Protecting Power Plant Assets

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Protection for all types of Power Plants
Learning Objectives

- Maintenance Coatings / Programs
- Corrosion – Brief Overview
- Surface Preparation – Brief Overview
- Protection Mechanism
- Life Cycle Costs
- Choosing the Correct Coating
- Working with a Qualified Contractor
Something to Think About!

• When it comes to maintenance, are we....

• Proactive?
  or
• Reactive?
Do you have a maintenance program?

- When we think of maintenance we should be thinking **Safety First!**
- Extending the Life of the Asset.
- Minimize unexpected shutdowns.
- Keep plant up to date to help eliminate high repair costs.
- Reduce Owners Insurance rates.
Corrosion defined by NACE

The deterioration of a substance, (usually metal), or its properties, because of a reaction with its environment.
Surface Preparation
Affects on System Selection

• When specifying surface cleanliness it should be noted that surface profile is as important.

• Surface profile promotes mechanical bond of the coating/lining system to the substrate.

  Steel (This is commonly specified in mils)
  Concrete (This is commonly specified as a CSP (1-9) “Concrete Surface Profile”)

Protective & Marine Coatings
Surface Preparation
Affects on System Selection

The greater the DFT the greater the Surface Profile
Surface Preparation Standards

SSPC = The Society of Protective Coatings

SSPC-SP 1  Solvent Cleaning
SSPC-SP 2  Hand Tool Cleaning
SSPC-SP 3  Power Tool Cleaning
SSPC-SP 5  White Metal Blast Cleaning
SSPC-SP 6  Commercial Blast Cleaning
SSPC-SP 10 Near-White Blast Cleaning
SSPC-SP 11 Power Tool Cleaning to Bare Metal
SSPC-SP 16 Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals

International Concrete Repair Institute (ICRI)
Guideline No. 310.2, “Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays”
Concrete Surface Preparation

International Concrete Repair Institute

Surface Profile Coupons

For more information visit icri.org
Life Cycle Costs

• Are we looking at short-term or long-term?
• NACE, National Association of Corrosion Engineers has a periodic paper that is updated for your review.
Expected Service Life and Cost Considerations for Maintenance and New Construction Protective Coating Work

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### Estimated Service Life

**Table 1A: Estimated Service Life for Practical Maintenance Coating Systems for Atmospheric Exposure**

*(in years before first maintenance painting)*

<table>
<thead>
<tr>
<th>Type</th>
<th>Coating Systems for Atmospheric Exposure (primer/midcoat/topcoat)</th>
<th>Surface Preparation</th>
<th>Number of Coats</th>
<th>DFT Minimum (mil/s)</th>
<th>Service Life①③</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylic</td>
<td>Acrylic Waterborne/Acrylic WB/Acrylic WB</td>
<td>Hand/Power</td>
<td>3</td>
<td>6</td>
<td>12   8  5  5</td>
</tr>
<tr>
<td>Acrylic</td>
<td>Acrylic Waterborne/Acrylic WB/Acrylic WB</td>
<td>Blast</td>
<td>3</td>
<td>6</td>
<td>17   12 9  9</td>
</tr>
<tr>
<td>Alkyd</td>
<td>Alkyd/Alkyd</td>
<td>Hand/Power</td>
<td>2</td>
<td>4</td>
<td>6    3  2  2</td>
</tr>
<tr>
<td>Alkyd</td>
<td>Alkyd/Alkyd/Alkyd (AWWA OCS-1C)</td>
<td>Blast</td>
<td>3</td>
<td>6</td>
<td>11   6  3  3</td>
</tr>
<tr>
<td>Alkyd</td>
<td>Alkyd/Alkyd/Urethane Alkyd</td>
<td>Blast</td>
<td>3</td>
<td>6</td>
<td>12   7  4  4</td>
</tr>
<tr>
<td>Alkyd</td>
<td>Alkyd/Alkyd/Silicone Alkyd (AWWA OCS-1D)</td>
<td>Blast</td>
<td>3</td>
<td>6</td>
<td>14   9  5  5</td>
</tr>
<tr>
<td>Epoxy</td>
<td>Surface Tolerant Epoxy (STE)</td>
<td>Hand/Power</td>
<td>1</td>
<td>5</td>
<td>12   8  5  5</td>
</tr>
<tr>
<td>Epoxy</td>
<td>Surface Tolerant Epoxy/STE</td>
<td>Hand/Power</td>
<td>2</td>
<td>10</td>
<td>17   12 9  9</td>
</tr>
<tr>
<td>Epoxy</td>
<td>Surface Tolerant Epoxy/STE</td>
<td>Blast</td>
<td>2</td>
<td>10</td>
<td>21   15 12 12</td>
</tr>
<tr>
<td>Epoxy</td>
<td>Surface Tolerant Epoxy/Polyurethane</td>
<td>Hand/Power</td>
<td>2</td>
<td>7</td>
<td>17   11 6  6</td>
</tr>
</tbody>
</table>
Coating System Selection

