Florida Department of Transportation Research

Susceptibility of Bridge Steel and Concrete Components to Microbiological Influenced Corrosion (MIC) and Microbiological Influenced Deterioration (MID) in Florida

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Project Manager
Matt Duncan
FDOT Materials Office

Principal Investigator
Kingsley Lau
Florida International University

Current Situation

Creatures that can destroy bridges are often portrayed as giant lizard-like monsters, but in reality, the creatures that can seriously damage bridges and other structures that stand in water are often microscopic, such as bacteria or microalgae. Larger marine animals, like barnacles, adhere to steel structures, often forming crowded colonies. The crevices in these colonies provide a rich environment for the growth of microorganisms which produce chemicals like sulfates or nitrates that promote corrosion. This type of damage has been found on Florida transportation structures that are built on steel that rest in Florida's generally warm waters.

Underwater structures are often colonized by barnacles and other marine life, which can host bacteria that are destructive to steel.

Research Objectives

Florida International University researchers investigated the effects of microbially induced corrosion (MIC) on steel. They experimented with a variety of protective methods to determine their ability to prevent or mitigate MIC.

Project Activities

The researchers identified three Florida sites, in brackish and fresh waters, where heavy encrustations which support MIC are found on underwater structures. Examination of steel samples placed at these sites revealed the presence of MIC organisms. Testing indicated highly aggressive corrosion conditions, often focused in crevices created by larger organisms, such as barnacle colonies on the sample surfaces. Laboratory investigation supported the idea that sulfate-reducing bacteria (SRB) played a significant role in the corrosion of field samples.

The researchers tested three protective approaches. The first, a barrier-type protectant, was a copper-free antifouling paint. The second was also a barrier-type protectant: polyurea, a type of polymer that is highly regarded for both its water-repellant and anticorrosion properties. The third approach was electrochemical: zinc was attached to the steel which changes the electrical properties of the steel and inhibits corrosive chemical reactions.

Protective barriers were tested in environmental settings as well as in the laboratory in solutions inoculated with SRB. Fewer barnacles grew on surfaces treated with anti-fouling paint than on polyurea-treated surfaces, and the painted surface had generally lower surface populations of SRB than other types of MIC bacteria. Tests on concrete showed heavy encrustation and microorganism growth, but no degradation of the concrete was seen. Tests using polyurea coating on concrete showed no reduction in encrustation or microorganism growth.

Tests of the electrochemical treatment were conducted in the field and in the laboratory. The corrosion rate was reduced, but it appeared that portions of the steel that became encrusted did not receive the full effect of the zinc.

Project Benefits

The observations of this exploratory study point the way to developing better protections for steel structures immersed in Florida waters.

For more information, please see www.fdot.gov/research/.