

Project Phases

I. Technology/Process concept and/or application formulated.

II. Analytical and experimental proof-of-concept of critical function and/or characteristics.

III. (If possible) Component and/or breadboard validation in a laboratory environment.

Research Funded by NASA on this Topic:

Proposal Number: 19-1- T6.06-2448
Side-Emitting Optical Fibers for Delivery of UV-C Light to Disinfect Key Bacteria in Space Station Water and Storage and Conveyance Systems

Proposal Number: 90-1- 12.03-0369
Design Modification of the Wiped-Film Rotating-Disk Evaporator for the Reclamation

Proposal Number: 12-2 H3.03-8904
Silver Ion Biocide Delivery System for Water Disinfection

Proposal Number: 19-2- H3.03-4124
Halogen Binding Resins for Potable Water Disinfection

Proposal Number: 10-1 X3.01-9805
Advanced Oxidation Technology for Potable Water Disinfection

References:
H3.03 Crew Accommodations and Water Recovery for Long Duration Missions

T6.06 Spacecraft Water Sustainability through Nanotechnology

H3.01 Process Technologies for Water Recycling in Space

H3.02 Water Recovery and Stabilization of Human Metabolic Waste (Feces)

X2.02 Spacecraft Habitation Systems, Water Recovery and Waste Management

X3.02 Water Processing and Waste Management

H3.04 Development of Treatment Technologies and Process Monitoring for Water Recovery

X12.07Advanced Life Support: Water and Waste Processing