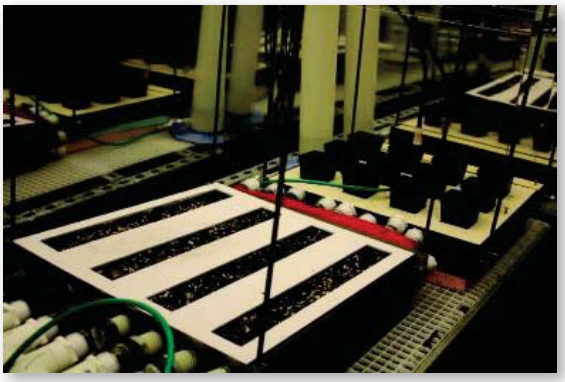
Phase Change Permeation Technology For Environmental Control & Life Support Systems Project

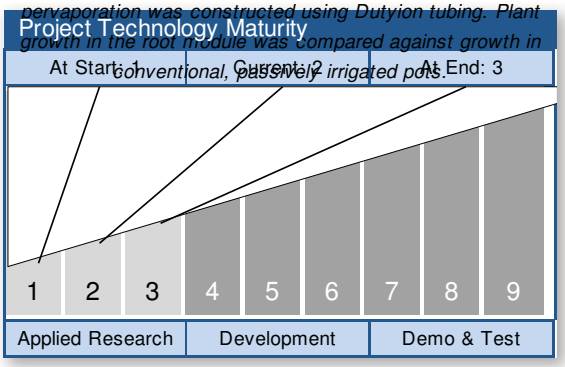
Center Independent Research & Developments: KSC IRAD Program

Office Of The Chief Technologist (OCT)

National Aeronautics and Space Administration



A large root module with increased surface area for pervaporation was constructed using Dutyion tubing. Plant growth in the root module was compared against growth in conventional, passively irrigated pots.



ABSTRACT

Use of a phase change permeation membrane (Dutyion™) to passively and selectively mobilize water in microgravity to enable improved water recovery from urine/brine for Environmental Control and Life Support Systems (ECLSS)and water delivery to plants for potential use in microgravity.

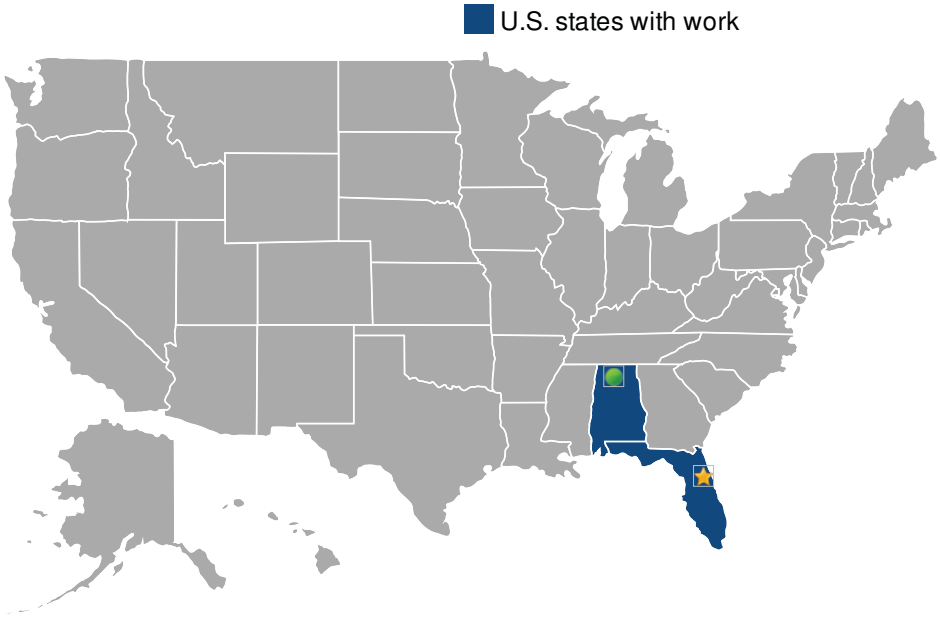
Technology Area: Human Health, Life Support & Habitation Systems TA06 (Primary)
Human Exploration Destination Systems TA07 (Secondary)

ANTICIPATED BENEFITS

To NASA funded missions:

This membrane may enable recovery of water from wastewater or brines generated by physical chemical water recovery systems, or enable polishing of water from biological water recovery systems increasing ECLSS efficiency. The passive nature of the “pervaporation” process would allow operation in a u-gravity environment. For root hydration in reduced gravity environments, Phase Change Permeation™ technology could reduce plant stress by allowing passive transfer of water vapor to the root zone of the plants. Water stress is a limiting factor for many terrestrial agricultural systems, and must also be controlled in plant growth systems deployed in...

Read more on the last page.



