Evaporator-Based Potable Water Dispenser (EBPWD)

UC DAVIS MECHANICAL AND AEROSPACE ENGINEERING

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/// OBJECTIVE

The EBPWD utilizes an evaporator-based cooling loop featuring refrigerant R134a and a peristaltic pump to dispense potable water below ambient temperature. A compressible bladder assembly, optimized ACTEX filter geometry, and enhanced safety features improve ECLSS performance and support long-duration missions beyond LEO.

/// SYSTEM OVERVIEW

The design assumes that similar ISS EXPRESS rack technology for payloads/experiments will be used on Lunar/Martian bases and space stations.

DISPENSER HOUSING

- Designed to fit within two stacked ISS Shuttle Middeck lockers
- Internal volume of 4.06 cubic feet: 23.00 in height, a width of 18.50” & 21.50” in depth
- Mass is approximately 15 kg

DISPENSER OPERATION

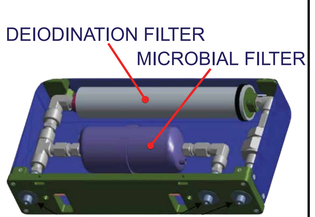
- The EBPWD will be connected to a water supply (22.5 psig and 22.5 °C)
- Dispenser is powered through a 28 Vdc auxiliary output
- Utilizes ISS EXPRESS Rack 6, which provides up up to 2000 watts & 20 amps

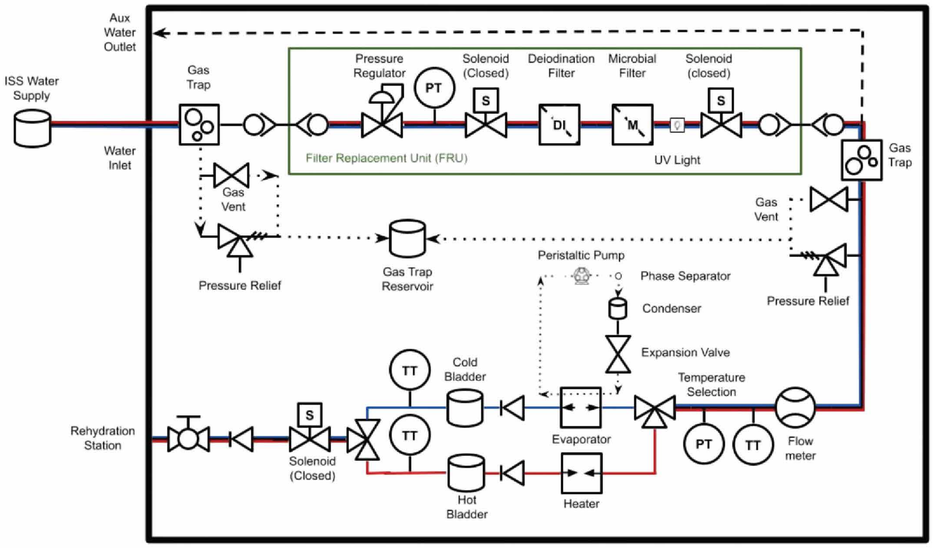
/// (FRU) FILTER REPLACEMENT UNIT

The FRU is responsible for purifying the ISS water for safe consumption, filtering out harmful concentrations of iodine (< 0.2ppm) and reducing CFU count present in the water (< 50 CFU/mL). The FRU utilizes a deiodination filter and microbial filter, respectively.

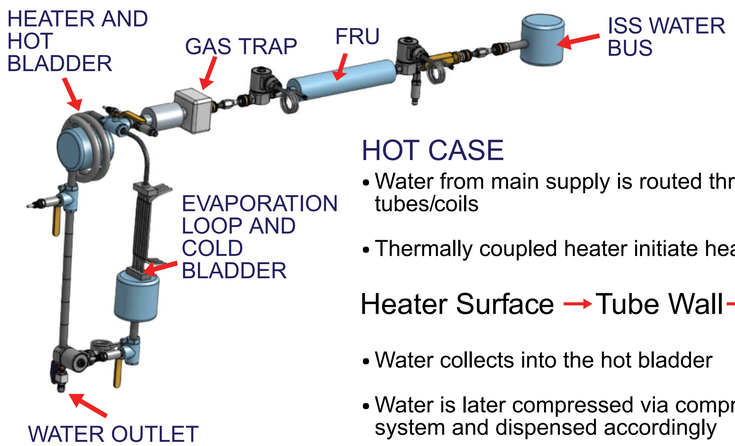
DESIGN GOALS

- Address pressure drop by developing early simulation to size filters in MATLAB
- Define filter parameters
- Build upon former ORU designs
- Improve FRU longevity





/// COOLING AND HEATING ARCHITECTURE



HOT CASE

- Water from main supply is routed through heater tubes/coils
- Thermally coupled heater initiate heat transfer:

Heater Surface → Tube Wall → Water

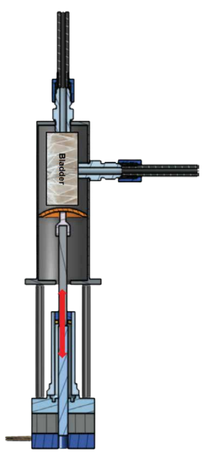
- Water collects into the hot bladder
- Water is later compressed via compression system and dispensed accordingly

COLD CASE

- Water is pushed through selected square microchannel in a multi channel heat exchanger
- Simultaneously: peristaltic pump circulates R134a through every other square microchannel
- Heat transfer occurs and water collects within the cold bladder
- Compression system pushes water, dispensed appropriately

Current Work

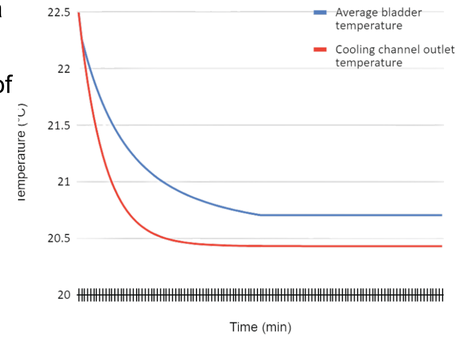
- Developed a calculator in Excel that will serve as the bases on sizing and characterizing both cooling and heating sub-systems



/// CONCEPT RESULTS & ANALYSIS

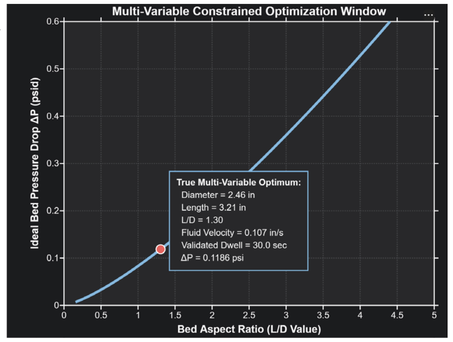
HEATING & COOLING CALCULATOR

- The calculator serves as a preliminary sizing tool
- Details heat transfer rate of each case



ACTEX- RESIN BED SIMULATION

- This simulation serves as a preliminary sizing tool for resin bed
- Details lowest pressure drop



/// FUTURE WORK

- Development of heat transfer simulation for hot and cold case
- Sizing and design of filters and UV Light in the FRU
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- Launch load and vibrational analysis of housing structure in Patran/Nastran
- Storage compartment design
- Power draw calculations from electronics, heater, valves, and other fluid components

/// ACKNOWLEDGEMENTS

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