- System selection for coatings/linings is not as simple as providing a coating that will resist a given commodity and exposure.
- System selection **must** consider a multitude of factors for a successful application.
Coating System Data Sheet (CSDS)

Substrate
• Concrete / Steel / Aluminum
• Surface Preparation Limitations

Service Environment
Atmospheric (int./ext.),
Buried, Immersion, Containment (BIC)
Elevated Temperatures and Under Insulation
Abrasion, Impact, High Traffic
Type of Traffic (Foot, Cart or Vehicular)
Joints, Cracks, Vapor Barriers, etc.
Primary or Secondary Containment (chemicals)

Application Conditions
Maintenance / New Construction / Fabrication
Schedule Requirements / Return To Service
Environmental Conditions
Exposure to adjacent work or operations (safety)
Protection Mechanisms of Coatings

• **Barrier Protection**
  The coating/lining *isolates* the electrolyte from the anode, cathode, and metallic pathway. Film reinforcement, with glass flakes or Micaceous Iron Oxide provides additional protection.

• **Rust Inhibitive**
  The slightly water-soluble pigments *permeate* to steel/coating interface and *passivate* the substrate.

• **Sacrificial**
  The coating/lining contains *pigments* that are more active than the metal and *sacrifice themselves* to protect the substrate.
Zinc Rich Coatings

- Atmospheric and Immersion Service
- Poor Resistance to Alkali and Acidic Environments
- Excellent Corrosion Protection
- Some Formulations – Shop Applications Only
Hot Dip Galvanized

*Need Protective Coating?*

- Recommended pH range: 5 to 10

- If colors are required, or pH exposure is outside of 5 to 10, a coating, or coating system applied to the galvanizing is recommended

- *Called a Duplex System*
Resin does not contain carbon - usually silicates

Advantages:
+ Performance Similar to Galvanizing
+ Meets Class B Slip Coefficient and Creep Resistance, .52
+ High Heat Resistance
+ Low Temperature Application
+ “Self-Healing” properties

Sacrificial / Galvanic Protection

Limitations:
- Spray Application Only
- Require moisture to cure
- Mud Cracking at high DFT
Organic Zinc Coatings (OZ)

Resin contains carbon:
- Epoxy, Polyurethane, Polystyrene

Advantages:
- + Class B Slip Formulations
- + Tolerates Less Stringent Surface Preparation
- + Used to Touch-up Inorganic Zinc (IOZ)

Limitations:
- - Resin Chemistry (e.g., < 250°F)
Flaked Filled Epoxy Coatings (EPF)

- Typical Epoxy Fillers
  MIO, Graphite, Glass, Mica, Zinc, Sand, Alum Ox
- Reduce permeability (Buried, Immersion, Containment)
- Increased abrasion resistance & impact resistance
- Reinforces coating tensile & flexural strength
- Improved Structural Edge Retention / Protection
- Increased heat resistance
- Corrosion resistance (zinc)
Flake Filled Pigments Improve Performance

- Micaceous Iron Oxide
- Glass Flake
- Red Iron Oxide
- Zinc Dust
Edge Retentive (ER) Epoxy Technology

45% Retention

15 mils = 7 mils on edge

70% Retention

15 mils = 11 mils on edge
US Navy Study:

Standard Epoxy @36 months

High-Build ER Epoxy @36 months
Epoxy Coatings

Advantages:
+ Excellent alkali, solvent and water resistance
+ Good abrasion resistance
+ Good acid resistance
+ Good exterior durability but may chalk and yellow
+ High film build possible
+ Low temperature application available
+ Dry heat resistance to 250° F
Coal Tar Enamel / Epoxy

