The Evaluation of Surface Preparation Methods for Chloride Remediation

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KTC-16-08/SPR14-484-1F 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

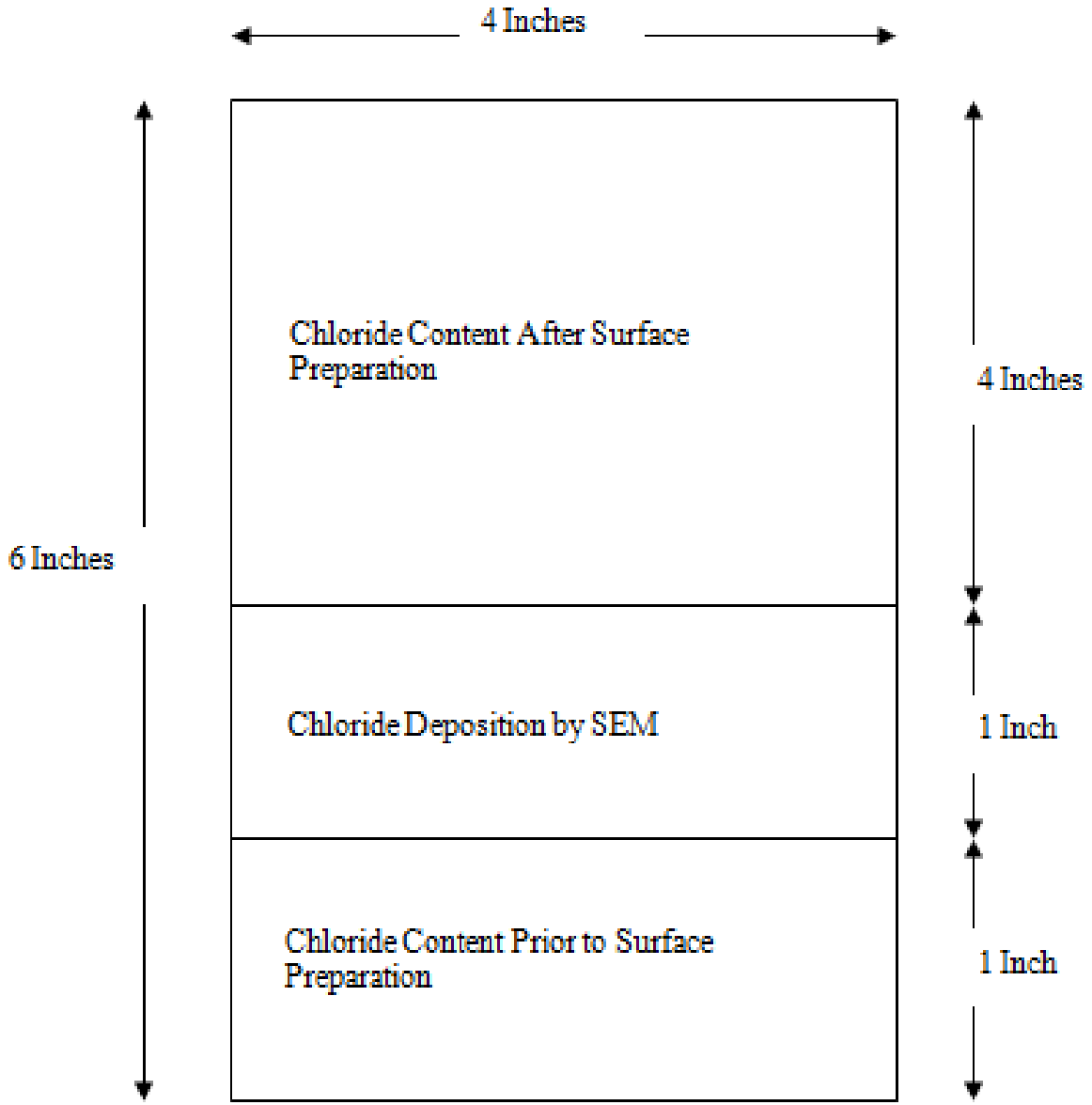
Research Approach

- 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.

