P/T Grouting Issues

Joey Hartmann, FHWA
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P/T Grouting Concerns

**Elevated Chlorides**
- Material issue
- Grout produced at Sika Marion
- 2001 – 2010
- Varying levels of chloride from less than specified 0.08% to as much as 4 or 5 times that amount
- Long(er)-term concern

**Soft Grout/Sulfates**
- Construction issue
- Grouts from multiple manufacturers
- Independent of elevated chlorides
- Primarily isolated to a handful of cases in FL and TX
- Immediate concern
Elevated Chloride Issue

Memorandum

Subject: **ACTION:** Elevated Chloride Levels in SikaGrout® 300 PT Cementitious Grout

Date: November 23, 2011

From: King W. Gee
Associate Administrator
Office of Infrastructure

To: Division Administrators
Directors of Field Services

In Reply Refer To: HIBT-1

The purpose of this memorandum is to inform you of an issue pertaining to varying levels of chloride found in grout used to fill tendon ducts in post-tensioned construction. The grout, SikaGrout® 300 PT, is a non-shrink, low-bleed cementitious material used to create a composite connection and provide a mechanical barrier between the high-strength steel strand tendons and infiltrating chlorides and water that may cause corrosion.
FHWA Activities

• Stakeholders Planning Group
• Industry Coordination
• Research
Stakeholder Planning Group

- Met on May 16, 2012
- Purpose:

  To evaluate any guidance developed as a result of the experimental and analytical research efforts, and identify additional needs with regard to managing affected bridges or communicating the issue.

- Mal Kerley (AASHTO)
- Kelley Rehm (AASHTO)
- Tim Keller (OH)
- Nancy Daubenberger (MN)
- Brian Merrill (TX)
- Mario Paredes (FL)
- Shirlene Cleveland (MD)
- Claude Napier (VA)
- Ted Neff (PTI)
- Randy Cox (ASBI)
Industry Coordination

• Focused on preventing re-occurrence...

• Post-Tensioning Institute (PTI)
  – Updated and re-issued grouting specifications
    [2 copies should be at your seat]

• American Segmental Bridge Institute (ASBI) and PTI
  – Updated their training course materials

• Presentations from PTI and ASBI this afternoon
Research: Objectives

• Produce information necessary for FHWA to provide further advice to bridge owners who are affected by the chloride issue

  – Determine the chloride threshold value(s) that are a cause for concern

  – Develop guidance that is triggered by identifying grout with chlorides in excess of the threshold(s)
## Research: Experiment Design

<table>
<thead>
<tr>
<th>Task</th>
<th>Specimen type</th>
<th>Quantity</th>
<th>Purpose: to determine effects of the following variables on corrosion</th>
<th>Test variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Single (king) Wire</td>
<td>40</td>
<td>chloride, stress, pH</td>
<td>Chloride concentration: (0.0, 0.04, 0.08, 0.2, 0.4, 0.6, 0.8, 1.0, 2.0, 5.0)</td>
</tr>
<tr>
<td>2.2</td>
<td>Single Strand (plus 16 backup)</td>
<td>24</td>
<td>chloride, void, strand geometry, stress</td>
<td>Chloride concentration: (0.0, 0.08, 0.2, 0.4, 0.6, 0.8, 1.0, 2.0)</td>
</tr>
<tr>
<td>2.3</td>
<td>Multi-Strand</td>
<td>8</td>
<td>chloride, void, stress, macro-cell corrosion</td>
<td>Chloride concentration: (0.0, 0.08, 0.2, 0.4, 0.6, 0.8, 1.0, 2.0)</td>
</tr>
</tbody>
</table>
Research: Specimens
Accelerated Testing Cycle

Expose the specimens to 3 temperature/RH conditions

- Ambient (77 °F) + 60% RH →
- Hot and Humid (104 °F) + 90% RH →
  Ambient (77 °F) + 60% RH →
- Freezing (17 °F) + 40% RH →
- Repeat (for six months)
Measurements/Data

**During Cycling**
- Corrosion potential
- Instantaneous rate of corrosion
- Visual inspection
- Grout resistance
- Macro-cell current

**Post-Cycling**
- Characterizing corrosion morphologies
- Measuring pit depths on individual strands
- Sampling grout powders for final chloride analysis
Research Team

• FHWA
  o Dr. Paul Virmani
  o Dr. Hamid Ghasemi
  o Dr. Firas Ibrahim

• Contracting (LTBPP)
  o Dr. S-K Lee
    (Task PI)
  o Dr. Ali Maher
    (PI, LTBPP Contract)

Draft Report: December 2012