Above Ground Coatings for New Construction and Maintenance Painting

Tim Bauman – Sherwin Williams

AUCSC

Appalachian Underground Corrosion Short Course

Learning Objectives

- Explain why paints and coatings are used
- Identify basic components of coatings
- Explain how coatings protect
- Describe how coatings cure
- Describe the risks and considerations when overcoating
- Identify basic aboveground coatings including their
  - Benefits
  - Limitations
  - Uses

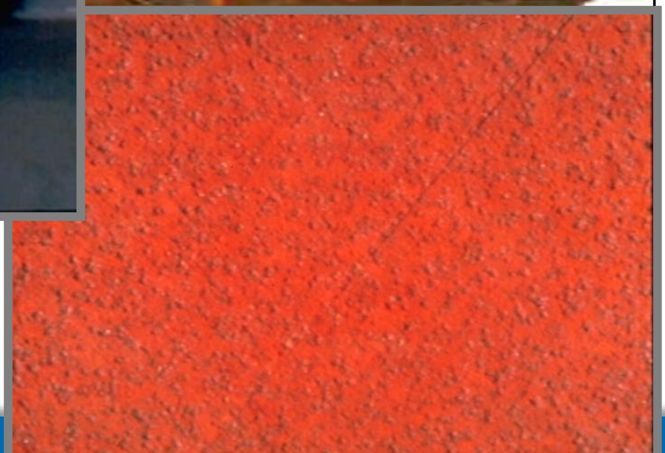
Above Ground Coatings

- Primers
  - Zinc (IOZ, MCU, Epoxy)
  - Epoxy
  - Acrylic
  - Alkyd
- Surface Tolerant Epoxies
- Moisture Cured Urethanes (MCU)

Intermediate Barrier Coats

- Topcoats
  - Polyurethane
  - FluoroUrethane
  - Polyaspartic Urethanes
  - Polysiloxane
  - Acrylic
  - Alkyd

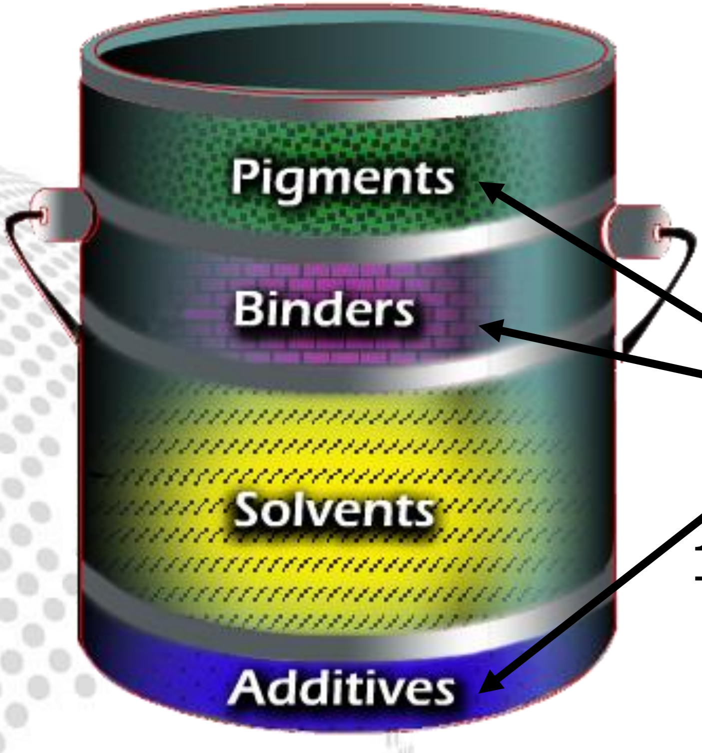


Steel wants to go back to iron ore!

Quality coatings demand quality ingredients:

- Pigments
- Binders
- Solvents
- Additives



Solids

1 Gallon = 1604 s/f @ 1 mil thickness

Volume Solids = Solids/Total

How Coatings Protect Surfaces

- Barrier
- Inhibitive
- Sacrificial

Corrosion Prevention

Stop the deterioration of a substrate. Corrosion is a natural process that displays the tendency of materials to “give up” energy and return to its natural state.