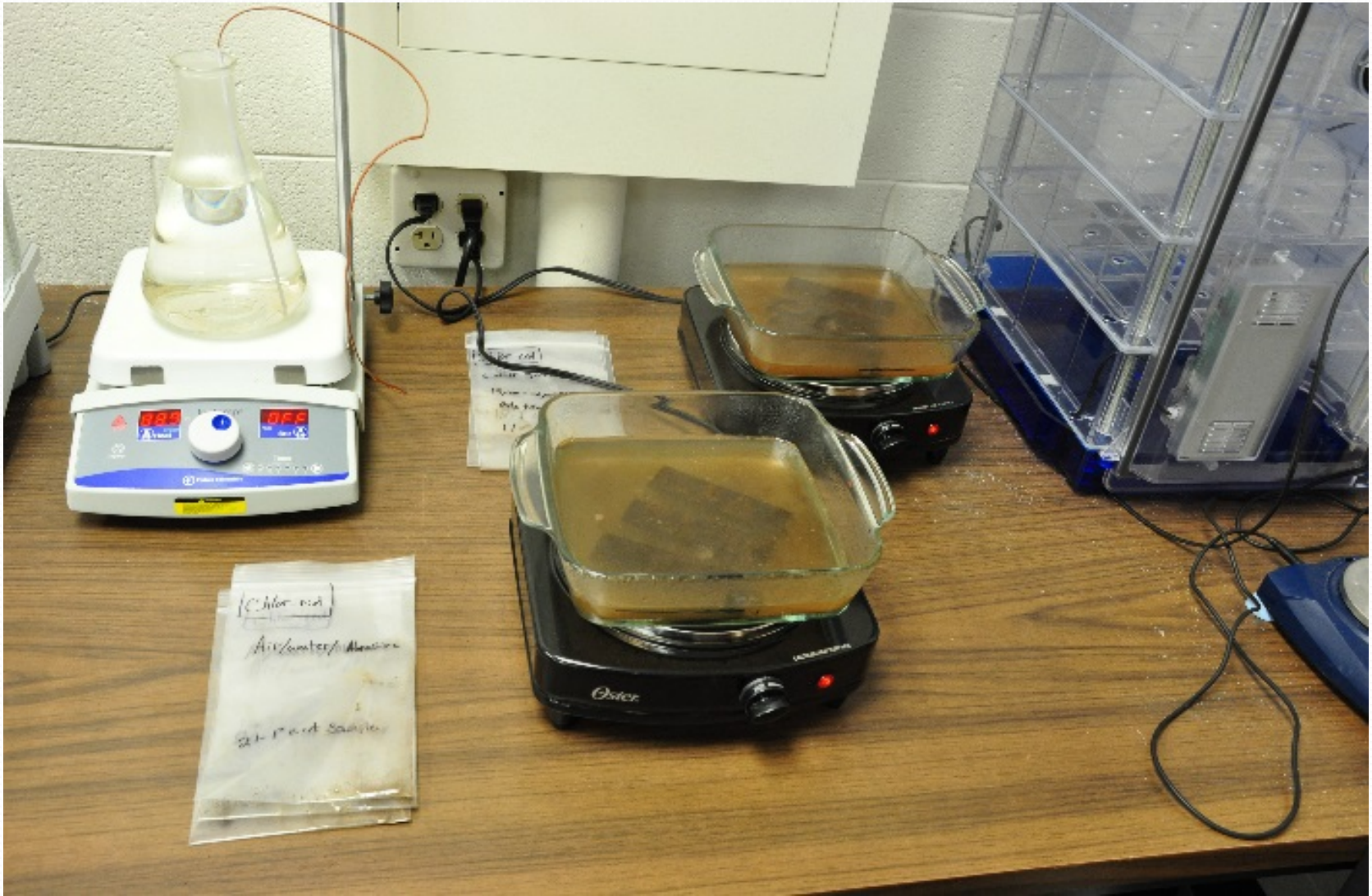
Test Panel Preconditioning

Surface roughness of the preconditioned panels was approximately 20 mils and chloride contamination averaged 500 µg/cm².

