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## Duplex Silicone Foul-Release Coatings

ESTCP funded project (PP-9502; [www.estcp.org](http://www.estcp.org))

NRL Managed Program (NRL, GE, NSWC/Carderock Division, FIT, SUNY- Buffalo and Bridger Scientific)

The fouling of marine vessels is a significant Navy problem. Marine fouling can increase fuel consumption by as much as 20%. Historically, marine antifouling paints have used compounds toxic to marine organisms as a means of combating fouling. The environmental impact of these toxic coatings has come under increased scrutiny. There is increasing concern about the toxic exposure to shipyard workers and the disposal of hazardous waste from antifouling paints removed during ship maintenance and repainting. Also, industrial and municipal facilities have incurred costs due to the clogging of water intake systems. Traditional methods for controlling biofouling of water intakes depend on the use of targeted chlorination.

NRL patented an advanced foul-release coating system called the duplex silicone coating system. This coating system employs a tough, cross-linked thermoplastic elastomeric layer to bond the foul-release silicone topcoat to the anticorrosive layer. The mechanical properties are imparted by this layer, while the topcoat provides the foul-release characteristics. Because they employ a physical rather than chemical means to reduce fouling, these coatings have been ruled exempt from reporting under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA; Public Law 95-396). They do not contain the toxic metals of antifouling paints and comply with anticipated restrictions regarding VOCs well into the next century. Foul-release silicone duplex coatings are compliant with current lead restrictions and contain no carcinogenic compounds.

## Objective

This ESTCP project demonstrated and validated the effectiveness of a new environmentally safe, duplex fouling release coating developed and patented by the Naval Research Laboratory (NRL). Coating performance was monitored for a period of at least 4 years on the following platforms: (a) two 30' U.S. Navy range control boats Dahlgren, VA), (b), six 41'-55' U.S. Coast Guard aluminum hull boats (Yorktown, VA; Panama City, FL; Wachapreague, VA; Mobile, AL), (c) a Navy transporter (Patuxent River, MD), (d) an ONR/Lockheed prototype hull designated SLICE (Honolulu, HI), and (e) on power plant cooling water intakes (concrete walls, steel trash racks/traveling screens/deflecting veins in Brayton Point, MA and Bay City, MI).

## Results

The new coatings demonstrated acceptable performance when applied to a variety of platforms in freshwater and marine environments. The characteristics evaluated included easy application and adhesion to substrates, durability, ease of repair, and ability to easily remove with a water jet any fouling that did occur. Abrasion resistance of hulls and keels was evaluated on U.S. Coast Guard boats. Installation costs are slightly higher, maintenance costs are expected to be comparable, and disposal

costs are lower for silicone foul release coatings compared to the copper ablative coatings they replace. The silicone coatings have experienced up to four years of service with no deterioration in performance. This indicates an effective lifetime at least as good as the conventional toxic coatings and the potential for reducing total life-cycle costs below the \$9-12 per square foot range of conventional coatings.

NRL owns two patents on the duplex silicone, easy-release coating system. In 2001, NRL executed a partially exclusive license with Smart Surfaces, LLC in Annapolis, MD. In 2002, the Naval Research Laboratory received the Federal Laboratory Consortium (FLC) Award for Excellence in Technology Transfer for the Advanced Non-toxic Easy Release Silicone Coatings.

## Benefits

Successful implementation of new anti-fouling coating technology could substantially reduce operating costs for the U.S. Department of Defense as well as U.S. maritime and electric power industries. An effective, environmentally benign coating would reduce Naval fuel costs by 10 to 15 percent (\$35 million to \$50 million a year) with additional cost savings from reductions in dry docking frequency, remediation of polluted harbors, and disposal of hazardous paint waste.

## Implications

The duplex silicone foul-release coating systems have been applied in several states and met all local environmental and occupational health standards. When in use, environmental impacts are greatly reduced because the principal mechanism of these anti-fouling coatings is passive.



Power Plant Cooling Water Intake- Steel Deflecting Veins (Left Side Coated with GE RTV11: Mussels Came Off When Tunnel Drained; Right Side Uncoated Steel: Covered With Zebra Mussels)



Concrete Wall in Power Plant Cooling Water Intake Coated With GE Exsil™2200 (Uncoated Concrete Wall Surface: Zebra Mussel Build-Up of 4 Inches)

**Airless Spray  
Application of  
the NRL  
Duplex  
Coating System**



Anticorrosive Epoxy Paint



Epoxy Amide Mist Coat (EPON 828/Versamid 140)



Silgan J-501 Tiecoat



GE 1154 (RTV11 + 20% SF 1154 Oil)



NRL Duplex Coating System (J501 Tiecoat + GE 1154 Topcoat) on USCG UTB Note: Fouling Easily Wiped Off by Hand (Bottom Right Photograph)

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