Barrier

- Most coatings serve as a protective barrier by isolating the substrate (metal, concrete, wood etc.) from the environment (moisture, heat, cold, UV, impact, abrasion etc.).
- Film reinforcement ,such as glass flakes or Micaceous Iron Oxide, further slows this action down.

Inhibitive

- Some pigments used in manufacturing primers control corrosion by forming inhibitive compounds.
- Compounds are slightly soluble in water, and upon contact with water vapor, passivate the substrate.

Rust inhibitive primers should never be specified or recommended for use in immersion service.

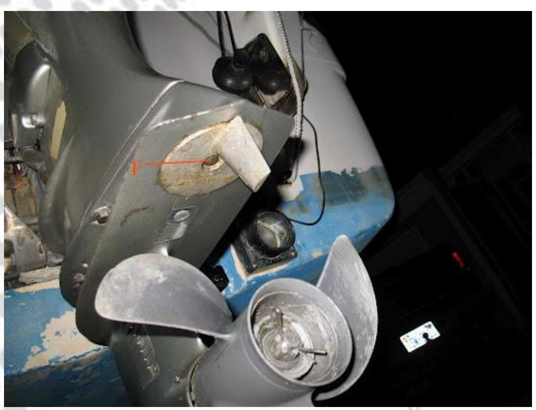
Sacrificial

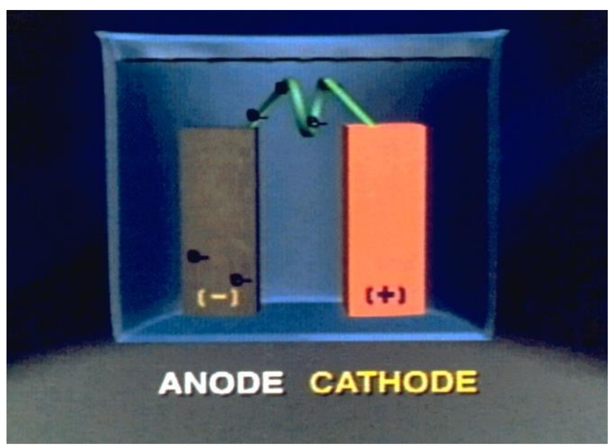
- When a zinc coating is applied to steel, the zinc, being more active (anodic) than the steel, *sacrifices* itself to protect the steel from corrosion.
- This is based on the galvanic series.

Active/Anodic

Magnesium
Zinc
Aluminum
Cadmium
Tin
Lead
Steel
Iron
Copper
410 Passive
304 Passive
Silver
Graphite
Gold
Platinum

Passive/Cathodic

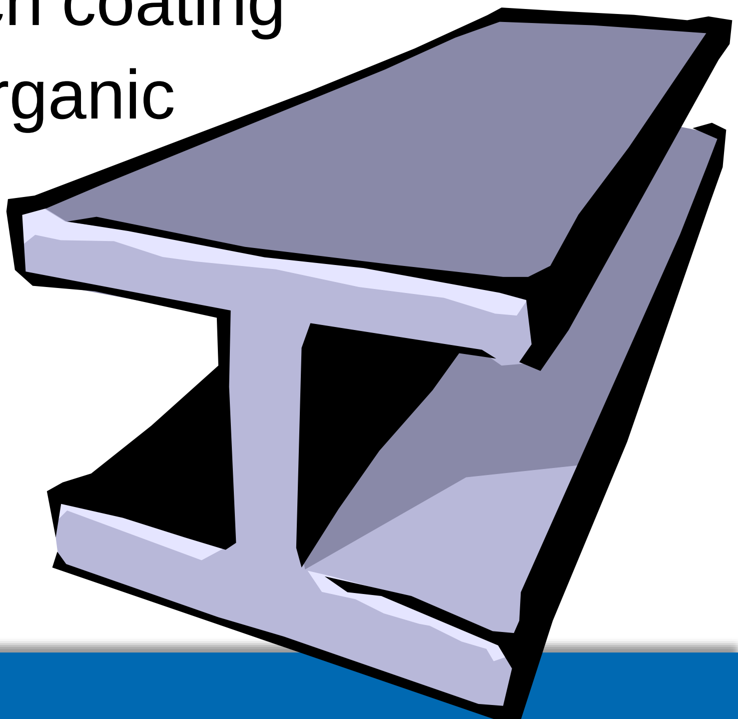




Zinc-Rich Primers

- Two or three-component, solvent-based, inorganic, ethyl silicate, zinc-rich coating
- Two or three-component, water-based, inorganic, zinc silicate coating
- Two or three-component catalyzed polyamide epoxy, organic zinc-rich coating
- Three-component water based organic amine
- adduct zinc-rich coating
- Moisture-cured urethane (MCU)

