Florida Department of Transportation Research

Corrosion Evaluation of Novel Coatings for Steel Components of Highway Bridges

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Current Situation

Steel components make up all or part of Florida bridges. Many are subject to harsh marine environments, but all are exposed to Florida's high humidity and rainfall, which can lead to corrosion. Durable protective coatings are needed to protect the steel in Florida bridges.

Research Objectives

This project sought to identify novel, commercially available coating systems for corrosion mitigation of steel and to test their behavior in Florida environments, including characterizing possible degradation mechanisms and durability of the coating systems.

This steel bridge depends on its bright blue coating to protect it from corroding in its moist environment.

Project Activities

From the available new coating products, two were of particular interest to the Florida Department of Transportation (FDOT): chemically bonded phosphate ceramic coating (CBPC) and thermal diffusion galvanized coating (TDG). Four coatings were tested: the new coatings, CBPC and TDG, and the currently used coatings, three-coat paint and thermal-sprayed metallizing. TDG samples were tested in four topcoat conditions. Researchers sent identical steel blanks to manufacturers for coating according to industry best practices. Coated samples were then returned to the researchers for testing.

As-received coated samples were initially tested for general characteristics, such as coating thickness, adhesion, and coating-substrate bond. For use in corrosion testing, some coated samples were scribed with a scratch which penetrated the coating. Scratched and as-received samples were tested in three environments: outdoor at the beach and inland; immersion; and in a specially constructed salt-fog chamber. Outdoor exposure times were four and eight months. Immersion exposure time was 30 days. Salt-fog chamber exposure times were 2200 and 5800 hours. Four immersion conditions were established by varying from chloride-free to 3.5% NaCl and from neutral pH to a high pH (13.3) simulating concrete pore solution.

The variety of exposures allowed a wide range of test types, from coating deterioration in outdoor samples to electrochemical testing of immersion samples. Despite the challenges imposed on the data analysis by variations in coatings as received, detailed analysis of the samples led to useful observations about their potential for use on Florida bridge components. Further research into these coatings is ongoing.

Project Benefits

Projects like this represent the continuing effort to improve materials and practices used in Florida transportation infrastructure. Identification of new and more effective coatings can make bridges in Florida more durable and significantly reduce life-cycle maintenance costs.

For more information, please see dot.state.fl.us/research-center