Test Panel Apportionment



Pre-surface Preparation Boiling Extraction



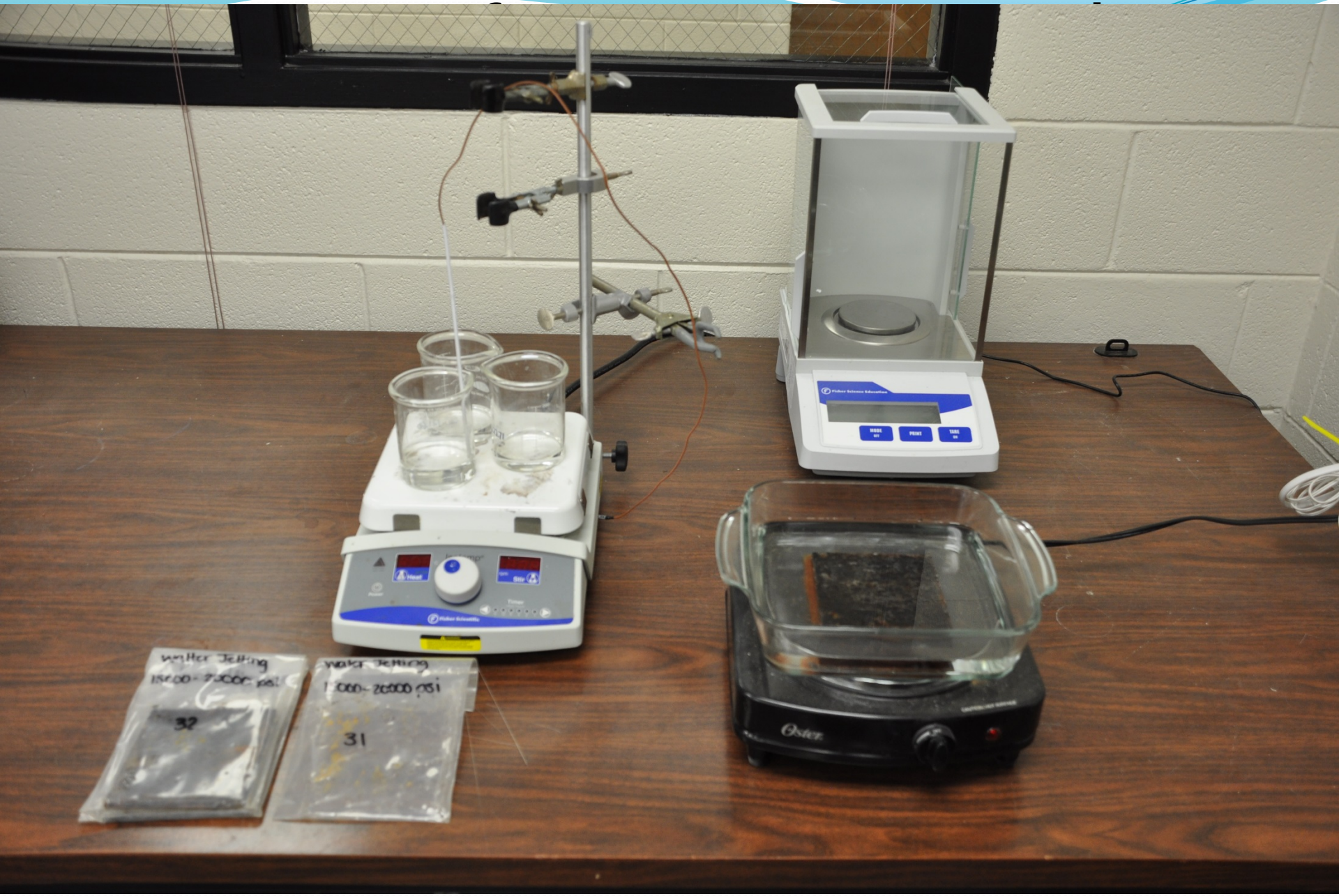
Surface Preparation Methods

Thirty-two surface preparation methods.

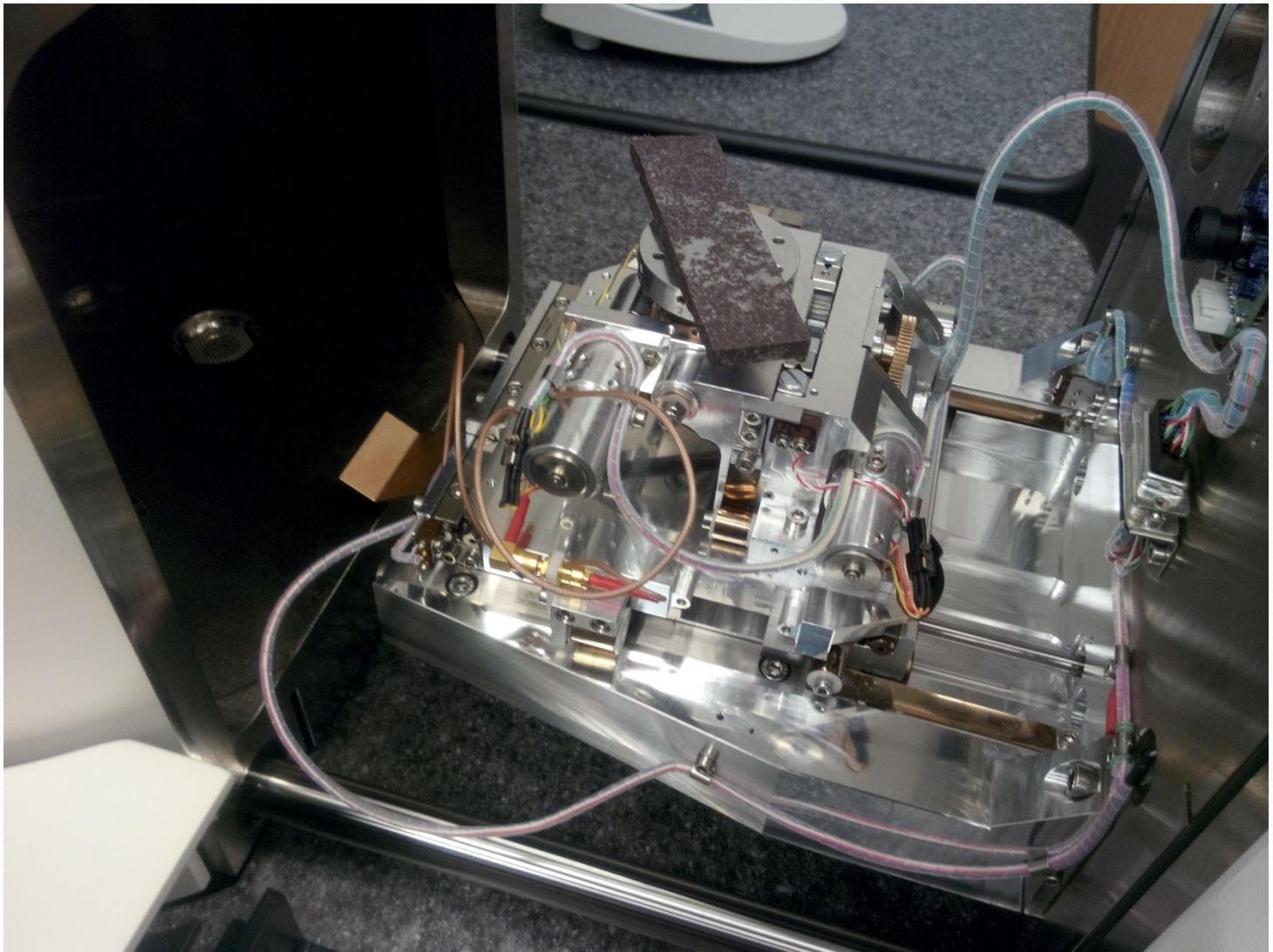
Eight dry methods, with combinations of abrasive material (steel grit, mineral slag, glass, and aluminum oxide), abrasive size, and re-blasting (after flash rusting).

