Corrosion Protection with Polymer Liners/Coatings

Presented by Aaron Hoffman
Lewis Concrete Restoration
Discussion Topics

• Functional Polymer Liner/Coatings
• Why use Polymer Liners/Coatings?
• Types of Coatings/Lining Systems
• Comparison
• Summary
Functional – The look of a long-service life 😊
Definition of Protective Coatings or Linings

• By the corrosion protection industry's definition (NACE); a coating is a material that is applied up to 0.125 inches (<125 mils) in thickness that develops an adhesive bond with surface of the material to be protected. When a material has been applied to a thickness of more than 0.125 inches (>125 mils) it is designated to be a liner; whether it is in a bonded or an un-bonded condition.
Rule of Thumb

- **Protective Coating** =
  - Applied at approximately 1.0 – 125.0 mils dft.
  - Designed to create a mechanical or chemical bond (adhesion) to the substrate.

- **Protective Lining** =
  - Applied at 125.0 – 500.0+ mils dft.
  - Can be bonded or un-bonded

FYI - Some say “Coating on the exterior and Lining on the internal”
Why are Polymer Liners/Coatings Used?

- Functional Protective Barriers
  - Chemical Resistance
  - Abrasion Resistance
  - Impact Resistance
  - High velocity water resistance

- Infiltration Control
  - Seal and protect manhole structure from infiltration from groundwater

- Visual anniversary inspections
Polymer chemistry for the protection of Manholes

- Epoxies
  - Hi-Build reinforced Epoxy (80-250+ mils)
  - Thin Film (20-60 mils)
- Polyurethanes
  - Elastomeric (80-300+ mils)
  - Moisture Curing Thin-Film (10-30 mils)
- Polyurea (80-300+ mils)
  - Pure
  - Hybrid
Epoxy (Thin Film)

Pro
• Long established coating with excellent performance properties to protect structures in industrial environments.
• Thin-film systems applied at 20.0 - 60.0 mils dft.
• Long pot life and can be applied by single leg, conventional airless equipment.

Cons
• Physical properties at the low end of what is normally required for the rehabilitation of degraded manhole structures.
• Multiple coats to meet higher film build requirements
• Can be sensitive to moisture and temperature during application
• Long return to service in wastewater immersion (>24 hours)
• Beware of the applicator!
  • Training, lack of surface preparation knowledge, and use of safety equipment (PPE)
Epoxy (High-Build Reinforced)

**Pro**
- Excellent Chemical Resistance
- Strong Physical Properties
  - Resistant to hydrostatic pressure due to groundwater
- Application to wet (SSD) concrete
- Good/Excellent adhesion (bond) to the host structure
- Fast return to wastewater service (2-24 hours)
- Typically, trained “Certified Applicators”

**Con**
- Rigid (Elongation 2%-10%)
- Expert/trained applicators a must!
Elastomeric Polyurethane

**Pro**
- Chemical Resistant
- Flexible and crack bridging (40%-100%)
- Fast cure
- High-Build (30-250+ mils)

**Con**
- Sensitive to Moisture
- Fair to good adhesion (bond) to the host structure
  - Primer are recommended for underground structures
Moisture Curing Polyurethane

**Pro**
- Single component
- Apply by hand tools or spray methods
- Can be applied at 99% RH

**Con**
- Very thin-film (10-20 mils)
- Substrate must be visibly dry
- Not for rehabilitation
- Coal-Tar
Polyurea – “Pure”

**Pro**
- Rapid Setting (Tack free 10-30 seconds)
- Flexible and crack bridging (100%-500% tensile elongation)
- Fast return to service
- High-Build (60-500+ mils)
- Good Chemical Resistance
- Can be applied at any ambient temperature (-20°F to 200°F+)

**Con**
- Fair/Good adhesion to primed concrete
- Sensitive to moisture during application
Polyurea - Hybrid

**Pro**
- Rapid Setting (Tack free 10-30 seconds)
- Flexible and crack bridging (100%-400+% tensile elongation)
- Fast return to service
- High-Build (60-300+ mils)
- Good Chemical Resistance
- Slower cure allows air to escape and reduce pinholes in the film
- Good adhesion to primed concrete

**Con**
- Fair/Good adhesion to primed concrete
- Sensitive to moisture during application
## Generic Product Comparison

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Epoxy (Thin-Film)</th>
<th>Polyurea</th>
<th>Polyurethane</th>
<th>Hi-Build Epoxy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhesion to Dry Concrete</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Excellent</td>
</tr>
<tr>
<td>Moisture Filled</td>
<td>Not recommended</td>
<td>Good (w/Primer)</td>
<td>Good (w/Primer)</td>
<td>Excellent</td>
</tr>
<tr>
<td>Wet (SSD)</td>
<td>Not Recommended</td>
<td>Not recommended</td>
<td>Not recommended</td>
<td>Excellent</td>
</tr>
<tr>
<td>Tensile Strength (ASTM D638)</td>
<td>Up to 7,000 psi</td>
<td>2,000-3,500 psi</td>
<td>(Flex)2,000-3,000 psi (Rigid) &gt;7,000 psi</td>
<td>5,000-8,000 psi</td>
</tr>
<tr>
<td>Tensile Elongation (ASTM D638)</td>
<td>4%-10%</td>
<td>75%-400%</td>
<td>5%-100%</td>
<td>2%-5%</td>
</tr>
<tr>
<td>Chemical Resistance 20% Sulfuric Acid</td>
<td>Poor/Fair</td>
<td>Good</td>
<td>Good</td>
<td>Excellent</td>
</tr>
<tr>
<td>Max mils per coat</td>
<td>Up to 50 mils dft.</td>
<td>300+ mils</td>
<td>300+ mils</td>
<td>Up to 250+ mils</td>
</tr>
</tbody>
</table>
However, Choose your Polymer Liner/Coating Wisely

Correct product selection, installation and Inspection can help prevent:

- Polymer coating or liner dis-bonding
- Aggressive corrosion after the failure
- Pinholes & thin coating
- Ground water infiltration issues
• Polymer Coatings/Liners are protective, functional, barriers against microbial induced corrosion (MIC), abrasion, erosion, and ground water intrusion.

• Polymer Coating/Liners are typically:
  • Epoxy / Fiber-reinforced Hi-Build Epoxy
  • Polyurethane
  • Polyurea

• And...Choose your polymer liner/coating wisely!
  • Know the conditions of sewer collection structures

• Trained/Certified/Approved Applicators a PLUS
• QA/QC Inspections / Third-Party Testing
Thank You