LUNAR WATER EXTRACTION via LUNAR AUGER DRYER ISRU (LADI)

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EXPLORE SPACE TECH

Mission

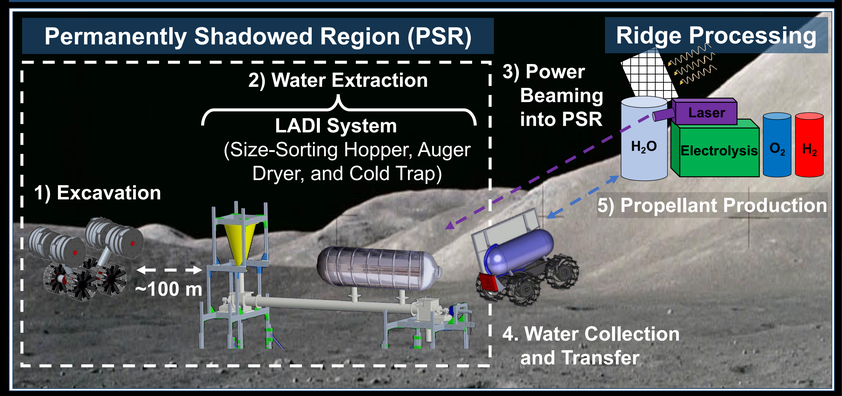
Develop a lunar water processing subsystem capable of operating inside a permanently shadowed region (PSR) to continuously process water-ice (and volatiles) for breathable air and propellant. Supports NASA's 2028 lunar sustainability goal.

Technology Gaps Addressed

Key technology gaps from 2020 NASA Technology Taxonomy and Lunar Surface Innovation Initiative team:

1. Icy regolith transfer in PSR environmental conditions
2. Icy regolith reactor processing inside PSR environmental conditions not verified by test

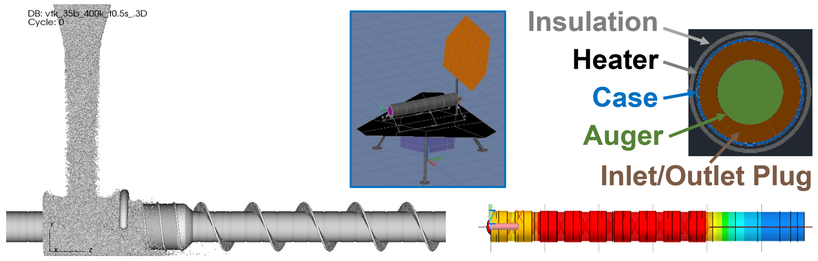
Lunar Water Processing Plant Con-Ops



Thermal, Mechanical, and System Models

Auger dryer models developed under LADI project:

- Auger casing thermal model predicts heater set points required for ground and environment testing
- Discrete element method (DEM) simulation can optimize plug geometry and predict solids flow in lunar gravity
- Thermal model integrated with auger sizing tool and MATLAB for parametric system-level studies optimized for mass, volume, or power and subscale or full-scale augers



***Above**: Sample DEM and CLPS Lander Thermal Models*

Mechanical & Thermal Testing and Results

Key lunar auger dryer mechanical design features:

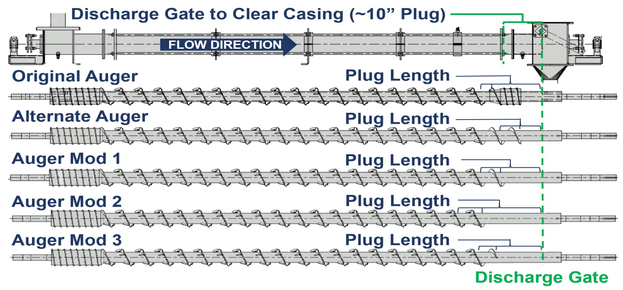
- Internal operating pressure below the triple point of water (611 Pa) in a vacuum environment
- Variable-pitch auger geometry creates (100% full) regolith plug seal at inlet & outlet to eliminate isolation valves and partially full (15%) heated section to promote mixing and drying

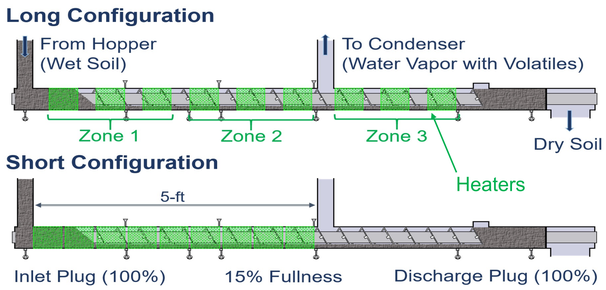
Key mechanical test results:

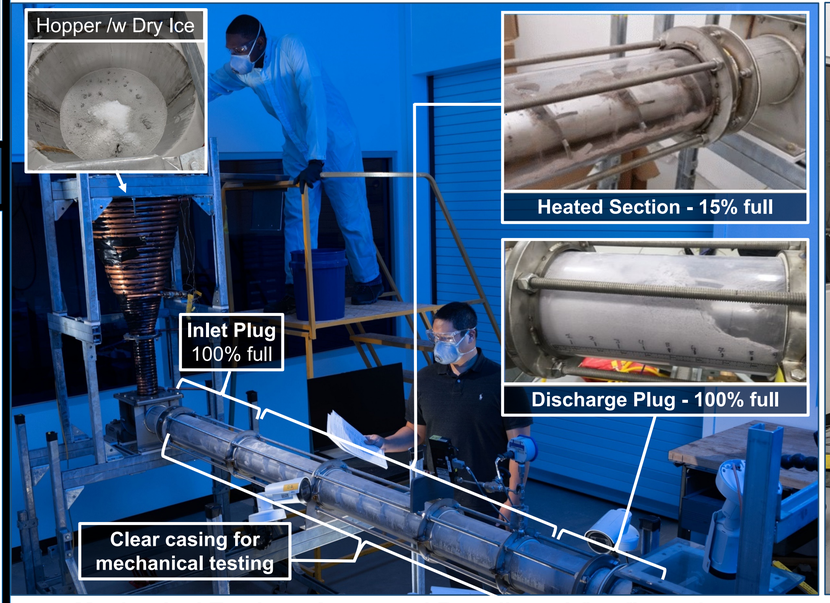
- 19 tests with Exolith Lab's Lunar Highlands Simulant (LHS-1) collecting torque, RPM, mass flow rate, gate angle, and power data
- Regolith plugs held pressure difference beyond water's triple point – verified with GN_2 injection
- Increased motor torque and plug strength during 5% icy simulant tests as ice melted to liquid water

Key thermal test results:

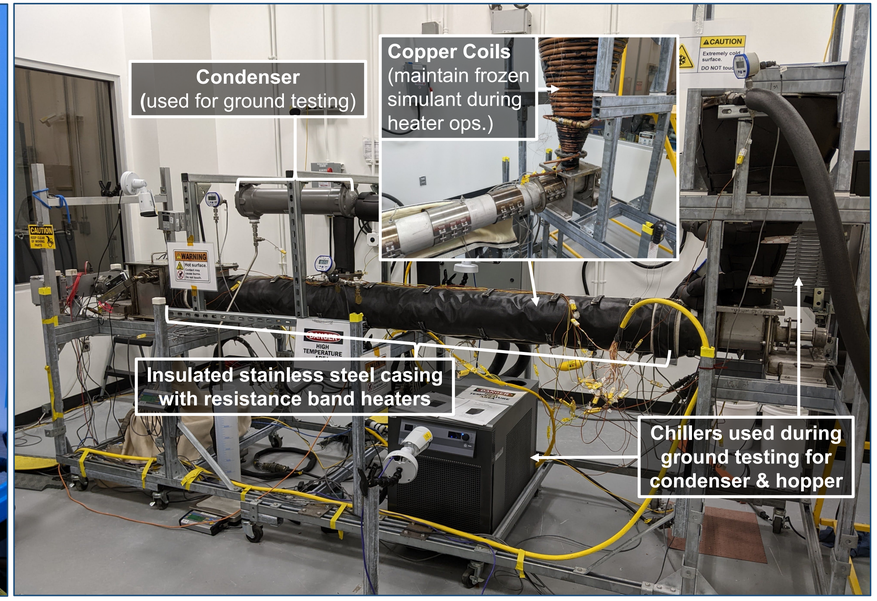
- Successfully separated water from a 5% icy lunar simulant mixture in laboratory conditions increasing TRL to 4
- Both the inlet and discharge plugs held internal pressure and the processed soil was verified dry by moisture balance







Mechanical Testing - Auger and Breadboard Configurations



Thermal Testing - Heater and Breadboard Configurations

Additional Project Information

- Next tech development steps include a.) expanding the thermal test matrix to investigate an increased lunar water range (2.7% to 8.5%) and b.) designing an Engineering Developmental Unit (EDU) sized for a Commercial Lunar Payload Services (CLPS) lander.
- This project was funded by NASA's Space Technology Mission Directorate (STMD) Game Changing Development (GCD) program.