Florida Department of Transportation Research

Evaluation of Corrosion-Inhibiting Materials Applied by Impregnation (Pressure Injection) Methods to Prevent Corrosion of Post-Tensioned Tendons

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Current Situation

Post-tensioned tendons (PTT) are bundles of steel cables that run through tubing called ducts. After the cables are placed, the duct is backfilled with grout and sealed to protect the cables from corrosion. However, corrosion can still occur where there are voids in the grout caused by excess water or from seepage through incomplete duct seals. Defects in the tubing or seal materials can also lead to corrosion. A recently developed system of corrosion control is based on a proprietary material that is pressure-injected into the tendon duct and works its way along the entire length of the PTT, ultimately saturating voids and grout deficiencies while creating a protective barrier on the surface of the cables. The impregnation material is intended to provide cost-effective protection with otherwise minimal disruption.

Post-tensioning makes longer, lighter bridge segments possible.

Research Objectives

University of South Florida researchers evaluated the long-term effectiveness and the service life of the impregnation method and materials.

Project Activities

The researchers built PTT mockups using correctly made grout or grout made with added sodium chloride or excess water. Mockups were injected with either the proprietary fluid (VPF) or an alternative fluid penetrant (AFP). Tests indicated successful corrosion abatement, with an effective service period of several months for the AFP, but at least twice that for the VPF. Autopsies on some VPF-injected mockups revealed that mockups made with correct grout showed a uniform coating of VPF on steel strands, indicating effective distribution of VPF in the space between the steel and the grout. For mockups with added chlorides, the VPF was unevenly distributed along the steel strands and tended to coat regions of minimal corrosion. Despite this, a 3-D corrosion damage analysis showed that the VPF substantially reduced the maximum corrosion penetration compared to untreated tendons.

Corrosion measurements of the mockups indicated that tendon impregnation might extend the time until the first strand failure by almost a factor of 3 when adequately applied. The VPF performance might be compromised by grout voids and chloride-containing water intrusion.

For a type of PTT called “bonded,” the bond between cable and grout is critical for the strength of the concrete component reinforced by the PTT. To test the effect of the penetrants on this bond, after mockup construction and grout curing, the tendons were pulled out, and the force required indicated the strength of the strand-to-grout bond. Strands treated with AFP indicated no difference between treated and untreated mockups. However, VPF-impregnated mockups showed reduced pullout resistance, indicating a decrease in bonding.

Project Benefits

VPF shows promising corrosion control capabilities for non-bonded PTTs after several months of service if adequately applied, which depends in part on adequate space between cables and lack of pre-existing corrosion products.

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