The Evaluation of Surface Preparation Methods for Chloride Remediation

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CHLORIDE CONTAMINATION REMEDIATION ON STEEL BRIDGES

• Study Objectives:
  • Review current processes for surface preparation
  • Precondition steel panels by cyclic salt fog exposure
  • Clean the corroded steel panels with candidate surface preparation methods
  • Assess any retained chlorides
Research Approach

• Use salt fog exposure to replicate contaminated/pitted field conditions.
• Measure chlorides on the panels by boiling extraction.
• Use scanning electron microscopy (SEM) to determine the distribution of any retained chlorides.
Surface roughness of the preconditioned panels was approximately 20 mils and chloride contamination averaged 500 µg/cm².
Test Panel Apportionment

- Chloride Content After Surface Preparation
- Chloride Deposition by SEM
- Chloride Content Prior to Surface Preparation
Pre-surface Preparation
Boiling Extraction
Surface Preparation Methods

Thirty-two surface preparation methods. Eight dry methods, with combinations of abrasive material (steel grit, mineral slag, glass, and aluminum oxide), abrasive size, and re-blasting (after flash rusting).

Twenty-four wet methods, with combinations of water pressure, water abrasive mixes, water temperature, and chemical additives.
Surface Cleanliness

- SSPC SP 10
- SSPC VIS4
- WJ-1
Post-surface Preparation
SEM Assessment
Post Cleaning % Cl⁻
Post Cleaning Cl\textsuperscript{-} Surface Concentration
Chemical Water/Abrasive

1. Map is 73 mils x 59 mils.
2. Spot is 4.7 mils across the horizontal axis.
3. Chloride removed — 99.1%
4. Chloride — 6.4 μg/cm²
Chemical Water Jetting

1. Map is 50 mils x 37.5 mils.
2. Spot is 2.25 mils across the horizontal axis.
3. Chloride removed – 98.5%
4. Chloride – 10.3 µg/cm²
Chemical Steel Grit 40/50

1. Map is 49 mils x 37 mils.
2. Spot is 3.6 mils across the horizontal axis.
3. Chloride removed – 98.1%
4. Chloride – 7.9 µg/cm²
1. Map is 117 mils x 88 mils.
2. Spot is 30.0 mils across the horizontal axis.
3. Chloride removed – 98.0%
4. Chloride – 10.3 μg/cm²
4.8K psi wash, Steel Grit 40/50

1. Map is 86 mils x 60 mils.
2. Spot is 18.1 mils across the horizontal axis.
3. Chloride removed – 95.9%
4. Chloride – 17.1 μg/cm²
Estimated Equivalent Chloride Levels

551 µg/cm²

1930 µg/cm²

409 µg/cm²

120 µg/cm²

326 µg/cm²
Conclusions

- Wet surface preparation methods are most effective in remediating chlorides.
- Repeated dry abrasive blast cleaning is nearly as effective.
- No method tested cleaned to less than 5 µg/cm² chloride.
- Remaining chlorides are deposited in “hot spots” with elevated chloride concentrations.
- Coating failure is likely at “hot spots”.
Thank You

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