# Cleaning and Protecting Concrete – Surface Preparation, Application, and Inspection



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# Cleaning and Protecting Concrete – Surface Preparation, Application, and Inspection

#### **Topics of Discussion:**

- Cleaning *Methods of surface* preparation and associated standards
- Materials *Coatings and water* repellents used on concrete
- Inspection Verifying the quality of installation, including:
  - New SSPC guide for detecting moisture in concrete
  - New SSPC standard for inspecting and classifying pinholes in coatings



#### Underlying Theme

Problems with painting/sealing concrete have plagued the Building Industry for decades – Answers are Transferable







# Methods of Surface Preparation and Standards/Guides





# Industry Standards and Guides

- SSPC-SP13/NACE No. 6, Surface Preparation of Concrete
- SSPC-SP12/NACE No. 5, Surface Preparation and Cleaning of Metals by Water Jetting Prior to Recoating
- SSPC Dry Blast Cleaning Standards under development:
  - Very Thorough Blast Cleaning
  - Thorough Blast Cleaning
  - Brush Blast Cleaning
- ICRI Guideline No. 310.2, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays



# Industry Standards and Guides (con't)

- ASTM Standard Practices
  - ASTM D4258, Surface Cleaning Concrete for Coating
  - ASTM D4259, Abrading Concrete
  - ASTM D4260, Liquid and Gelled Acid Etching of Concrete
  - ASTM D4261, Surface Cleaning Concrete Masonry Units for Coating

# **Methods of Surface Preparation**

- Air/Detergent/Water Cleaning
  - Air Blast Cleaning
  - Water Cleaning (Low Pressure)
  - Detergent Cleaning
  - Water Jetting (High Pressure and Ultra-High Pressure)
- Chemical Cleaning
  - Acid Etching
  - Chemical Stripping
- Mechanical Cleaning
  - Power Tool Cleaning
  - Dry Abrasive Blast Cleaning
  - Wet Abrasive Blast Cleaning

# Methods of Surface Preparation (con't)

- Air Blast Cleaning, Water Cleaning, Steam Cleaning, Vacuum Cleaning
  - SSPC-SP13/NACE 6
  - ASTM D4258, ASTM D4261



#### Detergent Cleaning

- SSPC-SP13/NACE No. 6
- ICRI Guideline No. 310.2
- ASTM D4258, ASTM D4261



# Surface Preparation/Cleaning Methods in Standards/Guides

- Water Jetting
  - SSPC-SP13/NACE No. 6
  - ICRI Guideline No. 310.2
  - ASTM D4259



#### Acid Etching

- SSPC-SP13/NACE No. 6
- ICRI Guideline No. 310.2
- ASTM D4260



# Surface Preparation/Cleaning Methods in Standards/Guides (con't)

#### Chemical Stripping

 Effective method of paint removal, but not addressed in the standards/guides

#### • Power Tool Cleaning

- SSPC-SP13/NACE No. 6
- ICRI Guideline No. 310.2
- ASTM D4259





# **Surface Preparation/Cleaning Methods in Standards/Guides**

- Dry Abrasive Blast Cleaning
  - SSPC-SP13/NACE No. 6
  - ICRI Guideline No. 310.2
  - ASTM D4259
- SSPC Standards under development:
  - Very Thorough Blast Cleaning
  - Thorough Blast Cleaning
  - Brush Blast Cleaning





# Surface Preparation/Cleaning Methods in Standards/Guides

- Wet Abrasive Blast Cleaning
  - SSPC-SP13/NACE No. 6
  - ASTM D4259

# In 2005, SSPC/NACE published joint WAB standards for steel:

- SSPC-SP5 (WAB)
- SSPC-SP10 (WAB)
- SSPC-SP6 (WAB)
- SSPC-SP14 (WAB)
- SSPC-SP7 (WAB)





# Coatings, Water Repellents, Stains

#### **Coating Expectations**

#### • Coatings

- Enhance aesthetics and image
- Protect substrates from deterioration
- Minimize intrusion of moisture
- Bridge fine gaps or openings in concrete
- Remain intact







#### **Coating Material Selection**

- Organizations such as Green Seal and Master Painters Institute (MPI) identify performance criteria for various generic types of architectural coatings
- Society for Protective Coatings (SSPC) publishes standards for the performance of industrial coatings and some architectural coatings (e.g., Paint 46, Elastomeric, Water Based, High Build, Flat, Performance-Based Coating for Masonry and Concrete)