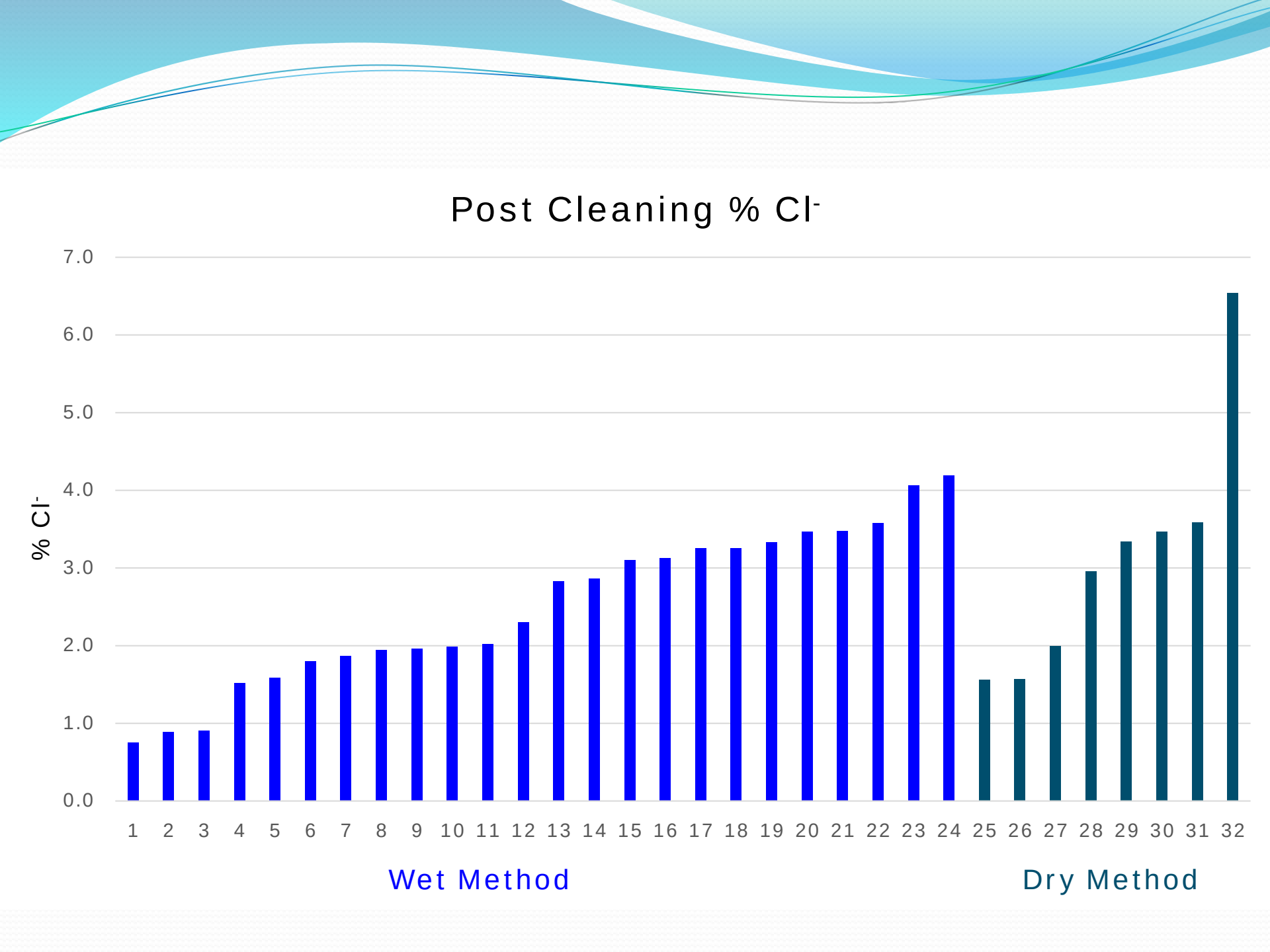
Twenty-four wet methods, with combinations of water pressure, water abrasive mixes, water temperature, and chemical additives.

