Maintaining Aesthetics – Coating Selection, Testing, and Repair

Kenneth A. Trimber
KTA-Tator, Inc.
Aesthetics Webinar
Objectives

- Identify laboratory and field tests used for the selection of coatings based on color and gloss stability
- Identify coatings that provide good color and gloss retention
- Identify challenges with coating application to achieve the desired aesthetics and the effects of weathering
- Identify problems with maintaining aesthetics during coating repair
Agenda

- Field/Laboratory Coating Selection Test Methods
- Coating Types
- Coating Application Challenges
- Effects of Weathering on Color, Gloss, Chalk
- Challenges with Coating Repair
Field and Laboratory Coating Selection Test Methods

A. Good – Accelerated weathering
   - Laboratory accelerated weathering
   - Outdoor accelerated weathering

B. Better – Outdoor natural exposure
   - South Florida natural weathering

C. Best – Real-world performance
Field and Laboratory Coating Selection Test Methods (con’t)

• Good – laboratory accelerated weathering
  – Xenon arc weatherometer/Ultra-violet light
    • ASTM G154, “Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials”
    • ASTM G155 “Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials”

  – ASTM D5894, Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
Field and Laboratory Coating Selection Test Methods (con’t)
Field and Laboratory Coating Selection Test Methods (con’t)

- Cyclic salt fog/UV accelerated weathering of 4 coating systems (alkyd primer/acrylic finish)
- 30 weeks – 1,200 hours (7 days cyclic salt fog/7 days QUV)
Field and Laboratory Coating Selection Test Methods (con’t)

• Good – outdoor accelerated weathering
  – Accelerated outdoor weathering
  – Mirrors are used to concentrate natural sunlight onto the coating. The samples are systematically wetted with deionized water
• Better – South Florida outdoor natural weathering
  – Coated panels exposed in South Florida, positioned at 45 degrees and facing south
  – American Architectural Manufacturer’s Association (AAMA) Addresses coating performance with specific emphasis on color and gloss retention
Field and Laboratory Coating Selection Test Methods (con’t)

• American Architectural Manufacturer’s Association (AAMA) Specifications:
  • 2603 – Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
    – 1 year South Florida exposure
  • 2604 – Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
    – 5 years South Florida exposure
  • 2605 – Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
    – 10 years South Florida exposure
Field and Laboratory Coating Selection Test Methods (con’t)

- Fluoropolymer coatings in South Florida exposure
  (Source: SSPC-TU 12, Ambient-Curing Fluoropolymer Finish Coats Applied to Metal Substrates)
Field and Laboratory Coating Selection Test Methods (con’t)

- Best – real-world performance
  - Long-term performance of the same or similar coating (generic type, baked, air dry) in similar gloss/color and in similar environments
  - Recognize that coating formulations change – verify that the comparisons are truly comparable products
## Coating Materials – AAMA

<table>
<thead>
<tr>
<th></th>
<th>AAMA 2603-02 (good)</th>
<th>AAMA 2604-05 (better)</th>
<th>AAMA 2605-05 (best)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>South Florida Exposure</strong></td>
<td>1 year</td>
<td>5 years</td>
<td>10 years</td>
</tr>
<tr>
<td><strong>Color Change (ASTM D2244)</strong></td>
<td>Slight fading</td>
<td>Max 5ΔE</td>
<td>Max 5ΔE</td>
</tr>
<tr>
<td><strong>Gloss Retention (ASTM D523)</strong></td>
<td>Slight fading</td>
<td>Min 30%</td>
<td>Min 50%</td>
</tr>
<tr>
<td><strong>Chalking (ASTM D4214)</strong></td>
<td>Slight</td>
<td>&lt;8</td>
<td>&lt;8 (colors)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;6 (whites)</td>
</tr>
<tr>
<td><strong>Typical Coatings that comply</strong></td>
<td>Baked enamel (polyesters, acrylics)</td>
<td>silicone-modified polyesters, 50% PVDF</td>
<td>70% PVDF</td>
</tr>
</tbody>
</table>

