



Wash Away in Space-Lunar Washer/Dryer

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Background: NASA is currently at work to support a potential long-term lunar mission, which would require astronauts to either bring a large amount of clothing or implement a laundry system for reusing garments. This study proposes the design of a washer-dryer combo optimized for lunar conditions, inspired by existing terrestrial technologies. **Aims:** This research endeavors to design a model washer-dryer combination which can operate and withstand lunar conditions. **Materials and Methods:** The machine is water-based, using less than 20 kg of water per cycle, consuming under 750 Watts of power, and weighing less than 50 kg to conserve valuable resources. It can wash up to 4.5 kg of clothing per cycle, enabling astronauts to clean a full week's worth of clothing in one load. The design also considers lunar gravity and pressure conditions to ensure efficiency and functionality in an extraterrestrial environment. The team has begun the design process, focusing on optimizing the system to meet the stringent demands of space missions while supporting the astronauts' daily needs. **Results:** This design has been completed and will be showcased at the NASA TSGC showcase in April 2025. **Implications:** Potential outcomes from this research and design include reducing the weight load of all future lunar modules and reducing waste from the astronauts residing on the moon for the long-term missions. **Key Words:** Lunar mission, laundry system, resource optimization, lunar gravity, design proposal.

Introduction

- NASA is currently considering different clothing and washer solutions for future Artemis missions
- The Texas Space Grant Consortium (TSGC) challenge tasked team with creating a water-based washer/dryer combo machine
- The machine will be located within a lunar cabin and operating connecting to the cabins water source