- MPI provides a list of approved products
- Over 230

   categories
   based on
   generic type,
   gloss, VOC

MPI#	Category Name
<u>1</u>	<u>Aluminum Paint</u>
<u>2</u>	Aluminum Paint, Heat Resistant (Up to 427°C - 800°F)
<u>3</u>	Primer, Alkali Resistant, Water Based
<u>3 X-</u> <u>Green</u>	Primer, Alkali Resistant, Water Based
<u>4</u>	Block Filler, Latex, Interior/Exterior
<u>4 X-</u> <u>Green™</u>	Block Filler, Latex, Interior/Exterior
<u>5</u>	Primer, Alkyd/Oil for Exterior Wood
<u>6</u>	Primer, Latex for Exterior Wood
<u>8</u>	Alkyd, Exterior Flat (MPI Gloss Level 1)
<u>9</u>	Alkyd, Exterior Gloss (MPI Gloss Level 6)
<u>10</u>	Latex, Exterior Flat (MPI Gloss Level 1)
<u>10 RR</u>	Latex, Recycled (Remanufactured), Exterior Flat (G1)
<u>10 RC</u>	Latex, Recycled (Consolidated), Exterior Flat (G1)
<u>11</u>	Latex, Exterior Semi-Gloss (MPI Gloss Level 5)
<u>11 RR</u>	Latex, Recycled (Remanufactured), Exterior Semi-Gloss (MPI Gloss Level 5)
<u>11 RC</u>	Latex, Recycled (Consolidated), Exterior Semi-Gloss (MPI Gloss Level 5)
<u>13</u>	Stain, Exterior, Solvent Based, Semi-Transparent

- Acrylic Block filler (MPI #4)
- Acrylic elastomeric (MPI #113)
- Alkali Resistant Water Based Primer (MPI #3)
- High-Performance Latex (MPI #311 and #315)
- Acrylic Texture Coat (MPI #42)
- Hydrophobic Paints (no MPI number)
- Silicone Resin Emulsion Paints (no MPI number)

#### • Acrylic Block filler (MPI #4):

- Block fillers are used to fill the porosity of the substrate.
- For exterior use, the block filler should not contain any polyvinyl acetate (PVA). PVA is water sensitive and could lead to blistering and disbonding if water becomes trapped beneath the film.



- Acrylic elastomeric (MPI #113):
  - Excellent barrier to bulk water, passing wind-driven rain tests
  - Good tensile strength/elongation
  - Tolerate some movement and fine cracking (~16 mils wide)
  - Lower permeance, can reduce ability of water vapor to escape



- Alkali Resistant Water Based Primer (MPI #3):
  - These primers are suitable for use on alkaline surfaces such as concrete and masonry and are used beneath latex or acrylic finish coats
- Latex Texture Coat (MPI #42):
  - These products contain an aggregate in order to create a textured finish on concrete surfaces such as pre-cast and tilt-up.

- High-Performance Latex (MPI #311 and #315):
  - Good weathering characteristics, lower wind-driven rain resistance than acrylic elastomerics, but potentially higher permeance
  - The difference in the product numbers is related to gloss (#311 is 35 to 70 units at 60°; #315 is a maximum of 35 units).



- Hydrophobic or "Lotus Effect" Paint (no MPI number):
  - Protect substrates by providing water repellency and resistance to soiling, mold and mildew.
  - High permeance allows vapor to escape.

• Silicone Resin Emulsion Paints (no MPI number):

- Provide excellent water repellent characteristics
- High permeance allows vapor to escape.
- An acrylic silane/siloxane sealer is often applied first on porous substrates.
- When using silicone coatings, the same type of material is frequently used for future overcoating

#### Epoxy/Urethane

- Excellent water resistance
- Urethane glossy, pleasing appearance
- Typically lower permeance

- Acrylic Block filler (MPI #4)
- Acrylic elastomeric (MPI #113)
- Alkali Resistant Water Based Primer (MPI #3)
- High-Performance Latex (MPI #311 and #315)
- Acrylic Texture Coat (MPI #42)
- Hydrophobic Paints (no MPI number)
- Silicone Resin Emulsion Paints (no MPI number)
- Epoxy/Urethane



# Water Repellents

#### Water Repellent Expectations

#### Water Repellents

- Enhance aesthetics and brand
- Protect substrate from deterioration
- Minimize intrusion of moisture
- Penetrate fine cracks to make surface hydrophobic



#### **Clear Water Repellents**

 Control moisture intrusion on above-grade vertical surfaces, such as integrally colored block, stone, concrete, terra cotta, brick or other unpainted material



#### **Clear Water Repellents**

- Paintable Water Repellent (MPI #34):
  - Clear water repellents (typically silane/siloxane) that penetrate into, and seal the surface of the concrete.
  - MPI indicates that the products on this list can be painted.
- Non-Paintable Water Repellent (MPI #117):
  - Clear water repellents (typically silane/siloxane) that penetrate into the surface of the concrete, causing it to be hydrophobic.
  - MPI indicates that the products on this list can not be painted and should only be used when the surface will be resealed with the same product in the future.

