PROJECT ID:
618

Citric Acid Passivation of Stainless Steels

Corrosion aboard ships, support craft and shore facilities is an ongoing maintenance issue. Citric acid passivation techniques can potentially reduce corrosion and exposure to hazardous chemicals typically used. (U.S. Navy photo by Mass Communication Specialist Seaman Kassandra Alanis)

OBJECTIVE

The overall objective for this project is to successfully demonstrate the performance of citric acid passivation as an alternative to current passivation techniques that use carcinogenic chemicals and strong, heated acids.

PROBLEM STATEMENT

Passivation is a chemical treatment for stainless steel and other alloys that enhances corrosion resistance. Currently, the process involves heated nitric acid and may contain hexavalent chromium, a known carcinogen and environmental toxin. Citric acid passivation has been identified as a promising alternative, but fatigue data is needed before this process is implemented across the fleet.

DESCRIPTION

Citrisurf 2250 is a commercial off the shelf citric acid product that has been identified as a promising alternative for stainless steel passivation. Testing has already been conducted that validates the performance of this product as a passivation technique in industry, at the original equipment manufacturer, and in other Department of Defense services. To date, there has not been enough data generated to determine if this alternative technique induces a fatigue debit onto stainless steel components. To address this data gap, this effort will generate fatigue curves at multiple stress levels. Partners at the Fleet Readiness Centers (FRCs) have recommended three commonly passivated steels as well as a representative steel for China Lake's needs for bomb lugs as the benchmark for implementation.

During the first year of this project, the team will procure and machine bar stock

for testing in accordance ASTM E466 – Standard Practice for Conducting Force-Controlled Constant Amplitude Axial Fatigue Tests of Metallic Materials.

In the second year of this effort, all fatigue data will be completed and combined into a data package comparing Citrisurf 2250 citric acid and nitric acid passivated stainless steel to determine if any fatigue debit is induced with the different passivation chemistry. In addition, tribology and surface friction testing will be conducted by Naval Air Warfare Center Weapons Division China Lake to address a critical weapons component requirement for proper arming and timing of energetics.

RETURN ON INVESTMENT

Implementation of a citric acid passivation alternative would reduce the amount of hexavalent chromium used at each FRC by approximately 500 pounds. This would significantly reduce chemical disposal costs. In addition, the citric acid passivation process does not require heated nitric acid, allowing for an annual usage reduction from 3,225 pounds to 0 pounds across the FRCs. Cost savings would also be achieved due to the reduced need for personal protective equipment and ventilation equipment for fuming nitric acid solutions.

NAVY BENEFITS

Transitioning to citric acid for stainless steel passivation would reduce hazardous waste disposal costs and emissions, improve occupational health and safety for workers, and improve turnaround time for parts by at least 50%. Additionally, current nitric acid passivation using hexavalent chromium is only permitted at depot level sites due to the complexity and cost of obtaining environmental and/or regulatory approvals. Citric acid passivation can be implemented at I-level repair facilities without chromium or strong fuming acid restrictions, therefore shifting stainless steel workloads to a lower level repair facility and increasing depot-level capacity for component overhaul.

TRANSITION DESCRIPTION

Pending successful results, FRC Southeast will establish a Citrisurf 2250 processing tank and Local Processing Specification to complete validation and verification testing. Technical warrant holders and transition partners will review the data package for concurrence, and if successful an authorization letter will be drafted, reviewed, and approved.

CONTACT

For more specific information about this project, contact the Principal Investigator at 301-342-2128.

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.