Design Constraints & Goals

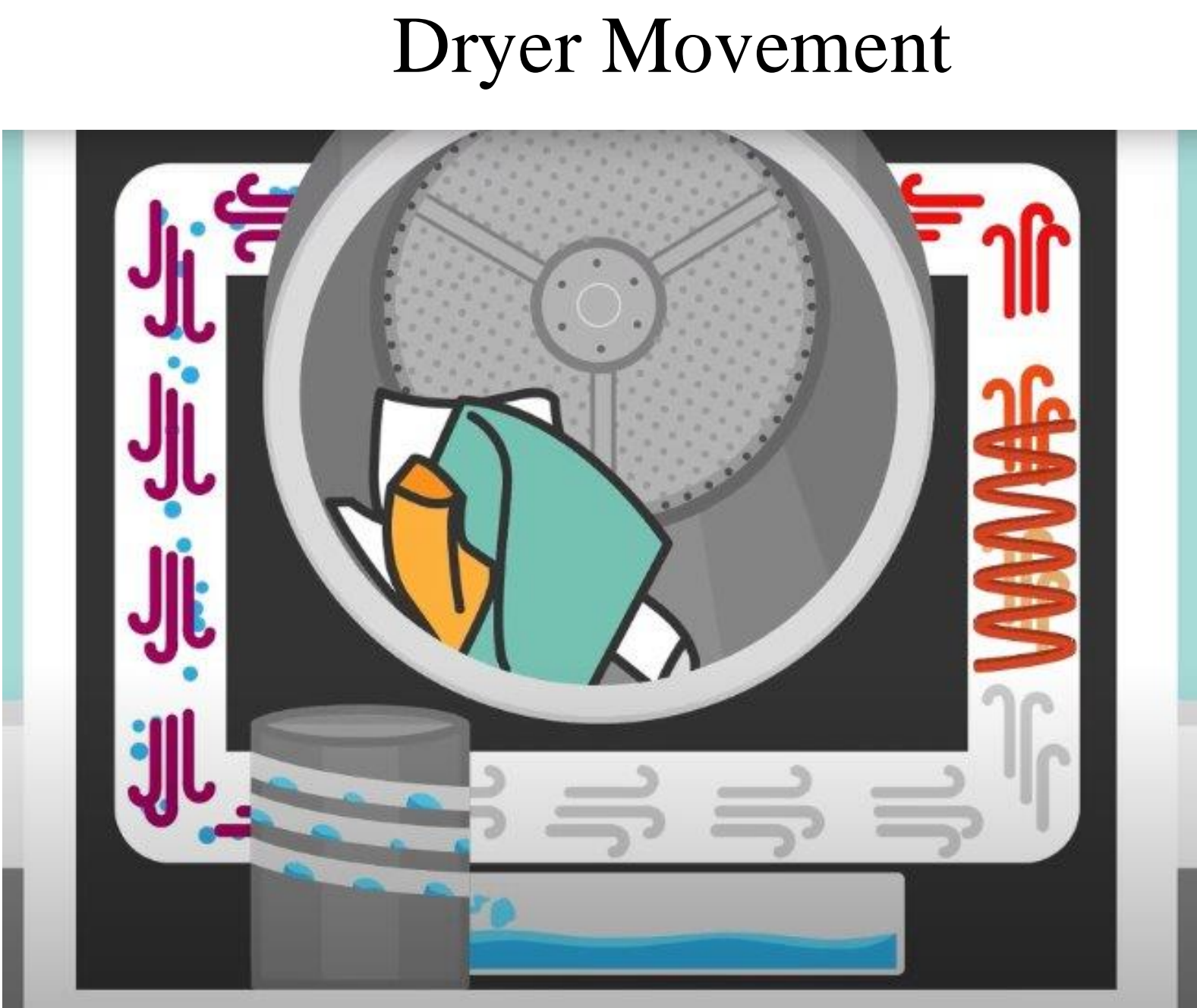
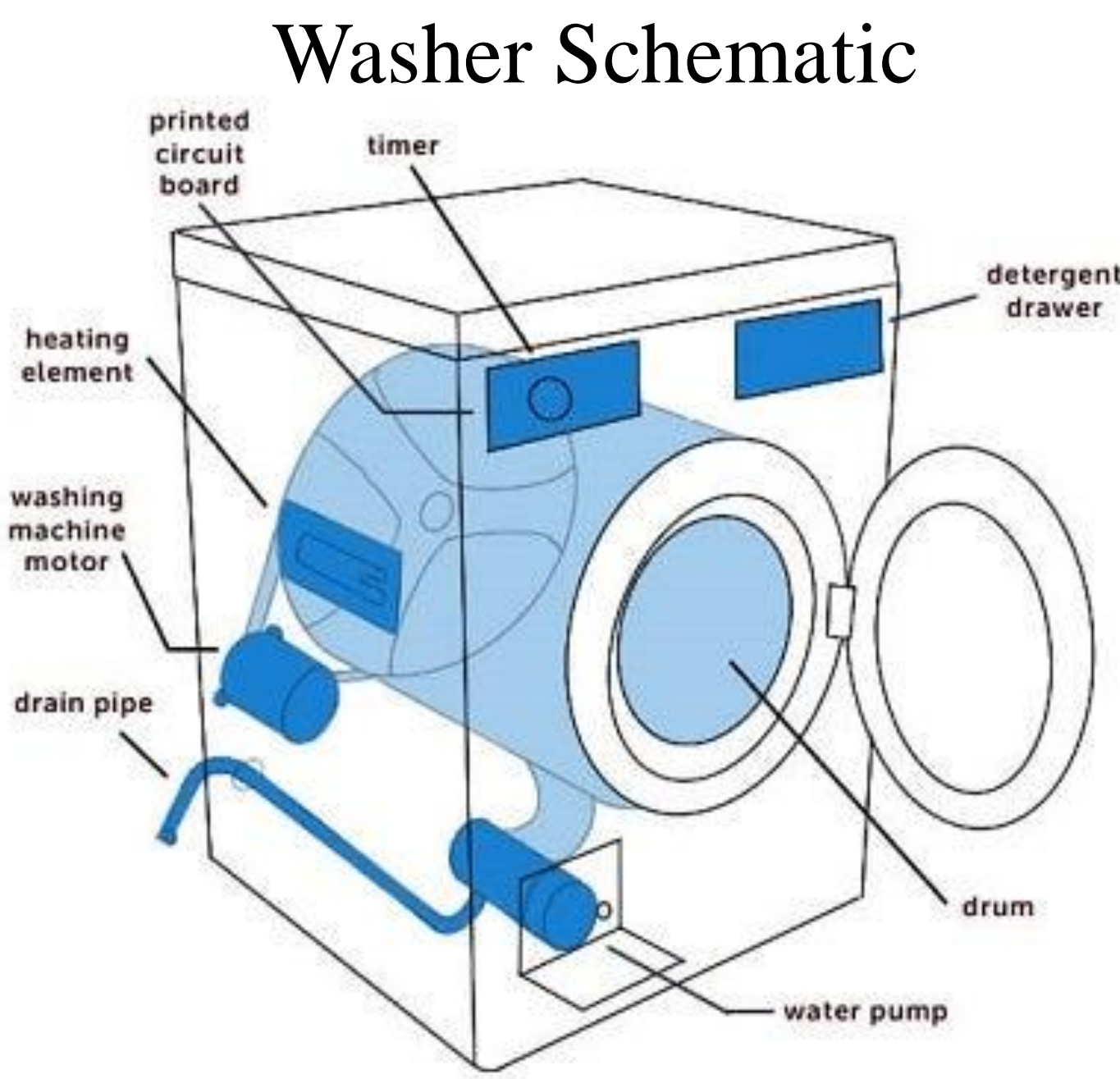
- Must be derived from existing washer/dryer all-in-one technology and be optimized for lunar gravity (1/6g)
- Must function reliably and not exhaust heat or humidity
- Must be operational at an atmospheric pressure of 70kPa
- Minimize the use of energy, time to launder, and water usage
- Minimize the size and volume of the machine
- Clothes must not come out damp
- Internal components can be installed in dustproof enclosures
- Energy recovery system to recover waste heat in dryer