zinc prime



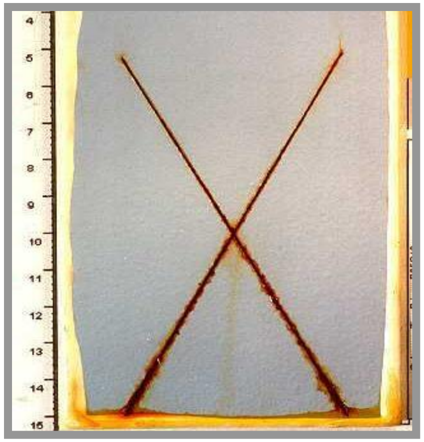
Zinc-Rich Primers

Contain High Percentage of Zinc Dust in the Dried Film So That There Is Direct Contact Between Zinc Particles and Steel

- Level 1 — equal to or greater than 85%
- Level 2 — equal to or greater than 77% and less than 85%
- Level 3 — equal to or greater than 65% and less than 77%

(per SSPC-Paint 20 Zinc-Rich Coating Type I – Inorganic and Type II – Organic)

- Sacrificial / Galvanic Protection (like galvanizing)
- Corrosion Protection Prevention of Undercutting



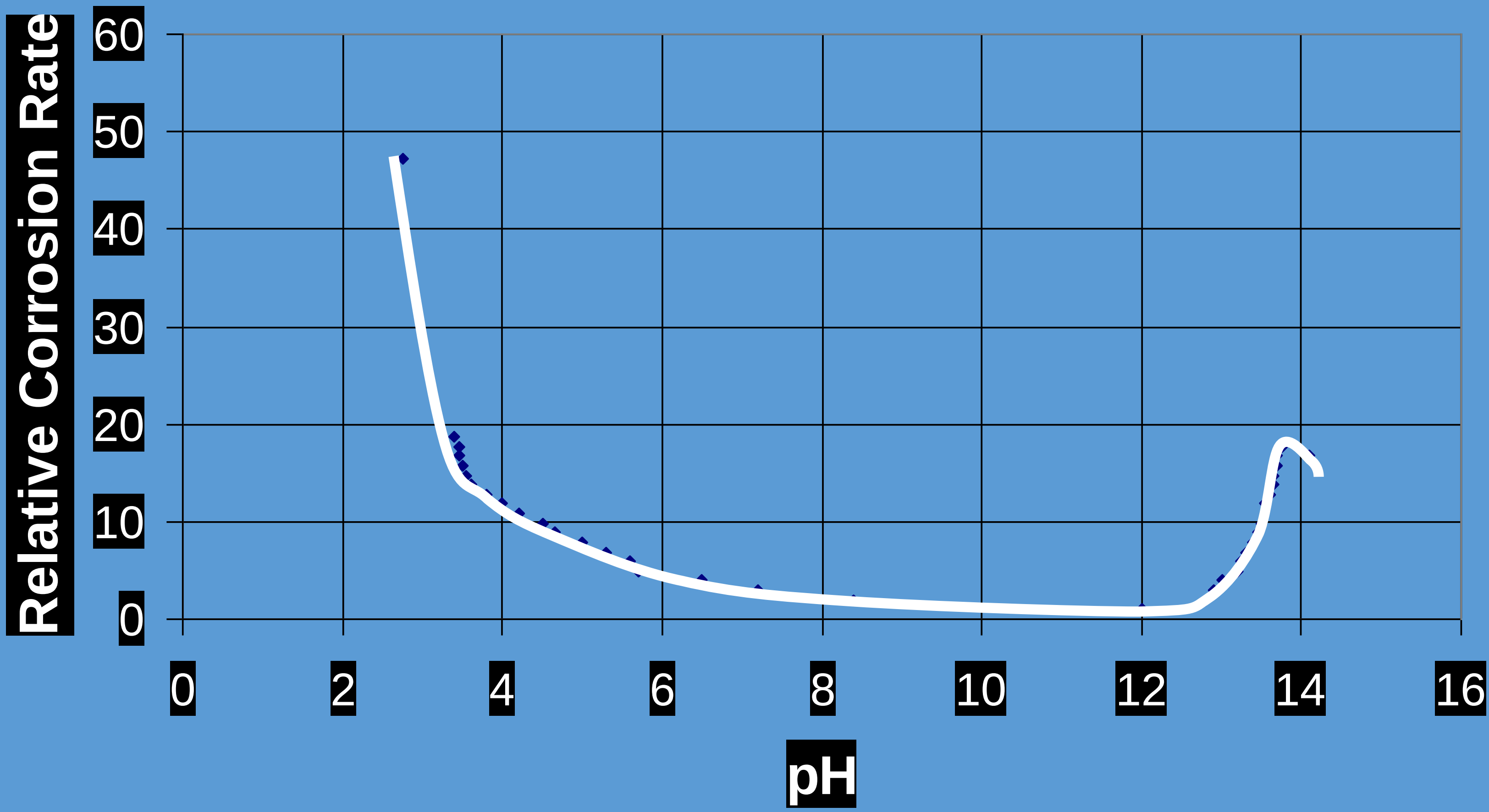
How Zinc-Rich Primers Cure

- IOZ = Solvent Evaporation / Moisture Curing or CO_2

- OZ = Solvent Evaporation / Chemical Reaction (Epoxy)

  Solvent Evaporation / Moisture Curing (MCU)

Corrosion Rate of Zinc vs. pH



Inorganic Zinc Rich Primers

- Better Surface Preparation Required
  (*Requires Angular Surface Profile)*
- Requires Special Application and Mixing Equipment
- Recommended pH Range of 5.0 - 9.0 (untopcoated)
- Prone to "Mud Cracking" at high DFT
- Shop Application

- Performance Similar to Galvanizing
- Heat Resistance to 750 F
- Low Temperature Application

Organic Zinc Rich

- Tolerates Less Stringent Surface Preparation
- Used to Touch-up Inorganic Zinc (IOZ)

MCU OZ Primers

- Can be applied during high humidity
- Ease of Application
- Fast Recoat / Fast Cure Times
- Low Temperature Application 20° F.
- Single Package Zinc-Rich Available

  - Special Reducers Required
  - Unused Portion Has Limited Shelf Life
  - Needs Relative Humidity to Cure