Note: PVDF stands for Polyvinylidene Fluoride.
## Coating Materials – Steel/Concrete

<table>
<thead>
<tr>
<th>Interior Steel</th>
<th>Exterior Steel</th>
<th>Galvanize</th>
<th>Standing Seam, Pre-finished metal</th>
<th>Concrete</th>
<th>Integral Colored Masonry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkyd</td>
<td>Alkyd</td>
<td>Acrylic</td>
<td>Baked PVDF</td>
<td>Acrylic</td>
<td>Silicons</td>
</tr>
<tr>
<td>Acrylic</td>
<td>Acrylic</td>
<td>Polyurethane</td>
<td></td>
<td>Latex</td>
<td>Silicone resins</td>
</tr>
<tr>
<td>Latex</td>
<td>Polyurethane</td>
<td>Polysiloxane</td>
<td></td>
<td>Polyurethane</td>
<td>Silanes</td>
</tr>
<tr>
<td>Latex/Alkyd dry fall</td>
<td>Polysiloxane</td>
<td>Polyaspartic</td>
<td></td>
<td>Stains (water and solvent based)</td>
<td>Siloxanes</td>
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<td></td>
<td>Polyaspartic</td>
<td>Fluoropolymer (PVDF, FEVE)</td>
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<td>Acrylics</td>
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Coating Application/Repair Challenges

- Appearance of new application
- Appearance after weathering
- Appearance of touch up
Quality of Application

- Quality of application – surface preparation, coverage, shadow-through, runs, sags, overlap of passes
- Weather conditions during application and curing
Quality of Application (con’t)

- Feathering
Quality of Application (con’t)

- Extensive power tool cleaning leaves many edges
Quality of Application (con’t)

- Overly aggressive blast cleaning
Quality of Application (con’t)

- Brush, roll, spray
- Runs, sags, pinholes, overspray
Quality of Application (con’t)

- Visible drops
Quality of Application (con’t)

• Effect of ambient conditions
  • Temperature/humidity restrictions often ignored
    – Can be too hot or cold for proper film formation/curing
    – Relative humidity can be too high for proper curing
  • Surface temperature should be at least 5°F greater than the dew point – condensation (not always visible) can oxidize freshly prepared metal, and impair film formation, curing, and adhesion
  • Acceptance criteria is found in the specification and manufacturer’s product data sheets
Quality of Initial Application (con’t)

- Exposure to moisture (dew) during drying
Appearance after Weathering

- Change in color
- Change in gloss
- Chalking
Changes in Color
Color Measurement
CIE L*a*b* Color Scale

- International Commission on Illumination (CIE)
- Measures color on 3-dimensional coordinate:
  - L* lightness/darkness
  - a* green/red
  - b* blue/yellow
Color Measurement
CIE L*a*b* Color Scale (con’t)

- $\Delta L^*, \Delta a^*, \Delta b^* -$ the difference between a standard and a sample or between samples
- During formulation, if $\Delta a^*$ is out of tolerance, adjustments are made (if $\Delta a^*$ is positive, the sample is more red than the standard or the sample being matched
Color Measurement
CIE L*a*b* Color Scale (con’t)

- $\Delta E^*$ – total color difference in a single value (sum of the squares of $L^*$, $a^*$, $b^*$)
- If $\Delta E^*$ is out of tolerance, you do not know which value(s) are responsible ($L^*$, $a^*$ and/or $b^*$) unless you review the individual values
Color Change

• Color change discernible to the naked eye:
  – Typically $\geq 3\Delta E$ for light colors
  – Typically $\geq 2\Delta E$ for dark colors
Color Change (con’t)

• Color card from paint store:
  – Darkest to lightest $\sim 17\Delta E$
  – Darkest to middle $\sim 9\Delta E$
Color Change (con’t)

- When deciding on an allowable $\Delta E^*$, need to recognize the possible range of appearance that could result.
Assessing Changes in Color

