



PROJECT ID:
614

Comparison of Innovative and Energy-Efficient Technologies for Wastewater Treatment Techniques for Reuse



Water sourced from aquifers at Naval facilities may be impacted by seawater, which can migrate via natural or anthropogenic processes. (U.S. Navy photo by U.S. Marine Corps photo by Gunnery Sgt. Rublin J. Tan)

OBJECTIVE

This project seeks to investigate new cost- and energy-efficient techniques and technologies for wastewater treatment and reuse.

PROBLEM STATEMENT

As climate change produces more frequent and intense droughts, there is more pressure around the world to seek new sources of fresh water. In the Navy, the problem is compounded by the fact that facilities are located in predominantly coastal regions. Proximity to coastal waters can impact the salinity of groundwater, such that seawater can intrude into freshwater aquifers via natural or anthropogenic processes. Treating wastewater for reuse is a viable solution; however, the current

standardized techniques—reverse osmosis (RO) and electro dialysis — are not cost- or energy- efficient and have significant limitations. RO methods utilize pressure, and for hypersaline groundwater, the higher concentration of salts require unattainable pressurizations that deem this method ineffective. Electro dialysis utilizes a distillation process which is extremely costly and energy inefficient.

DESCRIPTION

This project is comparing three innovative, proven, and energy-efficient technologies for wastewater treatment reuse; 1) Capacitive Deionization (CDI), 2) Temperature Swing Solvent Extraction (TSSE), and 3) resin optimization.



CDI utilizes a deionization process that desalinates wastewater to meet EPA standards and has a 95% recovery rate, making this tool much more efficient than either RO or electrodialysis. This method was successfully developed and beta tested for wastewater treatment by Naval Information Warfare Center Pacific. Developed by engineers at Columbia University, TSSE utilizes a low-polarity solvent that has temperature-dependent water solubility characteristics to preferentially remove water from wastewater salts. High throughput, energy- and cost-efficiency are benefits of TSSE, and has been shown to remove up to 98.4% of salts from wastewater, which is comparable to RO results.

The final technology, resin optimization, will leverage a collaboration with Purolite® to compare the efficiency of commercially available resins to the other two methods.

Each of these technologies will be tested over a 3-year period with various feedwater compositions and volumes. Test results from the comparisons of these technologies will assess effectiveness, energy and cost

efficiency, and attainability of wastewater to EPA standards with “purple pipe” field demo systems.

RETURN ON INVESTMENT

The ROI of this project is expected to be high as it will reduce the high energy requirements and costs associated with RO and electrodialysis. The Navy widely utilizes RO for its installations, including installations susceptible to saltwater intrusion. Many of these Navy installations have limited energy resources and both RO and electrodialysis have steep energy requirements that are not sustainable for long term usages for some Navy installations.

NAVY BENEFITS

Compared to RO, each of the proposed techniques have higher energy optimizations, opening up the opportunity for energy-limited Navy installations to employ the proposed methods with less burden. Additionally, the Navy will maintain a positive public image by reducing the burden on the ever-diminishing natural water resources that the surrounding community relies on.

TRANSITION DESCRIPTION

At the conclusion of the project, the final report will contain recommendations on which methodology will be best for wastewater treatment for reuse on Department of Defense installations. The project team will work directly with installations in need of technology to implement the methodology. This type of comparison has not yet been conducted and there is currently no published data – inside or outside the Navy — comparing the proposed wastewater treatment techniques. Therefore, the project team plans to publish findings in a scientific journal and present the results at a wastewater conference.

CONTACT

For more specific information about this project, contact the Principal Investigator at 858-212-3288.



ABOUT THE NESDI PROGRAM

The Navy Environmental Sustainability Development to Integration (NESDI) program is the Navy's environmental research and development demonstration and validation program, sponsored by OPNAV N4I Installations Division and managed by the Naval Facilities Engineering Systems Command from the Engineering and Expeditionary Warfare Center in Port Hueneme, CA. The mission of the program is to provide solutions by demonstrating, validating and integrating innovative technologies, processes and materials and by filling knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Navy readiness and lethality.

For more information, visit the program's web site at www.navfac.navy.mil/nesdi or contact Ken Kaempffe, the NESDI Program Manager at 805-982-4893, DSN: 551-4893 or kenneth.c.kaempffe.civ@us.navy.mil.

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