Epoxy Primers

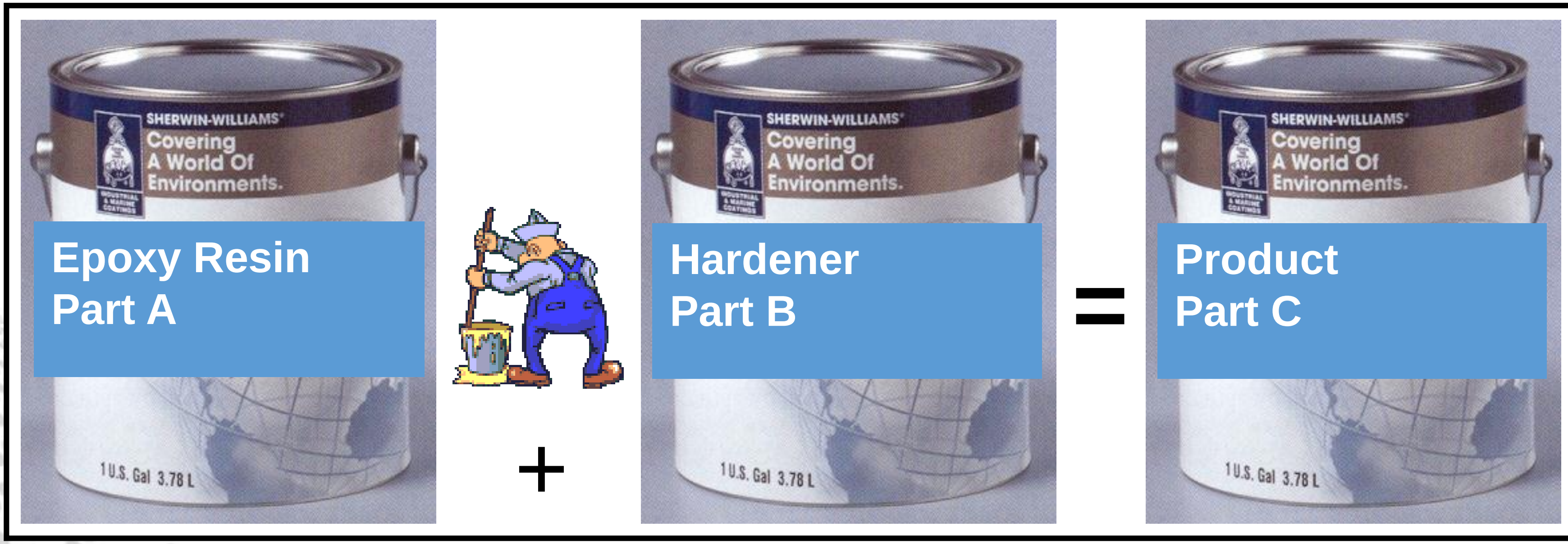
- Epoxy Resins or Emulsions of Epoxy Resins Which Cross-Link with Polyamides, Amines, or Other Hardeners.
- They Cure by Polymerization –

  The chemical

  joining of polymer

  chains

Catalyzed Epoxies



Solvent Based Epoxies

- Excellent Alkali, Solvent, and Water Resistance
- Good Abrasion Resistance
- Good Acid Resistance
- Good Exterior Durability *but …*
- High Film Builds Possible in One Coat
- Low Temperature Application Available
- Dry Heat Resistance to 250° F

Solvent Based Epoxy Limitations

- Two-Component
  - Induction Time (Sweat-In)*
  - Limited Pot Life*
- Recoat Window Restrictions*
- Chalks and Fades on Exterior Exposure
- Solvent Odor
- Special Application Equipment Might be Required

*Temperature dependent!

