New Options for Coating Water and Wastewater Treatment Plants

Learning Objectives

• Explain why wastewater flows have become more aggressive
• Explain how Microbiologically Induced Corrosion (MIC) accelerates deterioration
• Describe the different types of linings used for water and wastewater immersion
• Explain why and how inflow and infiltration (I&I) must be addressed
• Describe the different approaches to resurfacing
• Explain the advantage of using optically activated pigments (OAP) for holiday detection
• Identify coatings for anti-fouling and secondary containment
• Identify coatings appropriate for the exterior or water and wastewater treatment plant structures

New Lining Systems for Wastewater Structures

• Glass Flake Reinforced Amine Epoxy
• 100% Solids Epoxy Lining / Mortar
• 100% Solids Semi-Structural Epoxy
• 100% Solids Polyurethane Elastomer
• Fast Cure Polyurea Elastomer
Prior to the Clean Water Act of 1972, H$_2$S concentrations were below 10 ppm in most municipal systems. The result was very gradual acid attack to concrete and metals. As a result, thin film systems (<25m) such as coal tar epoxy provided effective protection for 10-15 years.

Following the amendment of the Clean Water Act of 1980, industrial pretreatment of wastewater affluent to eliminate or reduce the presence of heavy metals (lead, mercury, cadmium) was mandated. Prior to 1980, these metals killed or retarded the growth of bacteria. Consequently, H$_2$S has risen to levels as high as several hundred ppm, averaging over 30 ppm in collection piping, manholes and tanks. H$_2$SO$_4$ concentrations have risen from solutions of 1.5% to as high as 7%, resulting in pH ranges found to be as low as 1.5-2.5, and often less than 1.0 ! add decreased inflow/infiltration
Coating systems that served well prior to 1980, like coal tar epoxy, now often fail in months, not years!

Microbial H₂SO₄ generation attacks steel, concrete, and ductile iron.
Controlling Corrosion

1. Change design parameters.
   (Minimize slow flow or stagnant conditions in treatment stream)
2. Different materials of construction.
   (Use of vitrified clay, ductile iron, plastics, anti-microbial concrete)
   (Raise pH above 9 temporarily to kill SRB; sulfate reducing bacteria)
4. Installation of barrier coatings!

Add Flake Fill

All coatings are semi-permeable.
Crystals of MIO are fractured into thin flakes.

Types of Flake Reinforcement

- Glass
- Micaceous Iron Oxide (MIO)
- Graphite
  (resistance to halogenated acids)
Glass Flake Reinforced Amine Epoxy

- Upgrade to coal tar epoxy
- Corrosion, impact, and abrasion resistant
- Direct to metal application
- Maybe applied to a surface saturated dry (SSD) concrete
- Up to 20 mils dry in a single coat
- Enhanced performance and edge protection

Edge Retentive

- >70% Edge Retention

100% Solids Epoxy Lining / Mortar

- Amine cured
- Chemical Resistant
- Resistant to hydrogen sulfide gas, carbon dioxide gas, and microbiologically induced corrosion, and sulfuric acid attack
- High build capabilities – Up to 60 (even 250) mils DFT in one coat
- 125 - 250 mil mortar system
- Maybe applied to a surface saturated dry (SSD) substrate
100% Solids Epoxy Lining

- 100% Solids, Amine Cured, High Strength Epoxy capable of being applied >125 Mils DFT in a single coat.
- Maybe applied to a surface saturated dry (SSD) substrate.
- Extremely high physical performance characteristics for use as a structural liner in industrial and municipal wastewater environments.

High Strength Corrosion Protection Lining

- 100% Solids, Amine Cured, High Strength Epoxy capable of being applied >125 Mils DFT in a single coat.
- Maybe applied to a surface saturated dry (SSD) substrate.
- Extremely high physical performance characteristics for use as a structural liner in industrial and municipal wastewater environments.
100% Solids Polyurethane Elastomer

- Aromatic polyurethane
- High film build capabilities (> 250 mils)
- Flexible - capable of bridging a 1/8” crack
- Chemical, abrasion, and impact resistant
- Quick setting – short downtime
- Monolithic vertical & overhead application
- Primer required for application to concrete and application to a surface saturated dry (SSD) substrate

Accidentally Dropped Pipe

Polyurethane elastomer is well adhered!
100% Solids Polyurethane Elastomer

- 100% Solids Aromatic Polyurea capable of being applied up to 250 Mils DFT
- Fast set and cure - short downtime
- Seamless, flexible and waterproof
- Chemical resistant, impact, tear, and abrasion resistant
- Bridges moving cracks to 1/8"
- Retains physical properties at -20°F to 250°F
- Primer required for application to concrete and application to a surface saturated dry (SSD) substrate

Fast Cure Polyurea Elastomer

- 100% Solids Aromatic Polyurea capable of being applied up to 250 Mils DFT
- Fast set and cure - short downtime
- Seamless, flexible and waterproof
- Chemical resistant, impact, tear, and abrasion resistant
- Bridges moving cracks to 1/8"
- Retains physical properties at -20°F to 250°F
- Primer required for application to concrete and application to a surface saturated dry (SSD) substrate
Two 60 mil cross-coats

Chimney Seal
Brush Grade Polyurea

- 100% Solids, Aromatic, Pure Polyurea, Capable of being applied up to 250 MILs DFT in a single coat.
- The product offers a flexible liner capable of bridging a 1/8" crack. It will withstand severe traffic loading and is packaged in a side by side plural component cartridges for pneumatic application.
- Primer required for application to concrete and steel and application to a surface saturated dry (SSD) substrate.
Rehabilitation First

- Stop I/I (Infiltration and Inflow)
- Rebuild

Hydrophilic & Hydrophobic Polyurethane Grouts

- Polyurethane Foam: A flexible Polyurethane for cracks and pipe penetration.
- Hydrophobic: A Polyurethane capable of shutting off gushing leaks and filling voids.
- Gel: A Polyurethane gel that will seal leaks and stop infiltration through the walls.
- Oakum: A dry jute rope when soaked in Polyurethane is capable of filling large cracks.