Washer Functionality

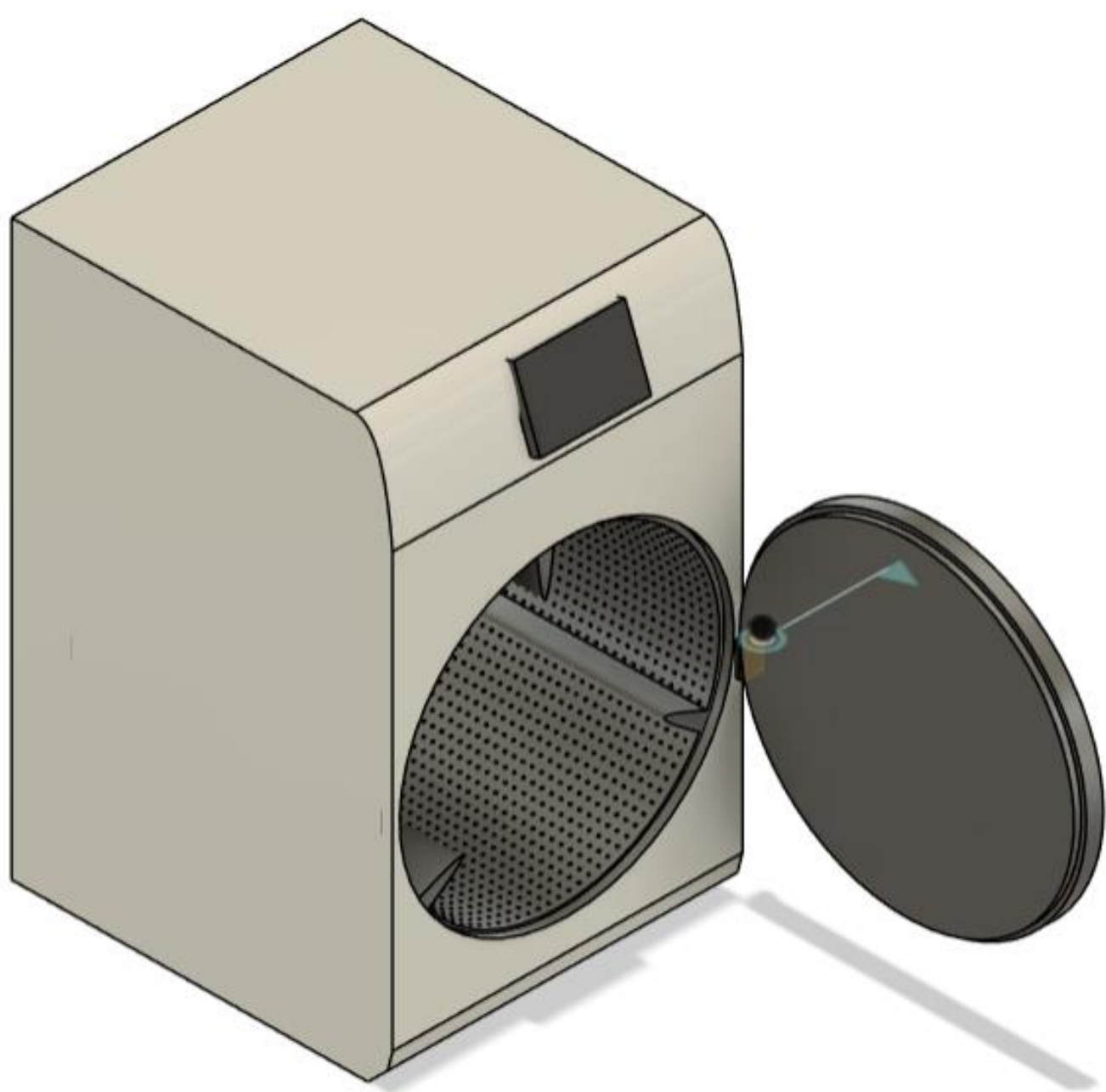
- Similar to terrestrial model in parts
- Longer soak period
- Slower spin speed for washing time
 - About 17.9 rpm
- No rinse cycle
- Higher spin speed for spin cycle
 - About 2000 rpm