History: (very brief) N. America
- It was originally formulated in the 1930’s. Contained coal tar pitch, mineral fibers and plasticizers to prevent cracking at low temps and sagging at high temps.
- Long Service Life if temps are consistent.
- Began extensive use at the Hoover Dam 1930’s
- Estimated replacement was 50-100 years

Data taken from research report Reclamation Managing Water in the West
Coal Tar Enamel / Epoxy

History: (very brief) N. America
- 1949 manufacturers provided epoxy coatings, however inadequate until 1959.
- 1984 Journal of Toxicology found components contribute to health hazards.

Fast Forward >>>

Data taken from research report Reclamation Managing Water in the West
Coal Tar Epoxy

Advantages:
- Inexpensive
- May be applied to existing coal tar in sound condition. Caution, testing should be done to ensure proper adhesion. Typically not recommended.

Disadvantages:
- Not as durable as today’s epoxies
- Requires a Blast Cleaned surface for proper adhesion.
- Turns brown when exposed to UV.
Coal Tar Epoxy

Current Formulations:

- Polyamide Coal Tar: COE Formula C-200a
  8.0 – 16.0 mils per coat / 50°F - 100°F

- High-Build Polyamide Coal Tar
  16.0 – 24.0 mils in 1 ct / 50°F - 120°F

- Moisture Cure Coal Tar
  5.0 – 7.0 mils per coat / 20°F - 100°F
Coal Tar Epoxy

Alternative Coatings:
- Non-Coal Tar Epoxy (Multiple Technologies)

Advantages:
- Surface Tolerant
- Low Temp – down to 0°F
- High Abrasion Resistant
- Brush & Roll Applications
- Plural Component Applications
Alternative Coal Tar / Vinyl Coatings

- Polysiloxane

- Properties of an Epoxy & Polyurethane
- Testing by the Bureau of Reclamation
- Isocyanate Free Coating
- VOC – 100 g/L
- Applications for both atmospheric & (immersion) testing past 3 years with excellent results
- DTM Direct-to-Metal or over Zinc
**Alternative Coal Tar / Vinyl Coatings**

- **Polysiloxane**
  - LT low temp option coming out by EOY.
  - Perfect for applications that are partially immersed. Color retention above the water-line.
  - Extensive testing is being done by the Bureau of Reclamation in Denver with positive results.
Sher-Loxane™ 800

High-Performance Polysiloxane

*Sher-Loxane™ 800* is a versatile, high-performance coating designed for long-term protection in highly corrosive environments. This advanced polysiloxane system delivers a high-gloss finish to bridges, water tanks, structural steel, and much more in just two coats, reducing total operational costs for a better bottom line.
Selecting a Qualified Coating Contractor

- Check the Contractors History.
- Should have a minimum 5 years of experience
- Their applicators should have the same.
- Provide a minimum of 3-5 case histories with similar projects and applications.
- Must have contact information for you to verify.
- Check their Safety Records.
- Get a written letter of approval from Coatings Supplier.
Corrosion & Coating Challenges for Power Plants - Review

Maintenance Program

- Safety
- Coating System that is easily maintained
- Wide Range of Environmental Conditions
- Rapid Return to Service
- Preparation & Application Limitations
- Environmental Impact
Corrosion & Maintenance Program for Owner Benefits - Review

- Safety & Accident Prevention
- Asset Protection for the life of the Asset
- Minimize costly shutdowns
- Minimize unexpected shut downs
- Lower Insurance Rates
Corrosion & Coating Challenges for Power Plants - Review

Maintenance Program

- Defining the Corrosion Environment
- Life Cycle of the Protective Coating
- Surface Preparation
- Application Equipment
- Application Conditions
- Contractor Knowledge & Experience
- Quality Control Program
How do I Determine the appropriate Coating or Lining?

- Protective Coating Company’s Resources
- Contact your favorite local Coatings Technical Expert
- Chemical Resistant Guides if Required
- Internal Audit Forms to collect project information
  - Concrete Tank Lining
  - Steel Tank Lining
  - Secondary Containment
  - Floor Coatings
  - Etc.
Please talk with me this evening!

Thank You!!

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