Florida Department of Transportation Research

Testing Methods to Assess the Durability of Concrete Permeability-Reducing Admixtures

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Current Situation

Many transportation structures in Florida use steel-reinforced concrete that is immersed in either fresh or salt water or exposed to water from tides, splashing, and rain. Water can penetrate concrete and initiate corrosion of the reinforcing steel. When the water is salty, i.e., carrying chloride ions, the situation is more serious. Corrosion of reinforcing steel is the primary mode of serious damage to Florida transportation structures. The Florida Department of Transportation (FDOT) uses several methods to protect reinforcing steel from corrosion and are always evaluating new ones. Permeability-reducing admixtures (PRAs), materials that can be added or applied to concrete to make it less susceptible to water intrusion and thus help protect reinforcing steel is a promising area of study. However, the protective effect of PRAs must first be proven for the types of cement that FDOT uses.

Steel-reinforced concrete is central to many structures like bridges, but it must be protected against water intrusion.

Research Objectives

University of Florida researchers examined protocols used to test the effectiveness of PRAs to develop a testing regime for use in Florida.

Project Activities

Broadly, PRAs are classified according to their mechanism for blocking water, whether they are effective under water pressure or not, and whether they are surface-applied to hardened concrete or included in concrete mixes. PRAs generally block water by either blocking pores in concrete, repelling water, or both. The American Concrete Institute organizes PRAs in five categories: hydrophobic water repellents, polymer products, finely divided solids, hydrophobic pore blockers, and crystalline products. PRAs are available in commercial products that make a variety of claims for their abilities, including reducing the permeability of concrete and healing fine cracks.

Because of the number of mechanisms, conditions for use, and methods of application, the researchers found a wide variety of PRA testing protocols from sources across more than a dozen countries. These protocols used one or more types of tests, including water absorption, water permeability, electrical resistance, porosity, compressive strength, flexural strength, and self-healing. The researchers examined each of these tests to determine how it had been applied, whether it could quantify PRA performance, and what its acceptance limits were.

The researchers found a critical gap in the literature between laboratory studies and field studies: there were no systematic tests that linked laboratory studies to field performance that would be relevant to the cement mixtures used by the FDOT. Recommended acceptance criteria for PRAs based on rapid laboratory penetrability and durability tests were not found. The researchers findings led to recommendations for a future study to determine PRA test requirements and acceptance criteria.

Project Benefits

This project laid the foundation to demonstrate the effectiveness of PRAs for Florida transportation structures, with the possibility of improving durability and reducing maintenance for these structures.

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