



Pancopia's high performance water recycling system designed for space exploration is revolutionizing how wastewater is purified on Earth.

# HIGH PERFORMANCE WATER RECYCLING SYSTEM FOR SPACE EXPLORATION

**A**n astronaut on the International Space Station (ISS) requires about one gallon of water each day, and at \$83,000 per gallon to lift into space, the costs can quickly add up. It is approximately \$500,000 per day to supply water to a crew of six astronauts on the ISS using launch vehicles for resupply. High costs have driven NASA to develop and utilize systems that recycle water in space. However, current systems are heavy, complex and fall short of 100% recycling, which may not be ideal for long-duration missions away from Earth, such as exploration of the Moon and Mars. Current ISS technologies, by design, depend on expendables that have to be supplied periodically. NASA continues to invest in new, lower cost solutions to recycle and reuse water for future manned space exploration efforts.

**PROJECT**  
Water Recycling System for Space Exploration

**MISSION DIRECTORATE**  
Human Exploration and Operations

**PHASE II SUCCESS**  
Total SBIR awards of \$885,000

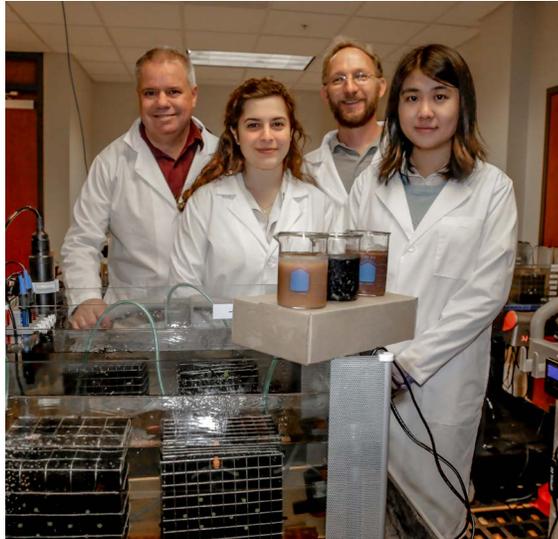
**SNAPSHOT**  
An innovative water recycling process that leverages novel microorganisms to provide cost-effective, closed-loop water purification on the International Space Station (ISS) and on Earth.

**PANCOPIA**  
Hampton, VA  
pancopia.com

Water is as critical for survival in outer space as it is on Earth. In fact, about three quarters of the cost of sustaining human life on the ISS is attributed to making safe drinking water available. Recycling water not only saves on resupply, but also makes space missions more Earth-independent and self-reliant. NASA has encouraged innovative approaches through the SBIR Program and has been successful in developing and infusing life support technologies. Pancopia, a Hampton, VA-based small business developed a new biological water recycling system that can remove high levels of organic carbon and nitrogen, the two major pollutants in wastewater.

The biologically-based technology makes use of a newly discovered group of bacteria called anammox, which is combined with two other types of bacteria used in conventional wastewater treatment (nitrifiers and denitrifiers) to purify wastewater. This novel technology can remove these pollutants more reliably and at a faster rate. In addition, Pancopia's innovation is more cost effective than existing systems. Traditional treatment systems are expensive due to the high amounts of energy and consumables required. Inclusion of anammox reduces treatment cost by improving the stability of the system.

LEFT  
From left to right:  
Bill Cumbie, CEO  
Rachel Willinger, Business  
Manager  
John Whitelaw, CTO  
Fei Dai,  
Laboratory Manager



RIGHT  
Phase II closed-loop  
Beta Reactor



“Pancopia’s system uses three types organisms to enhance the stability of the bacterial community. The different bacteria act as checks and balances to each other as they naturally adjust to changes in composition of the wastewater,” according to Bill Cumbie, Pancopia’s Founder and CEO. “The self-regulating feature of the distinct organisms allows for effective operation without specialized supervision which is responsible for the high cost of water purification. Less supervision equals less money to run the system.”

new water purification technologies, has identified Pancopia’s technology as a candidate to replace the nitrogen removal system at one of its large plants. Pancopia will pilot its technology at an HRSD plant this year, and plans to install its first commercial system in early 2019.

Pancopia received two commercialization awards with the United States Department of Agriculture (USDA) for this new recycling system — the Federal Lab Consortium’s (FLC) Excellence in Technology Transfer Award for the Southeast Region in 2017 and the FLC’s National Excellence in Technology Transfer Award in 2018. Pancopia partnered with USDA to license its patented anammox bacteria.

“Without NASA sponsorship of our technology via the SBIR program, Pancopia would not have been able to transform this innovative, disruptive technology from the laboratory to commercial implementation.”

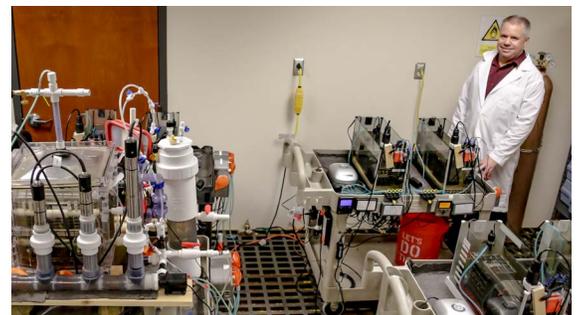
BILL CUMBIE  
PANCOPIA FOUNDER & CEO

Another innovation that has resulted from this research is the ability to freeze-dry the bacteria for transport and reactivation after extended periods of storage. Once activated, the water treatment process can start within two weeks. This has great potential for low cost transport of space-based systems. It also permits long-term storage of additional organisms for emergency backup.

According to Pancopia’s Bill Cumbie, “Without NASA sponsorship of our technology via the SBIR program, Pancopia would not have been able to transform this innovative, disruptive technology from the laboratory to commercial implementation. We are so excited to see how this technology can improve wastewater treatment, and potentially save federal, state, and local agencies billions of dollars in construction and operation costs.”

Although this technology was developed for use by NASA for manned space exploration, Pancopia is working on a similar system for municipal wastewater that has the potential to cut treatment expenses to less than half the current costs. Residents of Virginia may be the first to benefit from the award-winning water recycling system initially intended for astronauts.

The Hampton Roads Sanitation District (HRSD), which has an international reputation for pioneering



CEO Bill Cumbie performing continued testing with several bio-reactors on Pancopia’s novel wastewater treatment system