National Aeronautics and Space Administration

Life Support: Long Term Storage of Solid Waste in an Enclosed Membrane System

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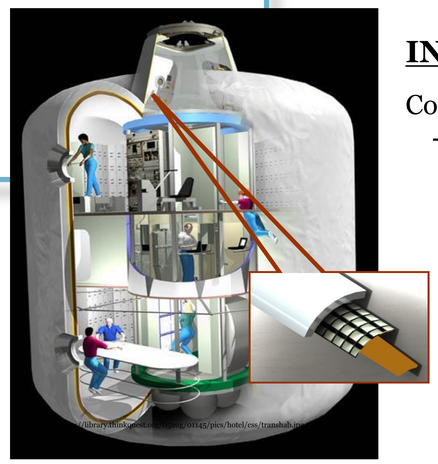
ABSTRACT:

In deep space missions, maintaining life support is of the utmost priority. In such a closed system, human waste must be stored and treated. By preparing membrane bags with homogenized ersatz (simulated feces) and a mixture of finely shredded carboniferous refuse, it may be possible to study the plausibility of a compost-like procedure to store human waste over a long period of time. The current goal is to develop an experimental protocol for future data acquisition of these concepts.

BACKGROUND:

For both space and resource efficiency, the proposed habitat structure for living space shows an inner wall layer composed of membrane filtration bags. The outer wall is filled with a supply of freshwater that serves dual purpose as life support as well as radiation shielding. As wastewater is created, the forward osmosis membrane bags are filled with a mixture of wastewater and refuse That are then dried passively using forward osmosis, and then actively using low-pressure ventilation or other vacuum process.



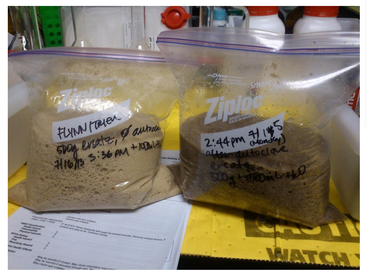
Artist rendition of the waterwall and living habitat

MEMBRANE BAGS

Hydration Technologies X-Pack™ Forward Osmosis Treatment Bag.

ERSATZ

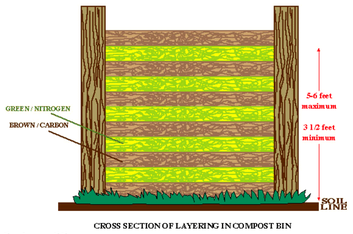
Made with:
- yeast
- miso
- polyethylene glycol
- peanut oil
- psyllium husks



In the future, this mixture will be inoculated with several species of microbes that are commonly found in human solid waste in an effort to minimize researchers from contact with human pathogens.

INSIDE THE BAGS

Contents:
- one side of membrane:
  - ersatz
  - carboniferous materials
  - goal is to anaerobically and rudimentarily compost the waste



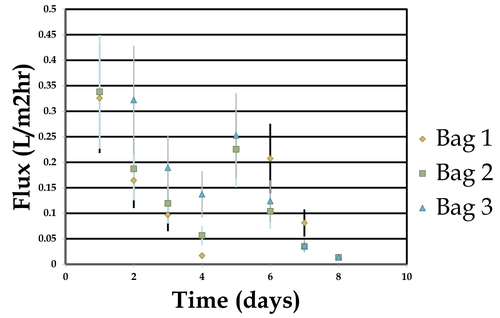
CROSS SECTION OF LAYERING IN COMPOST BIN

- other side:
  - saltwater to passively draw water out of the waste

EXPERIMENTAL PROCEDURE/ CONCLUSION:

In order to conduct experiments, a detailed procedure must be written. Primary experiments were conducted to determine optimal composition for the ersatz and sterilization procedures to combat carbon dioxide production of the yeast within an enclosed space. Currently, urine brine is being procured to continue testing the flux rate at which water crosses the membrane. By determining the flux rate, the amount of membrane required to treat the wastewater for a given amount of time can be determined. Ultimately, a refined experimental protocol and procedure will be the result of these tests.

Example graph of data to be obtained, showing flux of water in membrane bags



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