- Specially designed fade charts
Assessing Changes in Color

- Instrumentation—measure specific locations initially and periodically during exposure
- ASTM D2244, Calculation of Color Tolerances and Color Differences from Measured Color Coordinates
Case Study
5 Professional Stadiums

- 5 stadiums 7 to 16 years old (4 polyurethane; 1 acrylic)
- Painted structural steel surfaces:
  - 10 to 20% exhibited $\Delta E^* > 5$
  - 60 to 70% exhibited $\Delta E^* 2$ to $5$
  - 20% exhibited $\Delta E^* <2$
    (in indoor and well-sheltered areas)

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- Most fading was uniform and not noticeable unless non-faded areas could be seen at the same time
  - Challenge is getting touch up to match the current color
Changes in Gloss
Gloss

- The shine or luster of a surface
- Measured at standard angles:
  - 85 degrees for low sheen finishes
  - 60 degrees – most common for architectural coatings
  - 20 degrees – for high gloss such as automotive

- D523 - Standard Test Method for Specular Gloss
Gloss (con’t)

- Results are in gloss units
- MPI (Master Painter’s Institute) levels @ 60°
  - Flat max 5 units
  - Velvet-like max 10 units
  - Eggshell-like 10 to 25 units
  - Satin-like 20 to 35 units
  - Semi-gloss 35 to 70 units
  - Gloss 70 to 85 units
  - High gloss >85 units
Gloss

- Measure specific areas at time of installation and repeat over time to track changes
Chalking

- Formation of loose powder on the surface generally caused by degradation of the binder, causing release of surface pigment
Chalking
Chalking
Effect of Coating Performance on Aesthetics
Appearance of Touch up

- Poor match of current color
- Poor match of current gloss or texture
- Not squaring up, patchwork appearance
- Effect of application methods
  - Texture of brush touch-up on sprayed surface
  - Perimeter of overspray surrounding spray touch-up
Appearance of Touch up (con’t)

- Color match can be difficult to achieve, especially when the original coating has weathered
Appearance of Touch up (con’t)

- Change in color of touch-up coating in service
- Wrong product used
Appearance of Touch up (con’t)

- Poor match of gloss and texture
- Brush or roller touchup on sprayed component will be visible
- Overspray surrounding sprayed TU patches makes TU stand out
Appearance of Touch up (con’t)

- Poor squaring up
- Bottoms required sporadic touch up – could have painted all surfaces up to 5’ on all columns
Appearance of Touch up (con’t)

- Mismatched color in localized touch up of peeling coating
- Patchwork appearance readily apparent when seen from a distance
Appearance of Touch up (con’t)

- Removal of efflorescence and staining with soda blast effected color of integrally colored block
Appearance of Touch up (con’t)

- Poor color match of stain
- If the contrast in color is acceptable, should stain entire bricks, not partial
- If not acceptable, stain to logical break points
Summary

- **Identify laboratory and field tests used for selection**
  - Field exposure, outdoor accelerated weathering, laboratory accelerated
  - AAMA standards tie into S. Florida exposure
    - 2603 – Good – 1 year
    - 2604 – High Performance – 5 years
    - 2605 – Superior – 10 years

- **Identify coatings that provide good color and gloss retention**
  - Fluoropolymers (PVDF, FEVE), Polysiloxane, Polyaspartic, Polyurethane, Acrylic

- **Identify challenges with application to achieve aesthetics**
  - Surface preparation (especially overcoating - feathering)
  - Weather during application/drying creating mottled appearance
  - Application methods – brush, roll, spray
  - Runs, sags, drips, pinholes, overspray, overlap
Summary (con’t)

- Challenges with weathering
  - Changes in color, gloss, chalking difficult to match
- Identify problems with maintaining aesthetics during repair
  - Poor match of color, gloss or texture
  - Not squaring up, patchwork appearance
  - Non-uniformity due to methods of touch-up (brush touch up on sprayed surface, mist of overspray surrounding spray touchup)
Questions?

Ken Trimber – 412-788-1300, x204
(ktrimber@kta.com)