

# Analysis of Forward Osmosis Filtration on Synthetic Urine Substitute

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## Introduction

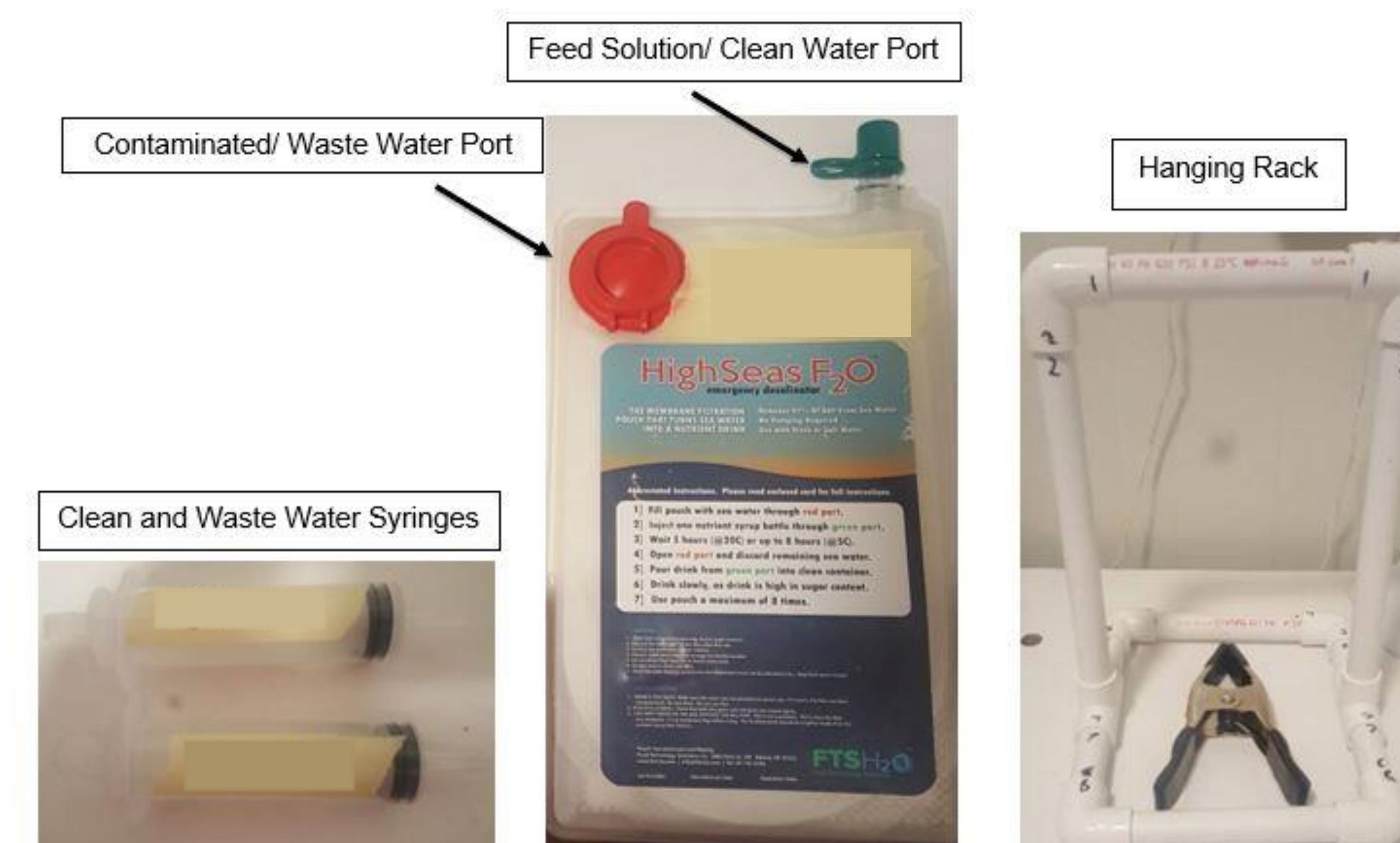
Life support is one of the most crucial system that supports manned spaceflight. These systems almost exclusively rely on mechanical filtration for water processing. This creates a large power draw, limiting the available power for other systems. This draw stems from the large pumps used for filtering water for the crew to use for both consumption and sanitation. To facilitate future long-term missions, passive Forward Osmosis (FO) filtration could be used to support necessary life support systems. To test the quality of the water filtered using this method, a urea-based urine substitute will be synthesized and tested using multiple methodologies to determine the Urea content in the filtered water solution.

## Forward Osmosis

Forward Osmosis (FO) is a form of filtration that uses the natural properties of concentration gradients to perform liquid filtration without the need for any powered systems. The filtration system is split into two chambers by a semi-permeable membrane. Contaminated water is filled into the first chamber of the system, while a high concentrated osmotic agent is filled into the adjoining chamber of the system. The concentration gradient between the high concentration osmotic agent, and the low concentration contaminated solution causes the water to pass through the semi-permeable membrane. This transfer dilutes the osmotic agent, while leaving behind the contaminants. The result of this process is a low concentration solution requiring little tertiary treatment to bring it to a safe potable water quality.

## Experiment

This experiment will be testing the quality of filtration of a Forward Osmosis system on a simulated urine sample. The results show whether FO is a viable method of filtering out Urea and Urea nitrogen from an aqueous solution. The findings could be used to provide both an example of FO successfully being used in simulated human waste processing, as well as providing a methodology to do quality assurance testing on future FO based water processing systems.



## Goal of Results

This experiment will provide a basis of quality testing on the FO process. Future water processing systems that utilize this technology will be able to adequately test the outbound water quality. Along with establishing a methodology for high fidelity water testing, this experiment has the prospective ability to establish a testable expected Urea rejection for future technology improvement.

## Methods and Materials

Conducting this experiment will require using three different methodologies so that the results not are not only accurate, but also self-validating. These methodologies will be utilizing spectrometry and H nuclear magnetic resonance to test for Urea in the post-filtration samples.

Two of the methodologies utilize spectrometry. These methods utilize reagent chemicals to treat the filtered fluid so that the Urea is detectable by a spectrometer. The readings of absorbance will then be compared against a standard curve of Urea standards.

The other methodology being utilized will be H nuclear magnetic resonance. This method will utilize an NMR spectrometer housed in the COAS chemistry laboratory to test for Hydrogen nuclei in the samples. This method will also use a standard curve to compare results against.



## Acknowledgments

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