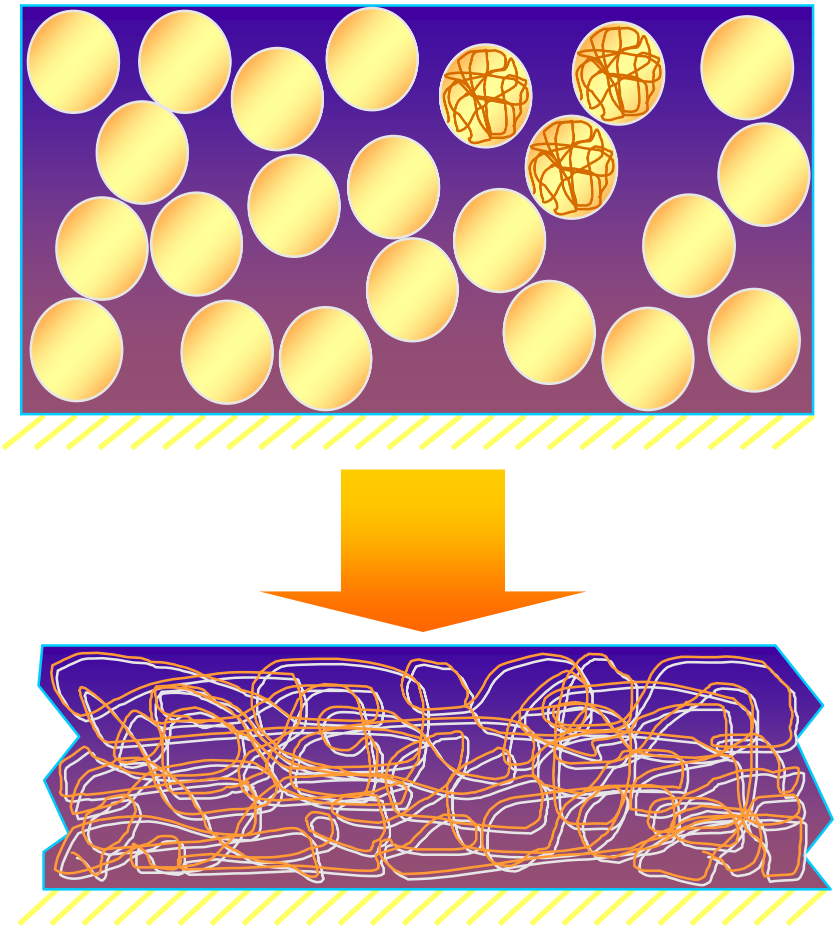
Waterborne Acrylic Primer

- Single Component Water Based
- Fast Dry
- Fast Re-Coat
- Excellent Corrosion Protection
- Must Contain Inhibitors

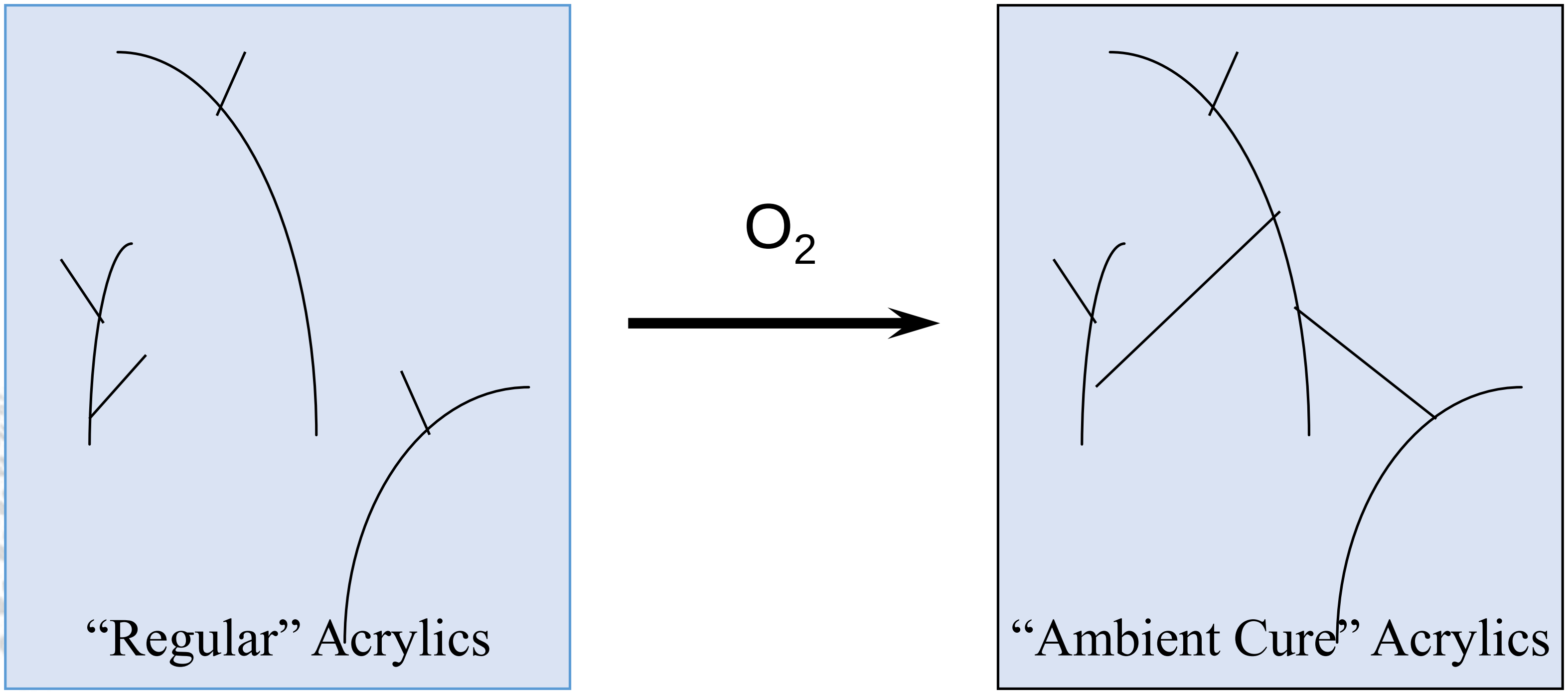
Sensitive to Temperature and Humidity During Application AND Curing (up to 30 days for cure)

Industrial Acrylics

- Cure by Solvent
  Evaporation
  AND Coalescence
- Co-Solvents (coalescing solvents) act as plasticizers for acrylics. These co-solvents contribute VOC's to WB coatings. Co-solvents must remain in the film until evaporation.



