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Accelerated Corrosion Testing of Grouts for Post-Tensioning Steel Strand

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Current Situation

Post-tensioning is widely used to strengthen concrete. For example, in bridge girders, plastic tubes are cast into the concrete, and after the concrete has set, steel cables are run through the tubes and tightened. The plastic tube is then filled with grout and sealed. Improvements in grout mixes and quality control testing have helped to assure that this system effectively protects the steel from corrosion. However, corrosion in the steel cables has occurred where voids have developed in the protective grout.

Research Objectives

Florida International University researchers assessed modifications of standard grout testing methods using purposely deficient grout to connect deficiencies with corrosion potential and to identify testing protocols that can help mitigate corrosion potential.

Project Activities

Four commercial grouts were used to prepare specimens as prescribed by test specifications. Three of the grouts were fresh, and two were cast after their expiration date. A standard grout mix ("neat" grout) was also prepared.

The grout specimens were tested using four methods: accelerated corrosion testing (ACT) as modified by the researchers; macrocell corrosion test; inverted-tee test (INT); and modified incline tube (MIT) corrosion testing. For each test, the grout specimens were prepared under a range of conditions, depending on the test: 10% more water than the manufacturer's recommendations and added sulfate, chloride, or both. Physical conditions were also varied for some tests, including degree of constriction on the pumping inlet and angle of the specimen during testing. The electrochemical noise technique was used to test for localized corrosion.

Overall, testing confirmed that inappropriate handling and preparation of grout can promote grout deficiencies. More specifically, the ACT was useful in detecting unacceptable grout. The macrocell test, included in the study as an economical form of more complex electrochemical testing, encountered complications that made results inconclusive. The INT setup was useful for identifying grout materials that were compromised by overwatering or prehydration. MIT tests confirmed the role of sulfate ions in increasing corrosion potential. They also showed that expired grouts developed the highest sulfate ion concentrations and had the greatest susceptibility for corrosion development. The electrochemical noise technique was effective for measuring localized corrosion of steel in alkaline solutions.

Project Benefits

This project advances the understanding of the role of deficient grout in the corrosion of steel post-tensioning cables. It also points the way toward better testing of post-tensioning grouts that can give more assurance of corrosion prevention.

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



The Ringling Bridge in Sarasota depends on post-tensioning cables and on correct preparation and use of grout mixes.