Surface Cleanliness

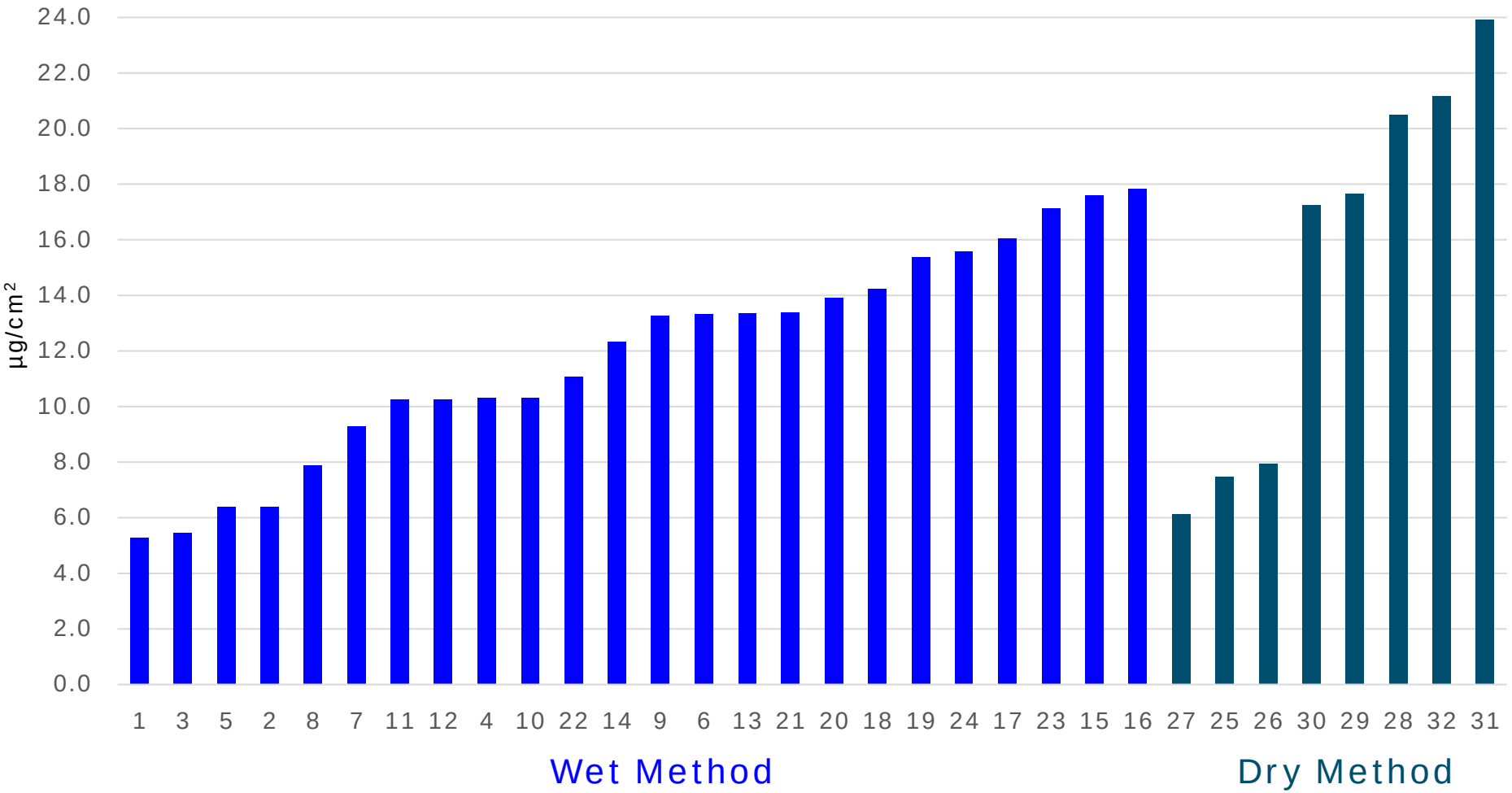

32
31
Oster

Post-surface Preparation SEM Assessment



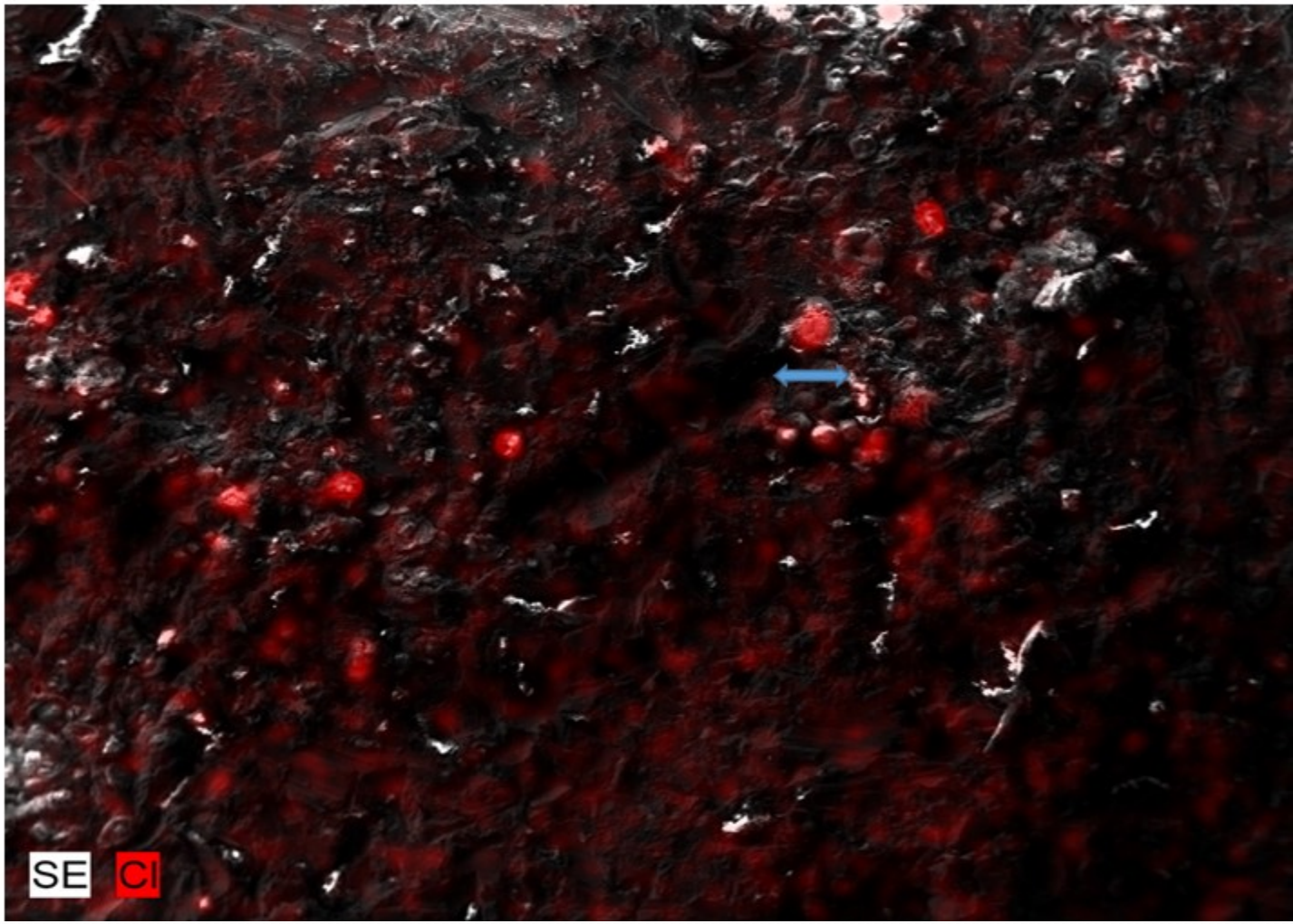

Post Cleaning % Cl-
% Cl-
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
Wet Method
Dry Method