“Ambient Cure” WB Acrylics



Polymer after film formation before ambient cure.

Polymer chains after crosslinking at ambient temperature in the presence of atmospheric oxygen..

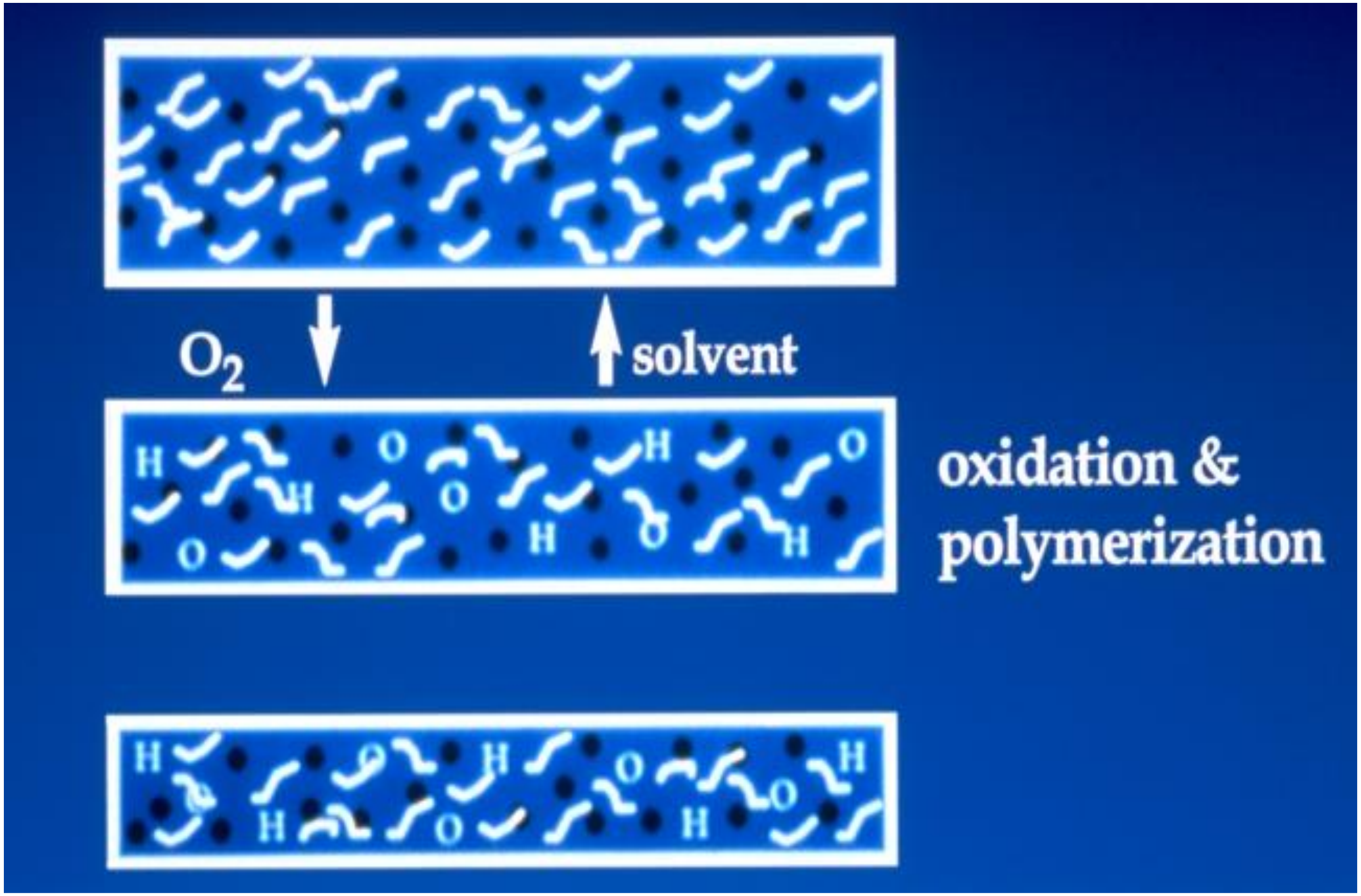
Alkyd Primers

Synthetic Resins Derived From a Reaction Between an Alcohol and an Acid. The Resins are Blended With Drying Oils and Cure by Oxidation

- Application as low as 40°F
- Single Package / Ease of Application
- Heat Resistance to 200-250° F
- Embrittle With Age
- Prone to Yellow / Saponify

Traditional Versions were High in Volatile Organic Compounds (VOC)

Cure by Oxidation



Drying Oil Amount

Short Oil Alkyd | Medium Oil Alkyd | Long Oil Alkyd

Fast Dry			Slow Dry
Aromatic Solvent Res.			Aliphatic Solvent Res.
Poor Penetration			Penetrates Rust
Fast Recoatability	(2	Hrs)	Long Recoat Time
Harder Film Quickly Embrittles			Softer / Pliable Film
Quickly Chalks			Good Exterior Durability

Surface Tolerant Overcoating Systems

- Assessment of Current Paint
  - Percentage (%) of corrosion
  - Adhesion to substrate and other coats
  - Thickness (DFT)
  - Number of coats
  - Chalking, blistering, etc.
- Consider Ultra-High Pressure (UHP) Water
  - Remove all the paint on most surfaces
  - NO abrasive dust or waste
- Wet Abrasive Blast Cleaning
  - Vapor Blasting

Main Menu | Table of Contents

SSPC-TU 3
May 1, 1997
Editorial Revisions November 1, 2004

SSPC: The Society for Protective Coatings

TECHNOLOGY UPDATE NO. 3

Overcoating

1. Scope

1.1 This technology update discusses the risks associated with the maintenance painting practice known as overcoating. Factors affecting overcoating application, service and costs are discussed.

1.2 This document is intended to serve as a resource for facility owners and others charged with developing and implementing maintenance painting programs.