Other Organizations Performing Work

QinetiQ North America/ESC

DETAILED DESCRIPTION

This project will explore a recent advancement in Phase Change Permeation™ technology to enable improved (1) water recovery from urine/brine for Environmental Control and Life Support Systems, and (2) water delivery to plants for potential use in microgravity. The innovation is the use of a phase change permeation membrane to passively and selectively mobilize water in microgravity.

Test objectives for water purification will determine the effects of temperature and waste water chemical composition on the water flux rate across the membrane and the chemical and microbiological water quality of permeate and effluent streams.Test objectives for water delivery to plants will determine the soil wetting characteristics of the Dutyion™ membrane material in normal gravity in preparation for future proposed flight testing.

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MANAGEMENT

Program Executive: Karen Thompson

Program Manager: Pamela Mullenix

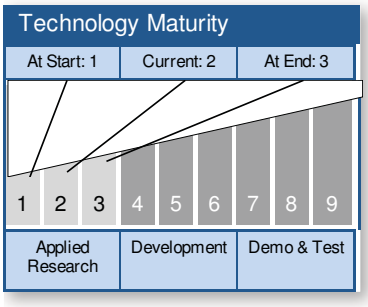
Project Manager: Raymond Wheeler

Principal Investigator: Howard Levine

DETAILED DESCRIPTION (CONT'D)

TECHNOLOGY DETAILS

Phase Change Permeation Technology for Environmental Control & Life Support Systems



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  Test objectives for water purification will determine the effects of temperature and waste water chemical composition on the water flux rate across the membrane and the chemical and microbiological water quality of permeate and effluent streams.

  Test objectives for water delivery to plants will determine the soil wetting characteristics of the Dutyion™ membrane material in normal gravity in preparation for future proposed flight testing.
- This technology is categorized as a material for other applications
- Technology Area
  - TA06 Human Health, Life Support & Habitation Systems (Primary)
  - TA07 Human Exploration Destination Systems (Secondary)

CAPABILITIES PROVIDED

A novel technology for the provision of water to plants in space and for the recovery of water from urine and brine by selective membrane permeation. Current technologies for water delivery to plants in microgravity and water recovery from brines in ECLSS Water Recovery Systems are mechanically inefficient and waste both water and energy.

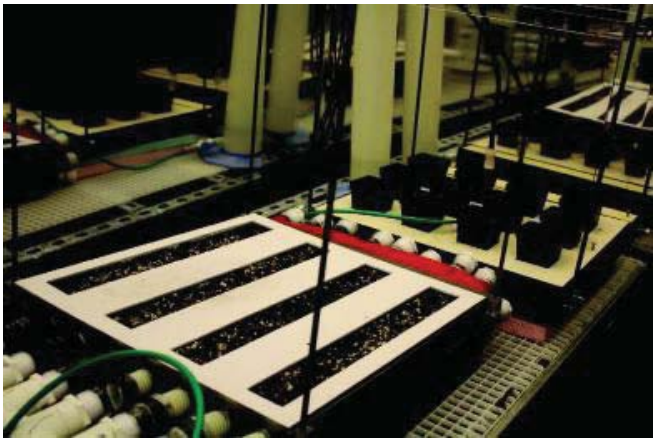
NASA is evaluating Dutyion, a phase change permeation membrane technology developed by Design...

TECHNOLOGY DETAILS

POTENTIAL APPLICATIONS (CONT'D)

Technology and Irrigation (DTI), for use in future advanced life support systems. The phase change membranes could be used to passively and selectively mobilize water in microgravity to recover more water from urine and brine for Environmental Control and Life Support Systems (ECLSS), A system using such technology might also be able to deliver water to plants in low gravity

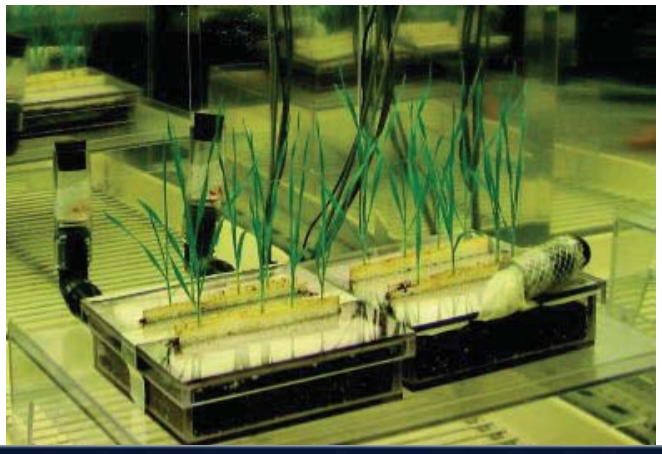
IMAGE GALLERY



Large Root Module using DTI Tubes and Membranes

Phase Change Permeation Technology

Radishes Grown in Root Modules



ANTICIPATED BENEFITS

To NASA funded missions: (CONT'D)

microgravity.

To the commercial space industry:

When used with brackish or saline water, most or all of the salt is retained within the membrane'spipes enabling the use of brackish or salty water to deliver pure water vapor to the soils for sustained periods without the need for pre-cleaning or first desalinating the water.