Corrosion Characteristics of Post-Tensioning Strands in UngROUTED Ducts

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462-6.2 During Installation in the Structure: The time between the first installation of the prestressing steel in the duct and the completion of the stressing and grouting operations shall not exceed seven calendar days. Any light surface corrosion forming during this period of time will not be cause for rejection of the prestressing steel.

Flushing of grout is not permitted and vacuum grouting is required to repair all voids and blockages as defined in 462-11.5.7. Flushing of ducts is only permitted as defined in 462-9 and 462-10.5. When flushing is permitted, use flush water containing slack lime (calcium hydroxide) or quicklime (calcium oxide) in the amount of 0.17 lb/gal.

Except when waived by the Engineer in writing, failure to grout tendons within the seven calendar days specified will result in stoppage of the affected work in accordance with 8-6.
Background/Problem:

- To control corrosion, FDOT Standard Specifications for Road and Bridge Construction (2009) limits period between PT strand placement and grouting to 7 days.

- If specification too conservative for some service environments:
  - Needless/costly construction requirements. Period may be extended.

- If specification too liberal for other environments:
  - Corrosion risk. Shorter period or alternative/supplemental control methods may be needed.
Needs/Objectives:

• Establish fact-based guidelines for duration period

• Determine/recommend practical alternative corrosion protection steps

• Selection based on
  - Environmental service conditions per FDOT classifications
  - Type of tendon and structure considered.
Tendon Set-Up
Inland Installation Set-Up
<table>
<thead>
<tr>
<th>Designation</th>
<th>Test Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCN</td>
<td>Dry duct (no free water inside) assembled under ambient conditions. Both ends <strong>Closed</strong>. <strong>No</strong> corrosion inhibitor.</td>
</tr>
<tr>
<td>DON</td>
<td>Dry duct but with simulated improperly sealed condition, by leaving one end cap out (a bug mesh was placed instead). One end <strong>Open</strong>. <strong>No</strong> corrosion inhibitor.</td>
</tr>
<tr>
<td>WCN</td>
<td>Wet duct (intentionally trapped water inside) assembled under ambient conditions with the addition of sufficient potable water to produce an internal atmosphere at 100% relative humidity. Both ends <strong>Closed</strong>. <strong>No</strong> corrosion inhibitor.</td>
</tr>
<tr>
<td>WCI</td>
<td>Wet duct assembled under ambient conditions plus the addition of sufficient potable water to produce an internal atmosphere at 100% relative humidity. Both ends <strong>Closed</strong>. Fogging with a water-based vapor phase corrosion <strong>Inhibitor</strong>.</td>
</tr>
</tbody>
</table>
Visual Corrosion Rating

1. Little or no corrosion, acceptable.
2. Some amount of surface corrosion, acceptable.
3. More corrosion but still acceptable.
5. Excessive corrosion, visible pitting, cause for rejection.
6. Further excessive corrosion, visible pitting, cause for rejection.
Little Or No Corrosion:
Acceptable

Photo 1: Strand Surface Before Cleaning
Photo 1A: Strand Surface After Cleaning

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Some Amount of Surface Corrosion: Acceptable

Photo 2: Strand Surface Before Cleaning  Photo 2A: Strand Surface After Cleaning

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More Corrosion: But Still Acceptable

“Pictures reproduced from Sason (1992) by kind permission from The Precast Prestressed Concrete Institute (PCI).”
More Corrosion: Borderline

Photo 4: Strand Surface Before Cleaning  Photo 4A: Strand Surface After Cleaning

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Excessive Corrosion, Visible Pitting: Cause for Rejection

Photo 5: Strand Surface Before Cleaning

Photo 5A: Strand Surface After Cleaning

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Further excessive Corrosion, Visible Pitting: Cause for Rejection

Photo 6: Strand Surface Before Cleaning  Photo 6A: Strand Surface After Cleaning

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Figure A3.4 – Inland – 8 Week Exposure

Initial

As-Extracted
Figure A3.8 – Seashore – 8 Week Exposure
Figure A3.9 – Most Severe Pitting Observed (Seashore Facility) – Set 1
Conclusions

1. Dry ducts do not show significant corrosion.

2. Only ducts with free water standing show some corrosion.

3. Corrosion was in the form of shallow pits.

4. Pitting did not cause significant tensile property changes.

5. Possible considerations could be made to extending time to grouting.
Thank You!