PROJECT ID:
603

Characterization of Antifouling Paint and Environmental Loading with Navy Dome System

USS Gerald R. Ford (CVN 78) enters Newport News Shipyard for planned maintenance. Copper is traditionally used in ship hull coatings due to its antifouling properties.
(Photo Credit: Mass Communication Specialist 3rd Class Zack Guth)

OBJECTIVE

The goal of this project is to test copper release rates of various types and ages of antifouling hull coatings at Navy harbors to better support regulatory standard setting.

PROBLEM STATEMENT

Meeting regulatory levels for copper concentrations in Navy harbors has long been an issue. One of the sources of copper is the antifouling coatings used on ship hulls. The current approach to determining the amount of copper released by these coatings is an American Society for Testing and Materials (ASTM) laboratory-based method that utilizes artificial seawater. This method is required for all paints to be registered and approved for use as antifouling coatings; but the method significantly overestimates the release rate of copper. Moreover, the method itself specifies that the rates "are not to be used for environmental loading calculations." However, in the absence of better information and data, the ASTM data are used by regulatory authorities to calculate environmental loadings and regulate antifouling coatings. A more scientifically defensible method for calculating copper loading is needed.

DESCRIPTION

Personnel from the Naval Information Warfare Center (NIWC) Pacific have developed novel methodologies to address knowledge gaps by conducting

in situ assessments of leaching rates on vessel hulls. The most reliable one of these methods is known as the dome method. In this technique, an acrylic dome is positioned on a hull by a diver and connected via tubing to a peristaltic pump above the water line. The dome is adhered onto the hull with vacuum pressure, allowing the system to isolate and recirculate a fixed volume of water, over a known hull surface area, for a fixed duration. Samples are collected in 15-minute intervals, analyzed and a simple time versus concentration plot is generated to establish copper release rates.

A similar technology, the in-water hull cleaning sampling device (or hull scrubber), will be applied for measurement of particulate load from cleaning. This technique also uses a diver-applied device, with systematic pressure provided through a spring release. The device includes a shaft with a handle, that is configured for the attachment of different types of cleaning materials (i.e., brushes or abrasive pads) used for cleaning of ship hulls. Once the hull scrubber is positioned, the handle is rotated to simulate the hull cleaning process and a fixed amount of water around the hull is captured and transferred to the surface for analysis. Total copper is measured in the hull scrubber, and used for estimation of particulate mass and concentration release from the ship hull. This information is used to estimate loadings. This approach is used to describe and quantify the expected loading from cleaning and the release of copper and zinc content in the particles associated with cleaning efforts.

These methods have been tested and proven to be effective for use in determining regulatory limits, and have recently been used by the State of California Department of Pesticide Regulation. The early part of this project will improve upon these existing technologies.

NIWC Pacific has teamed with personnel from the Naval Sea Systems Command (NAVSEA) to identify ships with different paint ages and sample their hulls with contractor support from SEAWARD Marine.

Historically, U.S. Navy's ship hulls have their antifouling coating replaced on an eight to 12 year cycle. This effort will aim to obtain copper leaching measurements on antifouling systems across this historical service life for naval vessels. The availability of antifouling systems for each age bracket will support this goal. A maximum of 36 events and over 100 individual measurements will contribute to this project.

Criteria for success is based on the ability to describe loading scenarios with aging of the antifouling coating system. Previously gathered data supports the hypothesis that leaching rates will decrease with aging of the antifouling system. This project will specifically address the lack of information and provide the data for realistic loading scenarios by integrating a coating age metric. This project will also provide data to demonstrate whether there is a difference between the leaching rates of older and newer coatings.

RETURN ON INVESTMENT

A decrease in the costs associated with implementation of regulatory limits is not expected; however, an increase on the likelihood to achieve regulatory compliance is foreseeable. Environmental loading quantifications estimated from measurements generated via this effort should support realistic assessment of environmental conditions, such as in Total Maximum Daily Load (TMDL) regulations, and assigning realistic and appropriate regulatory control (Uniform National Discharge Standards) of Navy discharges such as underwater ship husbandry and hull coating leachate.

This information can be included to support TMDL assessments in Navy harbors and at shoreside facilities via direct addition of the information into TMDL development, loading calculations or model improvement. Minimal requirements for further loading quantifications would be expected in the different locations. The expected life for the information provided by this effort will extend to when copper-based antifouling coatings formulations are significantly changed or discontinued from use by the U.S. Navy.

NAVY BENEFITS

The primary deliverables from this effort are robust quantifications associated with environmental

loadings, that will support realistic assessment of environmental conditions, such as in TMDL regulations. A more realistic assessment of copper loadings associated with antifouling paints may lead to more lenient regulations and cost savings associated with required mitigation.

The realistic loading scenarios produced by this effort should also be used for optimization of antifouling coatings lifecycle use.

TRANSITION DESCRIPTION

The collaboration with NAVSEA will serve as the main form of transition for this project. In addition, results will be presented to the Naval Shipyard Clean Water Act Working Group Charter, released via a final report, followed by an article in a recognized scientific journal.

CONTACT

For more specific information about this project, contact the Principal Investigator at 619-553-2373.

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.