Post Cleaning Cl^- Surface Concentration



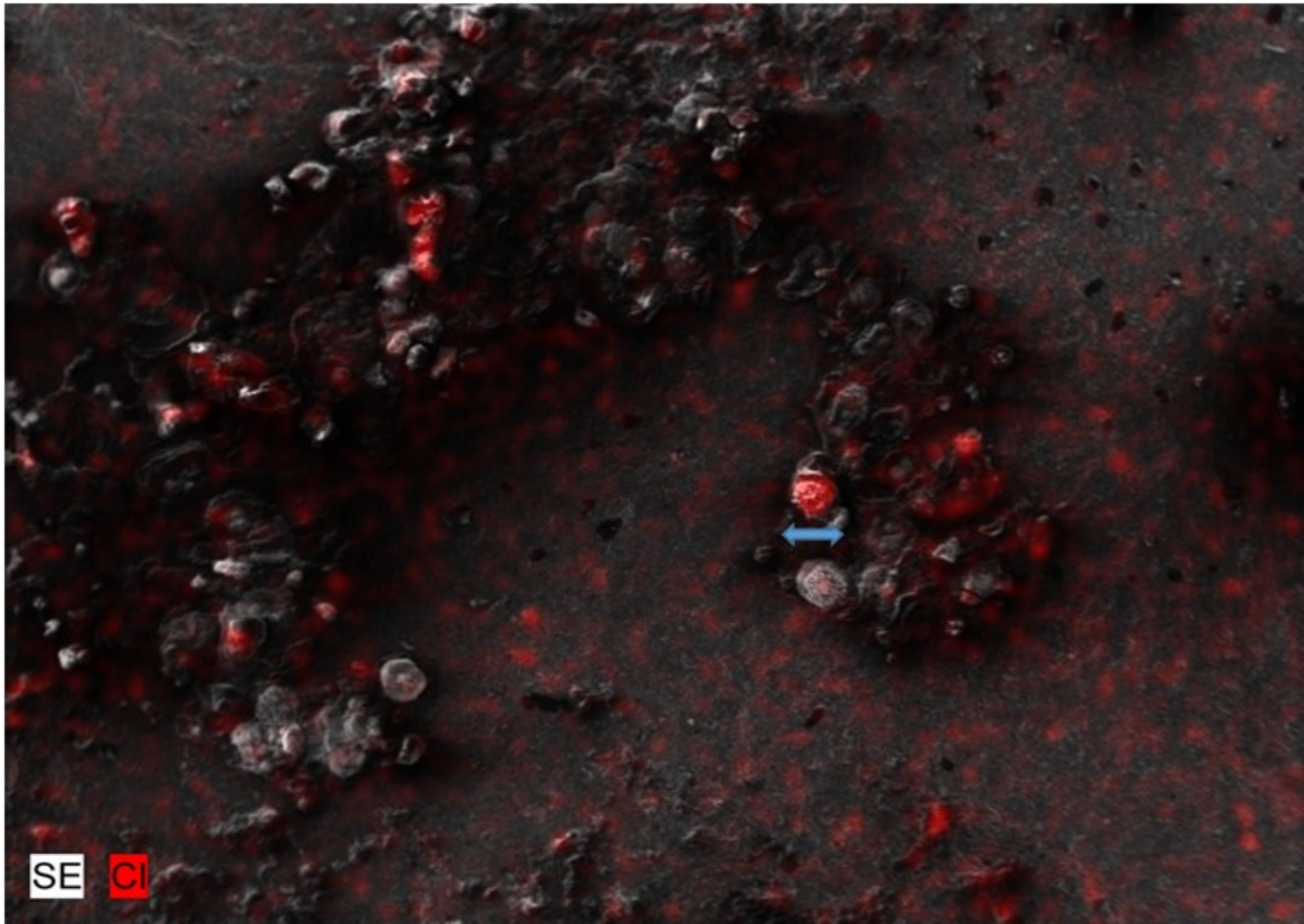
Chemical Water/Abrasive

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/cm^2



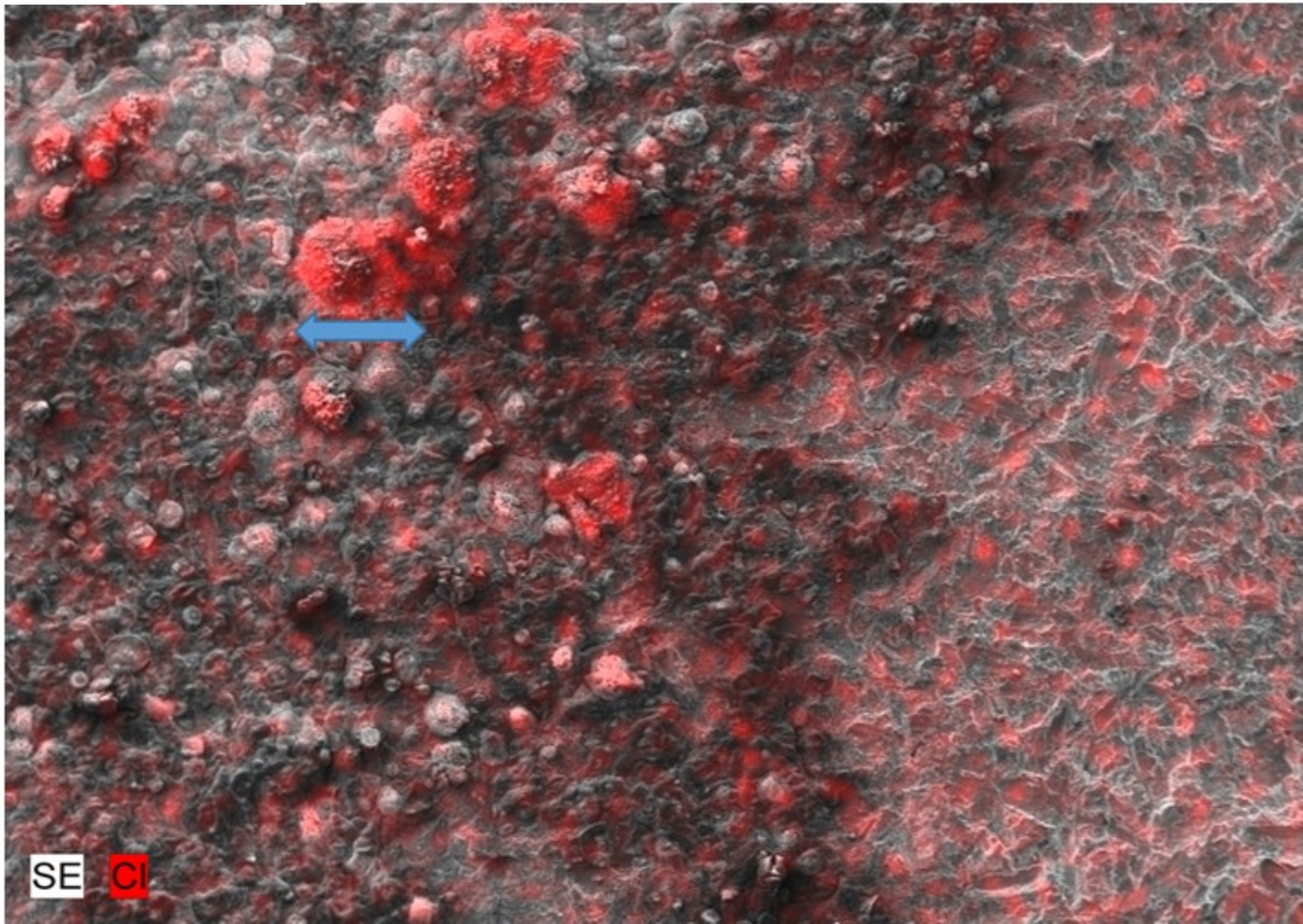
Chemical Water Jetting

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/cm^2