#### **Pigmented Water Repellent Stains**

- Pigmented Water Repellent Stains:
  - Stains are available as both solvent- and water-based. Chemistries vary.
- Mineral Water Repellent Stains:
  - Available in many colors, these stains are high-permeance potassium silicate materials that penetrate the surface to create a hard, insoluble silicate.
  - Good color retention.

#### Water Repellent Summary

- Paintable Water Repellent (MPI #34) silane/siloxane
- Non-Paintable Water Repellent (MPI #117) silane/siloxane
- Pigmented Water Repellent Stains
- Mineral Water Repellent Stains



# **Test Patches to Confirm Coating Appearance and Compatibility**

- Test patches of surface preparation, and coating work should be undertaken to:
  - Confirm the quality of surface preparation
  - Determine compatibility of coatings and water repellent
    - solvent borne repellent may not be compatible with a pre-existing water borne water repellent
  - Agree on appearance
    - Provide a visual and tactile representation of the specification requirements
  - Clearly establish the expectations of the work and resolve discrepancies before production work begins

#### **Benefit of Coating Test Patches**

- Establish the appearance of repairs
- Establish the degree of surface preparation required, e.g.,
  - Amount of paint to be removed
  - Extent of chalk to be removed
  - Roughening required or permitted
- Establish quality of paint application required, e.g.,
  - Coverage and continuity
  - Frequency of pinholes allowed







# **Coating Test Patches (con't)**







Quality of Installation

#### **Verifying Quality of Installation**

- Surface Preparation
- Ambient Conditions
- Moisture Content
- Material, Mixing, and Application
- Number of Coats and Thickness
- Dry Time and Cleanliness between Coats
- Continuity and Coverage

### **Inspection - Surface Preparation**









# **Inspection – Ambient Conditions**







#### **Inspection of Moisture Content**

- SSPC-Guide 23, Field Methods for the Determination of Moisture in Concrete and Masonry Walls and Ceilings, EIFS, and Stucco
  - Method 1 Plastic Sheet Method
  - Method 2 Electrical Impedance Moisture Meter
  - Method 3 Radio Frequency Moisture Meter
  - Method 4 Electrical Conductivity (Resistance) Moisture Meter
  - Method 5 Relative Humidity Probes

#### • Tables

- Table 1 Suggested Test Frequency of Walls Prior to Painting
- Table 2 Suitability of Test Methods/Probe Configurations on Various Substrate Types
- Table 3 Portion of Substrate Assessed and Reporting Units

# **Inspection - Moisture Content**









#### **Inspection - Moisture Content (con't)**









# SSPC-Guide 23

#### TABLE 1 SUGGESTED TEST FREQUENCY OF WALLS PRIOR TO PAINTING

Area Being Coated in a Given Day	Method 1 Plastic Sheet*	Method 2 Impedance	Method 3 Radio Frequency	Method 4 Conductivity	Method 5 RH**
≤ 10 m² (≤ 1000 ft²)	3 tests				
11 to 500 m <sup>2</sup> (1001 to 5000 ft <sup>2</sup> )	5 tests			Same as Method 1	
501 to 1000 m <sup>2</sup> (5001 to 10,000 ft <sup>2</sup> )	10 tests	Locate test zones every 7 to 10 m (25 to 35 ft) of wall, and test at 3 heights within each zone.			
>1000 m <sup>2</sup> (>10,000 ft <sup>2</sup> )	10 tests for first 1000 m <sup>2</sup> (10,000 ft <sup>2</sup> ) plus 1 test for each additional 175 m <sup>2</sup> (2,000 ft <sup>2</sup> )				

\* Test frequency differs from recommendations in ASTM D4263.

\*\* One probe in cavity and one probe in mortar joint in each location.

# SSPC-Guide 23 (con't)

5%.

