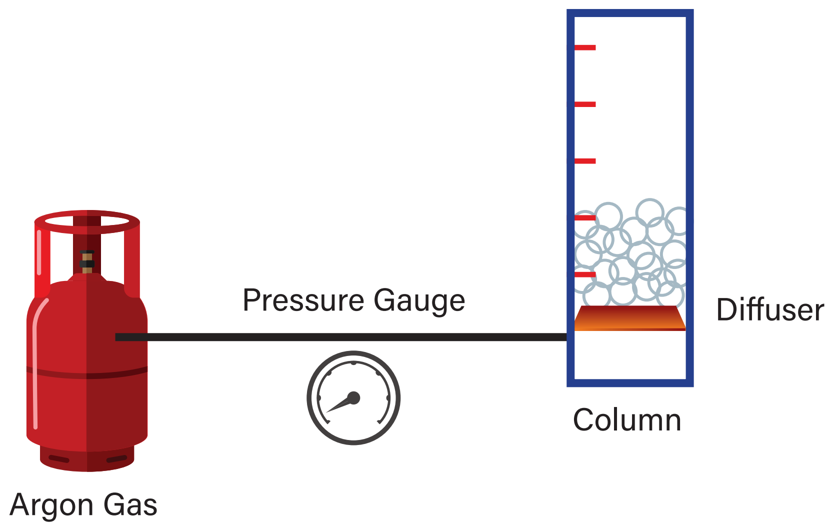
PROJECT ID:
587

Detection Methodology and Treatment Train Technology for PFAS Removal in Bilge and Oily Wastewater



Experimental set-up for detection methodology column tests.

(Schematic Credit: Itzel Godinez)

OBJECTIVE

This team plans to develop and validate a detection methodology for perfluoroalkyl and polyfluoroalkyl substances (PFAS) in bilge and oily wastewater (BOW) and to demonstrate and validate a two-part treatment technology.

PROBLEM STATEMENT

The family of PFAS consists of a large class of substances with unique chemical and physical properties that make them particularly persistent and mobile in the environment. In Japan, current practices dictate that bilge and oily wastewater transferred from Navy vessels to collection barges need to be sampled for the presence of PFAS. The turnaround time to analyze BOW samples is up to 35 days. While waiting for results, barges are placed offline, which disturbs normal operations at ports. In some cases, U.S. Fleet Activities have been forced to rent commercial barges for several times the cost of a government barge because there were no available barges to service Navy vessels coming to port. Furthermore, if the analytical results indicate the presence of PFAS, U.S. Fleet Activities must contract for the disposal and incineration of BOW and the decontamination of the barge. The latter actions can result in considerable costs to the Department of the Navy (DON). Hence, there is a critical need for prompt and cost-effective methodologies and technologies capable of detecting and treating PFAS in BOW in accordance with Navy policies.

DESCRIPTION

The general class of PFAS includes perfluoroalkyl and polyfluoroalkyl acids (PFAA) such as perfluorooctanoic acid (PFOA) and perfluorooctyl sulfonate (PFOS). PFOA and PFOS are pervasive in shipboard environments, most notably due to their historic use in aqueous film forming foam (AFFF) fire suppression systems.

PFAAs can be bubbled out of an aqueous solution by shaking, agitating or aerating it for a period of time. This action produces a foam layer on the liquid surface which isolates the PFAS groups. The project team will use an adaptation of this foam-forming technique to advance a detection methodology for PFAS in treated BOW.

Using the relationship between foam layer height and PFAS concentration in solution, a quantitative methodology will be developed to test for PFAS concentrations as low as 70 parts per trillion (ppt), which is the U.S. Environmental Protection Agency's Lifetime Health Advisory and the maximum concentration in treated effluent that DON currently allows prior to discharging into a sewer system.

Part two of the project will involve a two-stage treatment of PFAS in BOW. Partnering with Clarkson University, the team will use a plasma-based reactor to destroy and/or de-fluorinate PFAS groups followed by adsorption media beds to adsorb residual PFAS groups lingering in the treated bilge and oily wastewater. This technique has been shown to aid in the degradation of PFOS and PFOA.

For field testing, the two-part treatment technology will be combined and placed at the end of a bilge and oily wastewater treatment system (BOWTS) located in Yokosuka, Japan. Samples will be collected for analysis before and after the plasma reactor, and after each of the adsorption media beds. The objective is to demonstrate that the plasma reactor can destroy or de-fluorinate the majority of PFAS groups found in BOW and that the dual adsorption beds will provide, if necessary, additional removal to attain the targeted 70 ppt for individual or combined PFOS and PFOA. If proven successful, the two-part treatment technology can be scaled up to handle the volume processed by the BOWTS in Yokosuka, Japan.

RETURN ON INVESTMENT

A field demonstration at Wright Patterson Air Force Base with Clarkson University's mobile plasma reactor yielded the following costs associated with treatment of groundwater in the field: $0.12 per cycle or $0.0067 per gallon while reducing PFOS plus PFOA concentrations to less than 70 ppt. These costs will need to be modified to include specific characteristics of treatment of BOW. Nonetheless, it is expected that costs will far undercut current incineration rates of $3.00 to $4.00 per gallon for AFFF-impacted water.

Once the project is complete, a better estimate of return on investment will be possible, and these estimates will be included in the final report.

NAVY BENEFITS

Early detection of PFAS in BOW allows U.S. Fleet Activities to make prompt decisions or take actions for the proper handling and treatment of BOW, which reduces the risk of putting collection barges offline, prevents the need to rent commercial barges, and diminishes the probability of halting operations at ports and shipyards. On the other hand, incorporating the two-part treatment technology at the end of treatment train of a Navy-owned BOWTS eliminates the need dispose BOW with PFAS via Defense Logistics Agency's hazardous waste contract mechanism or contracted BOWTS on barges—both of which have high costs due to volume of BOW that needs to be processed. The detection methodology and two-part treatment technology have a potential cost savings that ranges from moderate to significant.

TRANSITION DESCRIPTION

Facilities at Yokosuka, Guam, Pearl Harbor, San Diego and Guantanamo Bay will benefit from this technology. Identified customers and stakeholders such as Naval Facilities Engineering Systems Command Public Work Departments, Navy Water Media Field Teams and Port Operations Officers at U.S. Fleet Activities will be involved from the start, and kept in the loop via quarterly conference calls, technology tours, social media, etc. A final technical report summarizing PFAS detection methodology and treatment technology, along with estimated return on investment, will be distributed.

CONTACT

For more specific information about this project, contact the Principal Investigator at 805-982-5864.

ABOUT THE NESDI PROGRAM

The Navy Environmental Sustainability Development to Integration (NESDI) program is the Navy's environmental research and development, demonstration and validation (6.4) program, sponsored by the Chief of Naval Operations, Energy and Environmental Readiness Division (OPNAV N45) and managed by the Naval Facilities Engineering Systems Command (NAVFAC) out of the Engineering and Expeditionary Warfare Center (EXWC) in Port Hueneme, CA.

The mission of the program is to provide solutions by demonstrating, validating and integrating innovative technologies, processes, materials, and filling knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Fleet readiness and lethality. The program accomplishes this mission through the evaluation of cost-effective technologies, processes, materials and knowledge that enhance environmental readiness of naval shore activities and ensure they can be integrated into weapons system acquisition programs.

The program is the Navy's complement to the Department of Defense's Environmental Security Technology Certification Program which conducts demonstration and validation of technologies important to the tri-Services, U.S. Environmental Protection Agency and Department of Energy.

For more information, visit the NESDI program 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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