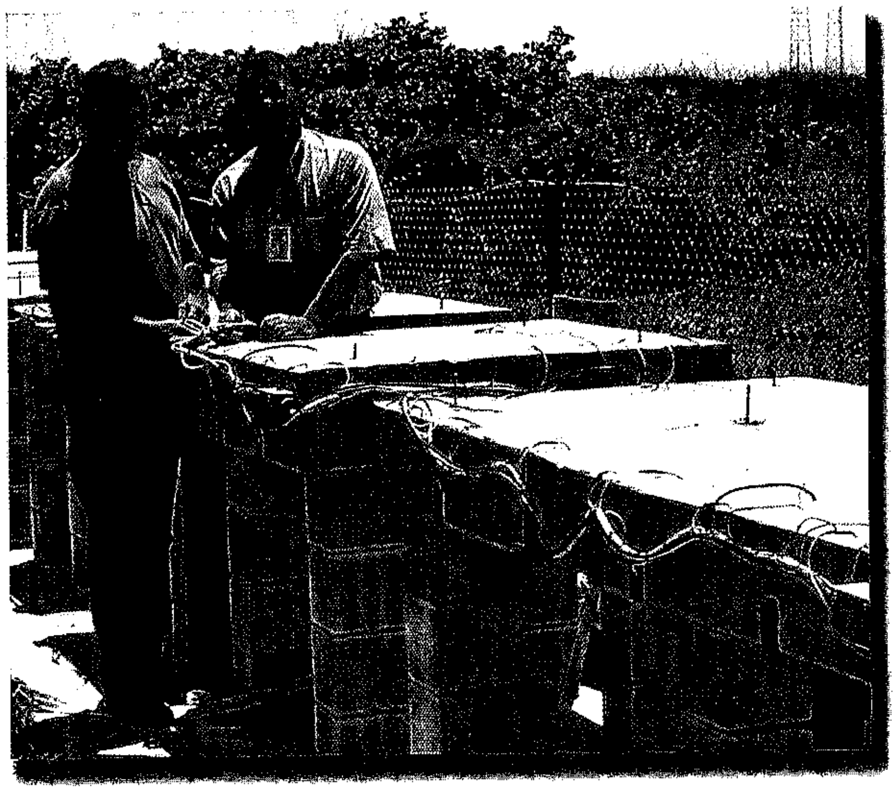
Liquid galvanic coating defends concrete rebar with cathodic protection



Joseph Curran, left, and Louis MacDowell attach CP wiring to test slabs of reinforced concrete painted with the liquid galvanic coating. Photo courtesy of NASA/Kennedy Space Center.

To address cracking associated with corrosion of the steel-reinforced concrete in the marine environment of NASA's Kennedy Space Center (KSC) (Florida), NACE International members Joseph Curran and Louis MacDowell III, FNACE, with the KSC's Corrosion Technology Laboratory, developed and patented a sacrificial liquid galvanic coating that is applied to the surface of the concrete and incorporates cathodic protection (CP) to prevent or mitigate corrosion of the embedded reinforcing metal structures. The coating is comprised of inexpensive, commercially available compounds and doesn't require continuous consumption of electrical power or power supply equipment to function. Additionally, the coating protects the concrete from weathering elements such as moisture, chlorides, and acidic air contaminants.

According to MacDowell, chief of the Materials Test and Chemical Analysis Branch at KSC, the technology features a liquid, inorganic metallic-filled coating that can be applied with a conventional brush or sprayer to a concrete substrate at room temperature to create a large anodic surface area. A stainless steel (SS) or titanium mesh of connecting wires is attached to the surface of the concrete, and the coating is applied over the mesh and allowed to dry. The connecting wires are mechanically connected to the rebar, and a galvanic current is established between metallic particles in the applied coating (the anode) and the embedded rebar (the cathode), which provides CP to the reinforcing metal structures. Reapplication of the coating, when necessary, will maintain electrical continuity and continued protection of the embedded rebar.

Information on corrosion control and prevention

The coating, MacDowell explains, is a mixture of fine, powder-like particles (~600 mesh) of zinc and magnesium in an ethyl silicate binder. The coating composition contains sufficient amounts of Mg and Zn to remain electrically conductive after application. He notes that the level of protection as well as the longevity of protection provided by the coating correlates with the amounts of Zn and Mg in the mixture.

MacDowell and Curran experimented with several formulations containing varying volumes of Mg and Zn, and determined that a mix of ~25% Mg and 75% Zn demonstrated optimal performance based on the results of depolarization testing they conducted on the various coatings compositions.[1] The researchers determined that the addition of a humectant helps maintain the galvanic activity of the applied coating by attracting moisture to the coating.[1] Adding a catalytic metal such as indium helps maintain the galvanic activity of the applied coating by evenly distributing the protection activity throughout the coating. The two researchers indicate that the addition of super-conducting metals also enhances galvanic activity by distributing the protection activity evenly throughout the sacrificial coating and may delay or prevent the passivation of the sacrificial coating.[1]

The coating's performance was established by KSC's Materials Science Laboratory and Beach Corrosion Test Site. Early tests showed that the coating meets the 100 mV polarization development/decay depolarization criteria for CP of steel rebar embedded in concrete as specified by NACE Standard RP0290-90, according to literature published by

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KSC. Other tests verified that the emb ded rebar became negatively polari when connected, indicating the prese of a positive current flow with a shif potential of >400 mV.

NASA has nonexclusively licensed patented technology to two compan It is currently being reformulated a tested on structures throughout world.

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Reference

1 Louis G. MacDowell, Joseph Curran, "Liquid Galvanic Coatings Protection of Imbedded Metals," U Patent 6627065, 2003. MP