Mitigating Grouted Post-Tension Strand Corrosion on Bridges

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Grout Issues which can lead to Corrosion

• Voids
  1. Bleed Water
  2. Grouting Problems

• Defective Grout
  1. Segregated
  2. Chloride Contaminated
  3. Carbonated
Identification of PT Grout / Corrosion Issues

- Sonic / Ultrasonic Methods
- Borescope
- Magnetic
Impact Echo – Rogers Overpass
Borescope Inspection

• Visual inspection of voids with minor physical impact
  – Borescope Diam. = 4 mm
Magnetic Flux – Champlain Bridge / Sunshine Skyway
Post-Tension Tendon Impregnation Process

- Corrosion protection process
- Impregnation material transported inside strands full length of tendon
- Impregnation material reduces corrosion by:
  - Coating exposed steel in voids
  - Improving corrosion resistance of grout
Test Specimen Undergoing Galvanostatic Testing
Verification of Corrosion Protection of Tendons with Voids
Potentiostatic Testing Tendons in Uncontaminated Grout with 4.5% Void

94.7% Reduction
PTI Treated with Voids vs. Untreated Tendons with Voids
Potentiostatic Testing
Tendons in Chloride-Contaminated Grout (2% Cl⁻)

93.1% Reduction
PTI Treated vs. Untreated Tendons
Interim Report:

Evaluation of a Silicon Based Polymer Corrosion Inhibitor for Post-Tensioned Tendons

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March 1, 2017
Removal of Anchorage Caps and Grout
Summary

• Impregnation is a corrosion protection process for tendons with grout defects
• Corrosion resistance of treated tendons is improved
• Impregnation may also be suitable for new structures where long service life is desired and the use of bonded tendons is preferred
Questions
Post-Tech PTI Impregnation
Verification of Corrosion Protection

Steel Plate

Post-Tension Strand

Post-Tension Strand in Grout

Potentiostatic Testing
Tendons in Chloride-Contaminated Grout (2% Cl)

93.1% Reduction
PTI Treated vs. Untreated Tendon

Total Current (Coulombs)

Untreated
Treated
Wick-induced bleed test by American Segmental Bridge Institute in April 2012 showing portland cement grout with about 4% bleeding after 24 hours of grouting operation.
Typical Test Results

0.47 mg/g dry
990 ppm Cl⁻
PH 9.8
7800 ppm SO₄²⁻

0.25 mg/g dry
980 ppm Cl⁻
PH 11.9
7100 ppm SO₄²⁻

0.14 mg/g dry
970 ppm Cl⁻
PH 12.7
55% moisture
4300 ppm SO₄²⁻

0.18 mg/g dry
950 ppm Cl⁻
PH 12.7
44% moisture
1900 ppm SO₄²⁻

0.09 mg/g dry
300 ppm Cl⁻
PH 12.7
14% moisture
310 ppm SO₄²⁻

Corrosion
Impregnation of Strands in Prestressed Concrete
Corrosion Testing of Impregnation Material Applied to Unprepared Steel
Verification of Corrosion Protection

PT Cable Samples Cast in Chloride Contaminated Grout

Galvanostatic Scans with Applied Current = 2.5 microA/cm²

Potential (V) vs Ag-AgCl Ref Cell

Time (s)
Verification of Corrosion Protection
PT Cable Samples in Chloride Contaminated Grout (2% Cl-)

Potentiostatic Scans with Potential Held at +200mV vs Ag-AgCl Reference Cell