Dryer Functionality

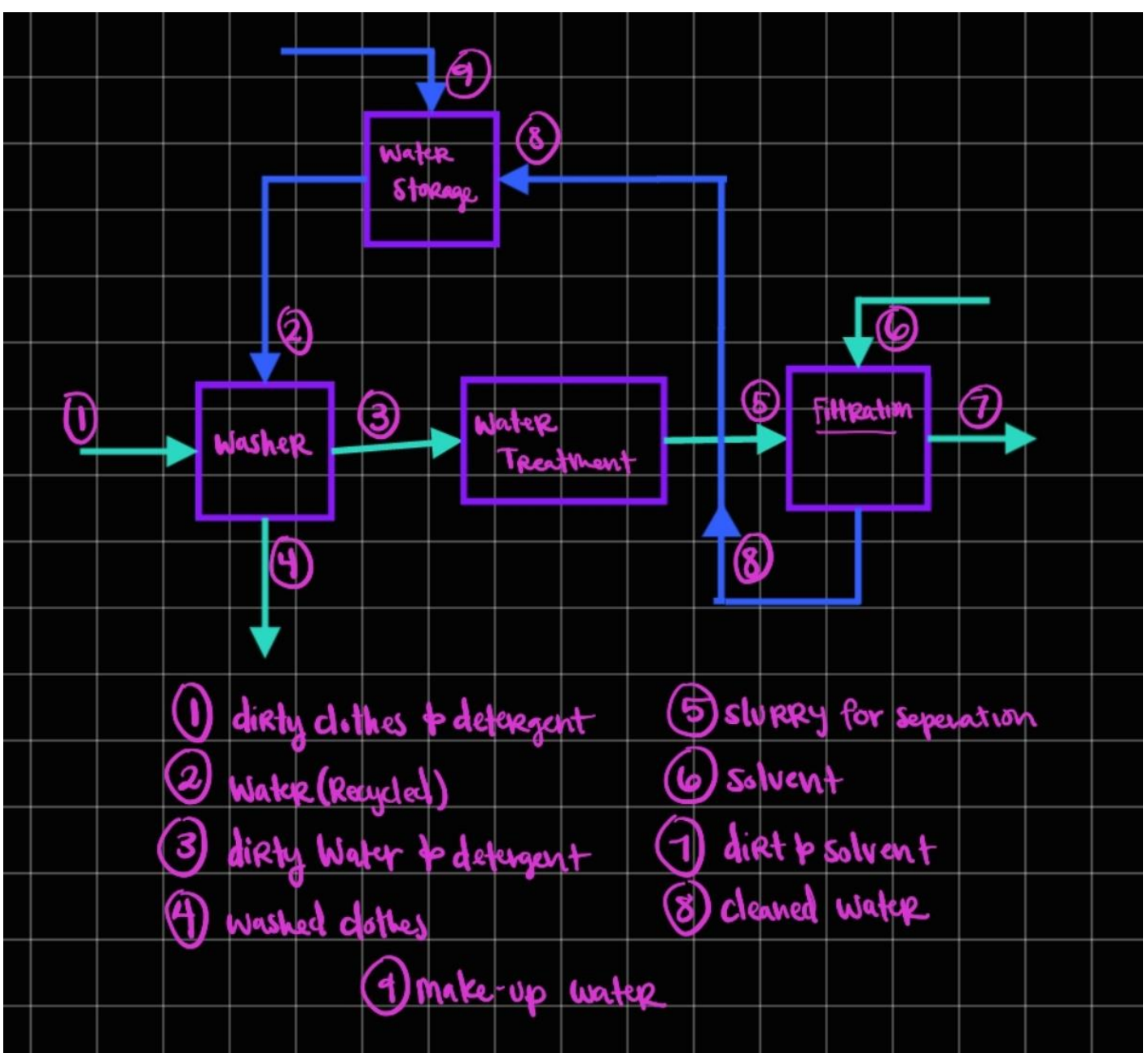
- Air is heated via a heating element and pulled into the drum
- The hot air evaporates and removes moisture from clothes
- The moist, cooler air is sent to a condenser to remove moisture
- The cool air is then sent back through the heating element
- To allow for tumbling action, dryer spin will be reduced to about 17.9 rpm



CAD Model



Water PFD



Description of CAD

The CAD model is based on the GE Profile Front Load Washer and Heat Pump Dryer. It is a horizontal-axis washer and drying machine.

Parts List

Part	Usage	Picture
ATO 500W Brushless Motor	Used to spin drum for washer and dryer cycles	
Askoll M222 85W Drain Pump	Controls water flow in washing cycle and modified for air in dryer	
Bosch Pipes	Transport water and air through system	
Drum	Holds clothes and spins during cycle, aluminum/stainless steel alloy	

Detergent

- Washer Sheets
 - Compact, lightweight and biodegradable

Water Usage

- Water usage remains below 20 kg
- Water enters in the washer cycle and is captured during the dryer cycle for filtration
- Pre-treated before returning to the main water base due to detergents

Energy Recovery

- Part of the energy of the exiting moist air is captured to heat incoming dry air
- Achieved by using a heat exchanger prior to heating the incoming air, and before condensing the hot air
- Heat exchanger functions as a regenerator minimizing the heat needed to warm the incoming air

Summary

The Lunar Washer-Dryer combo machine is based on a current terrestrial washer-dryer combo machine and optimized to work in a lunar environment. During the washer cycle, it utilizes less water by soaking the clothes for a longer time as well as eliminating the rinse cycle by increasing the spin speed during the spin cycle. During the drying cycle it uses a heat pump to operate as a heat pump dryer, using less energy overall to clean the clothes and preventing hot, humid air from leaking out into the atmosphere.

Acknowledgments

We would like to acknowledge our advisor Dr. Quincy Moore. We would also like to acknowledge our NASA advisors Michael Ewert and Andrew Arends.

Future Plans

- Wiring plans and logistics
- Code for different cycles
- Physical model
- Water recycling system

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