Research Notes
RSN 03-03 March 2003

Salt Helps Fight Corrosion

Bridges on Oregon's coast must withstand the corrosive marine environment. Many reinforced concrete bridges, some having historical significance, have been damaged by corrosion. In the late 1990s, the Oregon Department of Transportation (ODOT) began using impressed current cathodic protection (ICCP) and, to a lesser extent, sacrificial anode cathodic protection (SACP) to prevent corrosion damage.

ICCP forces electrical current through the concrete into the reinforcing steel to stop the corrosion. In SACP, no external current is provided; rather, dissimilar metals on the structure create a protective current, much like a battery. For both methods, a conductive material, or anode, is incorporated into the bridge so that the electric current can penetrate evenly through the concrete to protect the reinforcing steel. A common anode material, and the one most often used by ODOT, is zinc metal which is applied by propelling molten zinc onto the concrete.

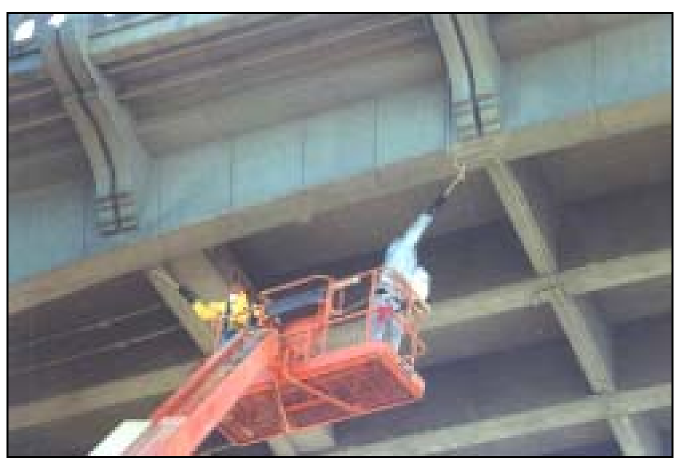
Experiments have shown that moisture at the interface between the zinc and concrete maintains the electrical efficiency of the cathodic protection system and extends the life of the zinc anode. However, sheltered areas of a structure receive less moisture than sections fully exposed to the environment. Cathodic protection zones in these drier locations do not operate at optimum levels.

Laboratory and Field Studies

The Department of Energy's Albany Research Center in conjunction with J. E. Bennett Consulting, Inc. investigated the effect of moisture-attracting chemicals called humectants on the performance of zinc anodes. The research was based upon prior work conducted by Bennett Consulting, which screened many different chemicals for possible use as humectants.

The humectants chosen for this study, $LiNO_3$ and LiBr, are salt solutions that are sprayed onto the zinc surface of the bridge. Laboratory studies were initially conducted to evaluate the performance of each humectant. Samples were tested in a controlled environment under several climatic conditions, including high and low relative humidity.

A follow-up, two-year field study monitored the effect of the two humectants on ICCP zones on the Yaquina Bay Bridge in Newport, Oregon. The effect of the humectants on interfacial chemistry and the influence of the chemicals on electrical operating characteristics were evaluated.



Applying the humectant solution to the under side of the Yaquina Bay Bridge for the two-year field study

Results

The results show that humectants increase the effectiveness of cathodic protection. LiBr is more effective for SACP, and $LiNO_3$ is more effective for ICCP. The improvement persists for up to three years with longer term improvement possible.

A life cycle cost analysis shows that humectants may be cost-effective where cathodic protection zones are easily accessible and the zones are not washed by rain. Rain can leach away the humectant, thereby eliminating any beneficial effect of the humectant.

Implementation

As a result of this study and its findings, ODOT will assess on a case-by-case basis whether humectants should be used to increase the efficacy of a cathodic protection zone.

Request a copy of the report

"Humectants to Augment Current from Metallized Zinc Cathodic Protection Systems on Concrete"

from the Research Group by phone, e-mail, or in person. Or view the report on the Research web page listed below.

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