National Defense Center for Energy and Environment

Corrosion Mitigation and Control

Protecting Mission-Critical Resources

Corrosion Mitigation and Control: Protecting Mission-Critical Resources for Today and Tomorrow's Use

Corrosion destroys equipment, decreasing readiness and reliability while causing safety hazards and increasing maintenance and other ownership costs. The Department of Defense (DoD) estimates corrosion costs the department over $23 billion annually. In addition, the Army attributes more than 50 aircraft accidents and 12 fatalities to corrosion since 1985.* The NDCEE is working to support corrosion control efforts across the equipment lifecycle — from design and materials selection through operation and maintenance.

* Government Accountability Office, GAO-11-318SP, March 2011, page 186.

Material investigations

- Collect and analyze data to characterize corrosion problems
- Determine the current material's condition
- Identify alternative materials and determine expected performance
- Estimate component service life in given environment using alternative materials

Technology evaluations and demonstrations

- Conduct laboratory corrosion testing on materials, coatings, etc. using state-of-the-art equipment
- Conduct outdoor exposure testing
- Monitor corrosion and degradation of assets using advanced sensor systems
- Draft guidelines and Joint Test Protocols (JTPs) for corrosion evaluations
- Employ Non-Destructive Testing (NDT) techniques and technologies to monitor corrosion and degradation

Outreach and awareness

- Disseminate demonstration findings
- Identify need areas for corrosion prevention
- Train personnel to implement corrosion mitigation strategies

For more than 20 years, the NDCEE has been identifying, demonstrating, evaluating, and fielding technologies in support of DoD readiness, sustainability, and the Warfighter. The below project descriptions are examples of our recent activities. Over the years, our corrosion mitigation support has involved identifying, demonstrating, and transitioning a wide range of environmentally friendly technologies that can be used to measure, control, and prevent corrosion. Examples:

- Designed and installed a prototype corrosion inhibitor application facility
- Demonstrated non-line-of-sight and other alternatives to replace electroplated hard chromium
- Demonstrated alternative manufacturing processes for applying coatings on base metals
- Developed and tested a corrosion sensor for detecting the onset of corrosion underneath coatings on tactical vehicles
- Helped installations overcome challenges to implementing a new Chemical Agent Resistant Coating (CARC).

The DoD defines corrosion as

"the deterioration of a material or its properties due to a reaction of that material with its chemical environment."

– DoD Corrosion Prevention and Mitigation Strategic Plan, Corrosion Policy and Oversight Office, January 2014, page 1.

Better Corrosion Detection

Demonstrated the ability of 4 NDT technologies to detect, at varying degrees, corrosion found on aircraft airframes. We also fabricated and applied Corrosion Under Paint (CUP) Test Standards, utilizing a patented process, to facilitate NDT. These standards could be applied to any military asset that suffers from corrosion and is or could be inspected using NDT techniques. With NDT, costly, unneeded repairs and repainting can be avoided, without compromising safety.

Optimized Corrosion Prevention Process

Validated an alternative oven heating process for removing cosmoline, a rust preventive for assets in storage. Our findings resulted in a new process for parts with simple geometries such as pinions and gears. This process offers increased shop throughput and reduced hazardous material usage and waste. Corpus Christi Army Depot should realize a 55-80% reduction in labor hours compared to traditional removal methods including hand scrapping.

Improved Aircraft Corrosion Inspection Practice

Developed an enhanced tool kit to maintain H-60 aircraft. With the kit, maintenance specialists can remove forward bridge tie rods and eccentric bushings, which are particularly susceptible to maintenance-induced damage during corrosion inspection. Such damage in critical areas require aircraft to be removed from service for more maintenance, which decreases aircraft availability, generates waste in the form of scrapped parts, and increases ownership costs.

Superhydrophobic Coatings

Investigated extremely water-repellant coatings to determine if their rapid water runoff properties can reduce corrosion as well as provide water-proofing, anti-icing, anti-fouling, and drag-reduction benefits. We identified 12 potential coatings and 43 potential coating additives for military applications. We are fostering technology transition of these coatings, such as for deicing applications to replace chemical deicers.

Inhibiting Saltwater Corrosion in Helicopters

Developed a gasket kit that provides corrosion prevention to nose bay avionics while allowing electrical conductivity. This kit significantly inhibits saltwater corrosion while reducing ownership costs of the H-60, maritime multimission helicopters. To put savings into perspective, addressing nose bay corrosion damage requires approximately 350-400 labor hours and 9-10 weeks of down time per MH-60R helicopter for a cost of $1.8 million annually.

Non-Toxic Coatings for Electrical Connectors

Evaluated 3 alternative coatings for electrical connectors in ground systems such as Stryker vehicles. We developed and applied a test protocol to conduct laboratory and outdoor exposure testing addressing Army needs—beyond military specification. Our real-world assessment showed how electrical connectors with these coatings will perform on fielded Army assets, particularly when mated to connectors with a legacy system of cadmium/hexavalent chromium.

DoD Technical Resource

Situationally Aware

National Defense Center for Energy and Environment

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Corrosion Mitigation and Control Matters

Unless actively prevented or the process stopped, corrosion is a chemical process that degrades a material's useful properties until the material is consumed. For instance, steel is very susceptible to "general" or "uniform" corrosion; other metals, such as aluminum, are more susceptible to localized corrosion as well as cracking. Metals are particularly vulnerable, as evident by rust, but corrosion affects other materials, too. To fight corrosion, a number of successful technologies and innovative process changes have been developed and implemented, as exemplified on the previous pages.

- How is your organization combating corrosion?
- Is any equipment showing signs of corrosion?
- If yes, on what components or areas?
- How often is equipment removed for maintenance to specifically address corrosion issues?
- What is the readiness impact of this removal from service?
- Is there a safety impact of using equipment that has significant corrosion?
- What is the cost impact of mitigating corrosion on equipment?
- Does equipment need to be replaced because of corrosion?
- How often?
- Does your organization offer training on corrosion mitigation strategies?

How may we help you solve your corrosion issues and extend the life of your equipment and weapon systems while reducing maintenance costs?

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