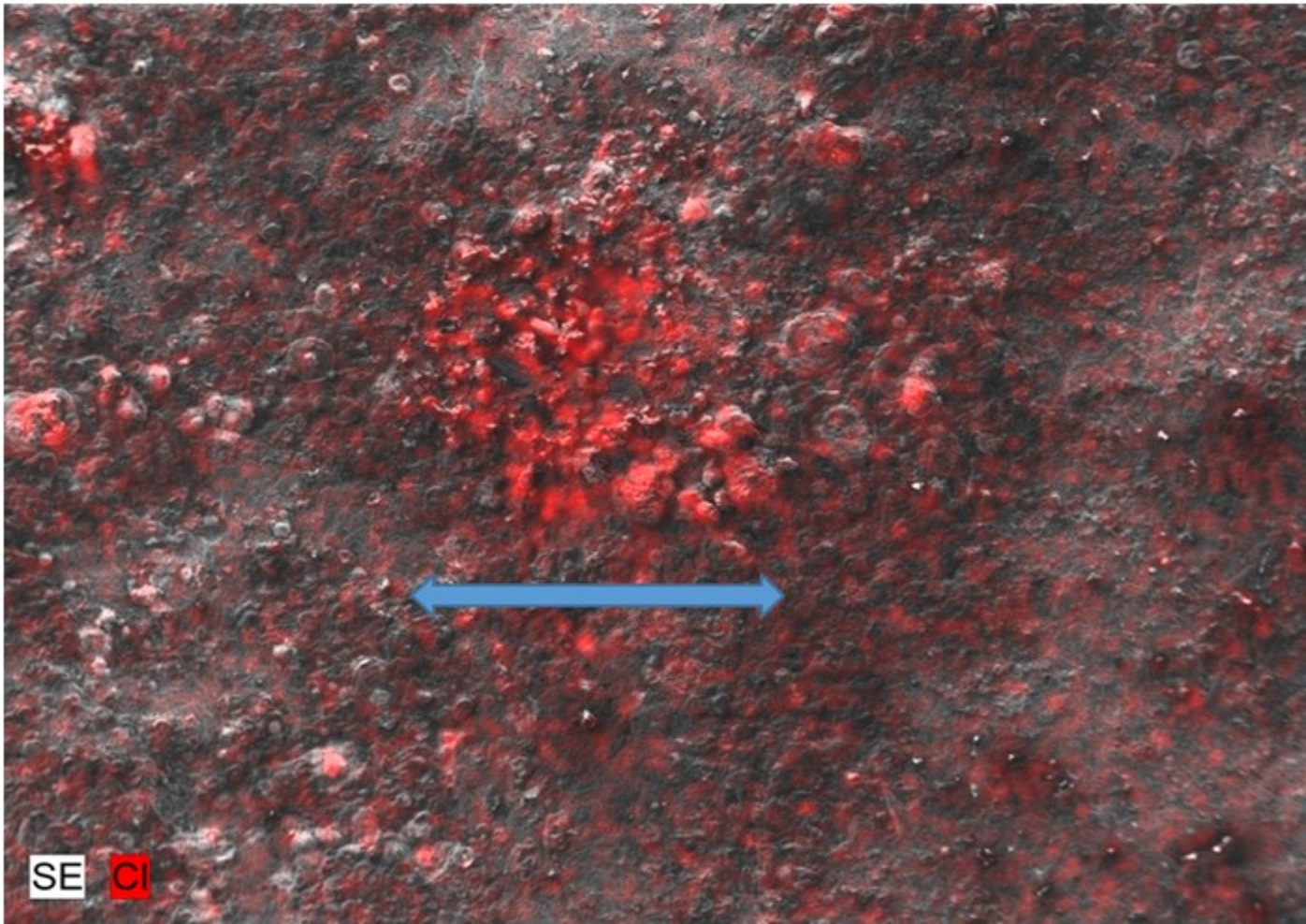
Chemical Steel Grit 40/50

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/cm^2



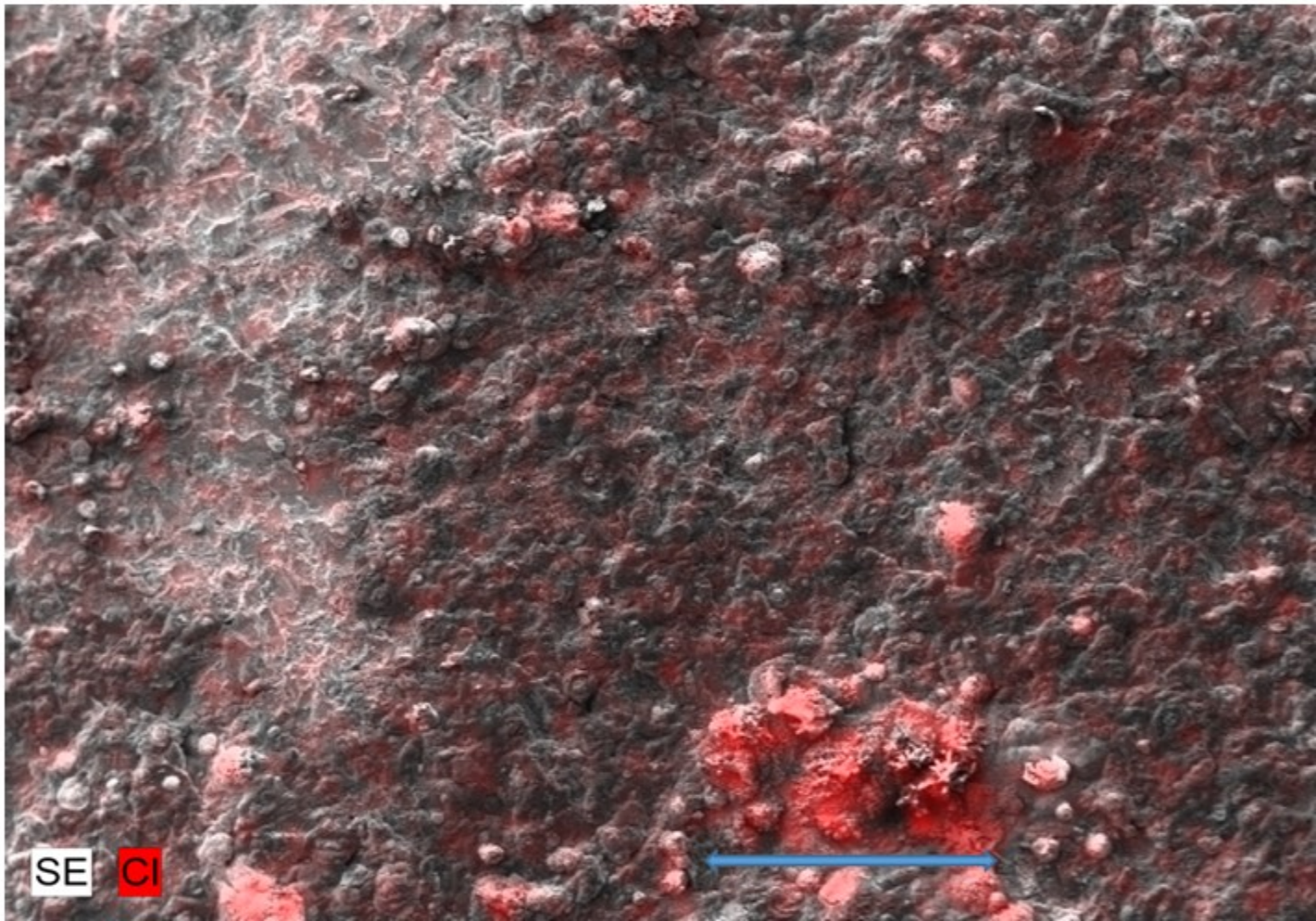
Chemical Mineral Slag

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/cm^2



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/cm^2



Estimated Equivalent Chloride Levels

551 µg/cm^2

1930 µg/cm^2

409 µg/cm^2

120 µg/cm^2

326 µg/cm^2

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/cm^2 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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