Grouting Leaks in main line pipes can easily be accomplished using Acrylates or Acrylamide grouts.

- Portland cement by-products or calcium aluminates
- Sprayed or trowel applied
- New product mixes allow radial spray with no entry into manhole
- Will degrade as the original surface did
Polymer Modified Mortars

Advantages
1. Good Bond Strength
2. Aesthetic finish
3. Faster overcoat than pure portland

Disadvantages
1. Susceptible to MIC
2. Longer overcoat than other formulations
3. Repair mortar requires surface preparation prior to coating

Water Based Epoxy Cement Resurfacer

- Reduces outgassing concerns associated with epoxy resins
- May be applied to a surface saturated dry (SSD) substrate
- Will hang vertically up to 1/4" thickness on a dry substrate with spray application and 3/16" with hand trowel application
- Epoxy materials can be applied directly without the need for a primer.

Micro Silica/Fumed Silica Mortars

Advantages
1. Tighter matrix – lower permeability
2. Chemical resistant
3. Drives water off faster than pure portland
4. Lower cost than Calcium Aluminate

Disadvantages
1. Susceptible to MIC
2. Longer overcoat time than Calcium Aluminate Mortar
## Calcium Aluminate Mortar

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>1. Withstands MIC longer than portland based materials</td>
<td>1. Susceptible to MIC, but at a reduced rate.</td>
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<tr>
<td>2. Faster set times (Typically 4-24 hours)</td>
<td>2. Cost</td>
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<tr>
<td>3. Can be used as a stand alone liner</td>
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Two types available in the market:
- Pure or Fused Calcium Aluminate Mortar
- Binder or paste are calcium aluminate and the aggregates is typically dolomitic limestone (Dolosand)

## Potable Water Linings

- Optically Activated Pigments
- Low VOC, Low Viscosity, High Build Potable Water Epoxy*
- High Solids Potable Water Epoxy*
- 100% Solids Polyurethane & Polyurea Elastomers for Potable Water*

*ANSI/NSF 61 Certified

## Common Areas of Corrosion

**What can be done to help stop this from happening again?**
Traditional Holiday Detection Equipment

After Coating is Cured & Solvent Free
Cannot Detect Low Film Build

Topcoat over Fluorescent Primer Holiday in Pit

Topcoat Holiday: Blue crescent is prime coat fluorescence

Primer Defects Welds and Edges

White Light Inspection
Fluorescent Inspection
Low VOC, Low Viscosity, High Build Epoxy

- Available with OAP Technology
- <100 g/l VOC & NSF Standard 61 approved
- Low viscosity primer
- Fast “dry hard” times for stacking of plate
- High build topcoat (up to 14 mils)

High Solids Potable Water Epoxy Lining

- Available with OAP Technology
- <100 g/L VOC
- Up to 50 mils in one coat
- Low Temp Hardener
- Edge Retentive
- Fills pits and voids
- Excellent wetting
- 24 hour return to service

100% Solids Polyurethane & Polyurea Elastomers for Potable Water

- Single Coat Application
- Applications up to 100 mils DFT in one coat
- 0 VOC
- Return to immersion service in potable water in 24 hours @ 77F
- Provides a smooth glass like appearance
Other Water & Wastewater Coating Enhancements

- Silicone Release Agents
- Styrene Free Vinyl Ester Linings
- Fluoropolymer Urethane Exterior Finishes
- Mildew Resistant Polyurethane Finishes
- Non-Sacrificial Anti-Graffiti Coatings

Silicone Release Agents

- Transfer technology from the marine industry to satisfy a problem in W&WW
- The silicone technology prevents the adhesion of soft fouling, like algae, and reduces cleaning time drastically
- NSF Standard 61 approval has allowed the coating to be use for intake pipes prior to chlorine inject to prevent zebra and other mussel attachment
- The silicone technology allows for barnacle growth to be easily removed in salt water intakes

SherRelease
Styrene Free Vinyl Ester

- Removed the hazards associated with styrene (health, spark and shrinkage)
- VOC’s <15 g/l
- Changed in technology increased crosslink density which improved chemical resistance
- No longer requires the addition of wax solution on final coat for proper cure

Fluoropolymer Urethane

- Ambient cured
- Superior color and gloss retention
- Available in a wide range of colors
- Graffiti resistant

Mildew Resistant Polyurethane

- Mildew Resistant aliphatic acrylic polyurethane
- Excellent color and gloss retention
Anti-Graffiti Coating

- Single component, moisture-cure, siloxane-based coating
- Non sacrificial with excellent cleanability.
- Low VOC
- Can be applied over bare concrete or previously painted surfaces
- Clear and limited colors

Anti-Graffiti Testing

Summary

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