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Army Corrosion Program Identifies New Corrosion Mitigation Techniques

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An Army program known as *Technology Demonstration for Prevention of Material Degradation* is yielding significant results in countering corrosion—a pervasive problem that is both ubiquitous and complex. The U.S. Army Corrosion Office at Picatinny Arsenal is leading efforts to address and solve the overall problem.

The Army's *Technology Demonstration for Prevention of Material Degradation* program has identified a variety of new corrosion mitigation techniques to effectively combat corrosion and material degradation on military equipment and pre-positioned assets. Such techniques include the use of environmentally friendly alternative coatings, the early detection of material degradation through sensors and nondestructive testing (NDT) equipment, and the establishment of Corrosion Control Centers. The problem of material degradation can be successfully addressed by effectively identifying the corrosion-related information sources, managing corrosion-related data, exchanging information on technical approaches or best practices among the DoD organizations, and making effective use of various Service-sponsored corrosion Web sites to select the most appropriate corrosion prevention and mitigation techniques.

The Army Corrosion Office is charged with identifying material degradation problems, including corrosion in critical Army assets, and evaluating promising technologies or methods to prevent and mitigate material degradation through the transparent assessment of alternative candidates. The Army's corrosion prevention and control efforts have focused on evaluating commercial, modified-commercial, and new technologies for preventing material degradation, as well as the targeted transition of sufficiently mature technologies into Army weapon systems and other assets.

Implementing a proven technology often not only increases mission readiness, but also improves system reliability and performance, reduces maintenance frequency, improves service life, reduces environmental impact, enhances operational safety, and improves the life-cycle costs of Army assets. To achieve these benefits, the Army Corrosion Office relies on industry experts, research institutes, and independent contractors, as well as Army research and development facilities such as the Army Research Laboratory (ARL) and the Army Armaments Research, Development and Engineering Center (ARDEC), to conduct testing on corrosion-resistant materials and new protective coatings using tests and procedures endorsed by NACE International and ASTM International.

Concurrent Technologies Corporation (*CTC*) has been a prime contractor for the Army Corrosion Office since 2000. *CTC*, an independent, non-profit, applied research and development organization, has partnered with leading research institutions, academia, and other governmental agencies to address the material degradation and corrosion measurement and control issues facing the Army.

Army Launches Prototype Corrosion Service Center

In the early 2000s, the Army began establishing a corrosion service center for tactical and fielded vehicles and provided necessary personnel training. In a joint effort with the Army Tank-Automotive and Armaments Command (TACOM) and CTC (under the National Defense Center for Environmental Excellent [NDCEE] contract), a Prototype Corrosion Service Center for preventing corrosion on Army vehicles was designed and operated. This service center is a modular and

portable facility that thoroughly washes and applies corrosion inhibitor to wheeled vehicles and equipment in a semi-automated manner.

The Prototype Corrosion Service Center comprises an enclosed, modular deck structure, and wash and inhibitor application system. Vehicles driven though the facility undergo an automatic wash cycle in preparation for application of the inhibitor. The vehicles then re-enter the facility to go through the automatic inhibitor application cycle. Wash fluids are recycled using a closed-loop system. The Corrosion Service Center provides better application speed and saves labor hours.

Under a separate contract, *CTC*—working closely with the Army Corrosion Office—reviewed lessons learned from the Corrosion Service Center at Fort Hood, Texas, and incorporated them into the second-generation redesign of the Corrosion Control Center at Fort Bragg, North Carolina. The redesigned system at Fort Bragg applies corrosion inhibitor in a semi-automated process that eliminates the inhibitor/water waste stream and reduces an operator's exposure to inhibitor chemicals. This is accomplished by eliminating the vehicle wash cycle and implementing a system where vehicle drivers do not have to drive through the service center during the inhibitor application process.

Construction of a Corrosion Control Center at Fort Bragg. Photo courtesy of Concurrent Technologies Corp.