TABLE 2 SUITABILITYOF TEST METHODS/PROBE CONFIGURATIONS ON VARIOUS SUBSTRATE TYPES

Substrate Types/ Textures	Method 1 Plastic Sheet	Method 2 Impedance	Method 3 Radio Frequency	Method 4 Conductivity*	Method 5 RH Probe
Poured Concrete/ Tilt up	Good	Good	Good	Good	Good
Precast - smooth	Good	Good	Good	Good	Good
Precast - textured	Marginal	Poor	Marginal	Good	Good
Smooth CMU	Good	Good	Good	Good	Good
Split-faced CMU	Marginal	Poor	Marginal	Good	Good
Grout (when surrounded by block)	Good	Poor	Good	Good	Good
EIFS, Stucco	Good	Good	Good	Good	Good
Painted Surfaces	Marginal	Marginal	Good	Good	Good

\* For detection of moisture below the surface, holes must be drilled in the substrate. See Section 4.4.1.

#### TABLE 3 PORTION OF SUBSTRATE ASSESSED AND REPORTING UNITS

Measurement Characteristics	Method 1 Plastic Sheet	Method 2 Impedance	Method 3 Radio Frequency	Method 4 Conductivity*	Method 5 Relative Humidity
Substrate Depth	Bulk	Top 25 mm (1 inch)	Top 19 mm (3/4 inch)	Surface*	Bulk
Reporting Units	None (visual)	% moisture (relative scale)	Relative Scale	Relative Scale	% of moisture Saturation

\* If nails are driven into the substrate, or holes are drilled to obtain subsurface readings, see Section 4.4.1.

# Inspection – Materials, Mixing, and Application









#### **Inspection – Number of Coats and Thickness**





#### Inspection – Number of Coats and Thickness (con't)

 Can measure film or estimate based on coverage rates and amount of product used





#### Inspection – Dry Time and Cleanliness between Coats



# **Inspection – Continuity and Coverage**







# SSPC-PA 18, Standard for Visual Evaluation of Pinholes in a Concrete or Masonry Coating (to be published by Dec 2017)

Classifies the pinholes based on frequency

Classification	Number of Pinholes per Evaluation Spot
None	0 pinholes
Low	1 to 10 pinholes
Moderate	11 to 20 pinholes
High	>20 pinholes

# SSPC-PA 18, Standard for Visual Evaluation of Pinholes in a Concrete or Masonry Coating

 Provides acceptance criteria based on service environment

Classification	Service Environment	
None	Interior atmospheric coatings applied to areas such as medical, food, drug, or pharmaceutic clean rooms, or areas frequently wet or washed down	
	Immersion coatings	
	Floor coatings	
Moderate or less	Atmospheric coatings applied to interior and exterior surfaces in general areas	

# SSPC-PA 18, Standard for Visual Evaluation of Pinholes in a Concrete or Masonry Coating

- Defines the size of each spot to be examined as approximately 1 sq ft (size of a block face), termed evaluation spot
- Defines the number of evaluation spots to be examined based on the size of area painted

Size of Area	Number of Evaluation Spots
<300 sq ft	1 spot for each 100 sq ft
300 sq ft to <1,000 sq ft	1 spot in 3 different 100 sq ft areas
>1,000 sq ft	1 spot in 3 different 100 sq ft areas in each 1,000 sq ft

 Describes a process for making additional evaluations around non-conforming areas to map out the extent of the deficiencies

#### **Summary**

- Surface Preparation
  - Standards (ASTM, SSPC, NACE, ICRI)
  - Water/detergent/pressure washing/water jetting
  - Chemical stripping, acid etching
  - Power tool, dry blast cleaning, wet blast cleaning
- Coatings for Concrete
  - Block fillers, latex, acrylic, acrylic elastomeric, hydrophobic, silicone resin emulsion paint, epoxy, urethane



# Summary (con't)

- Water Repellents for Concrete
  - Silane. siloxane, silane/siloxane blends, clear paintable (acrylic), pigmented stains (water-borne and solvent-borne), mineral (potassium silicate) stains



# Summary (con't)

- Verifying the quality of material installation
  - Surface Preparation
  - Ambient Conditions
  - Moisture Content (SSPC Guide 23)
  - Mixing and Application
  - Number of Coats and Thickness
  - Dry time and Cleanliness Between Coats
  - Continuity and Coverage (SSPC-PA 18)



# Summary (con't)

- Learn from the building industry
- Solutions are transferable





# **Questions?**



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