Efforts to prevent corrosion emphasize life-cycle corrosion research and the development of improved coatings or other surface treatments that could prevent, retard, or inhibit corrosion. The Army's program is based on scientific approaches to demonstrate technologies that improve corrosion protection of materiel and weapon systems.

One of the Army Corrosion Office's notable examples is the sacrificial metallic coatings project. This project explores the use of sacrificial metal-macro coatings, such as zinc-rich paints and hot-dip galvanizing, to extend the coating life of Army service vehicles. The project is a multi-year effort aimed at saving costs and possibly extending Army vehicle coating service life. The Army expects that the sacrificial metallic coating technique will lead to new field-based kits for repairing smaller damage to fielded vehicle coatings.

Besides metallic corrosion, non-metallic materials such as canvas and wood degrade on fielded and stored tents after being exposed to weather conditions, the environment, and microbial attack. Because of this growing problem, the Army Corrosion Office has been exploring techniques for protecting canvas and wood materials to extend their operating life. The Office has evaluated a replacement treatment containing siloxane polymers and concluded that it shows a marked improvement in protecting cotton webbing from ultraviolet (UV) degradation, compared with aqueous copper-8 quinolinolate, which is currently used to provide protection against environmental degradation of the cotton webbing used to seal the seams in military tenting.

Moreover, copper-8 has been discontinued by U.S. manufacturers as a result of environmental concerns. The replacement treatment, however, has the Environmental Protection Agency's seal of approval; it is cost-effective, and its three-part formulation provides protection for cotton fibers against moisture, microbes, and UV degradation. The Army Corrosion Office has selected this replacement treatment for field demonstrations.

Accomplishments in Corrosion Monitoring

Good monitoring techniques for detecting the incidence, nature, and severity of corrosion early, both in fielded systems and facilities, are essential, so that DoD can remain mission-ready and ensure it has reliable equipment. Detecting

material degradation early would allow corrective maintenance to be performed in its earliest stage, thus lessening the extent of repair.

The use of corrosion sensors and nondestructive testing (NDT) has recently been considered as a potential technique for detecting corrosion in critical structures and military equipment. The Army Corrosion Office has deemed a commercial flash thermography unit as very promising for inspecting hidden corrosion and other defects in aircraft components. The Army has been testing the flash thermography NDT system to detect hidden flaws and material degradation problems in Army assets. The procedure uses prepared corrosion test specimens tailored to a specific application to emulate corrosion defects or flaws that the Army asset experiences in fielded scenarios. The availability and use of an effective inspection system would permit maintenance personnel to repair corrosion damage locally before it requires extensive repair or replacement of an entire component. This system is expected to be field-tested at Army maintenance depots.

Furthering Reliable Information Exchange Online

DoD organizations need to exchange corrosion information rapidly and reliably to sustain materiel readiness and combat corrosion. Because of its prime importance, the Army has affected DoD outreach by launching Army corrosion Web sites such as http://www.armycorrosion.com and http://www.armycorrosion.net to provide information exchange about material degradation prevention and control and to foster relevant communication throughout DoD. The Web sites provide fast, reliable information exchange, and they broadening user knowledge based on leading edge technologies, research, and development results in academia and industry sectors, as well as technology transition successes.

The http://www.armycorrosion.com Web site is open to the general public. It contains information on corrosion awareness, including an information exchange about current corrosion technologies among DoD organizations, technical papers, presentations, and training for military personnel on corrosion prevention topics. The http://www.armycorrosion.net secure Web site is designated for authorized military personnel and users.

The secure Army Web site is designed and maintained by Concurrent Technologies Corp.

Two distinguishing features in both Army Corrosion Web sites are the Joint Test Protocols and Joint Test Reports. The Joint Test Protocols, which consist of documents outlining the critical requirements and tests that manufacturer-developed products must satisfy to be accepted for DoD product lists, are posted for general audiences. The Joint Test Reports, which provide a standardized procedure for evaluating new materials and processes as corrosion control techniques, and determining their suitability for Army materiel, are available for authorized personnel.