1.3 Overcoating is one of several maintenance painting options. This document is not intended to provide a detailed description or comparison of the relative merit and cost considerations of overcoating versus other maintenance painting options. For a more complete and detailed discussion of maintenance painting practices, the reader should refer to SSPC-PA Guide 5, Guide to Maintenance Painting Programs.

2. Description and Definitions

2.1 DESCRIPTION

Loose coating: Coating that has delaminated and disbonded from the substrate or other coats, but has not fallen off.

Marginally adherent coating: A coating that exhibits tape adhesion of 2A or less (per ASTM D 3359), such that the overcoating risk is moderate or high.

Overcoating: Application of coating materials over an existing coating in order to extend its service life, including use of the appropriate cleaning methods. The procedure includes preparation of rusted or degraded areas, feathering edges of existing paint, low-pressure water washing of the entire structure to remove contaminants, application of a full intermediate coat over repaired areas, and optional application of a full topcoat over the entire structure. Overcoating may be a cost effective alternative to complete coating removal and repainting. When the old coating contains lead, cadmium, or chromium, overcoating may be a particularly attractive option due to economic considerations. Overcoating presents certain risks as well.

Repaint: Complete removal of the existing coating system followed by application of a new coating system (including

ALSO SSPC PA Guide 5 – Guide to Maintenance Painting Programs

Risks of Overcoating

- Curing and solvent stress on existing paint with new coating *(do test patch!)*
- Delamination
- Life expectancy is hard to determine
- Premature failure of the overcoat system
- Future repair

Cost Considerations

- Overcoat systems: Typically 40% to 65% vs. the cost of complete removal/replacement
- Removal/Replacement: Expensive and dependent on several factors
- Present Cost of Overcoat vs. Future Value of complete removal/replacement
- Project Schedule/Operations - impact of adjacent operations.

Key Points in Decision Process

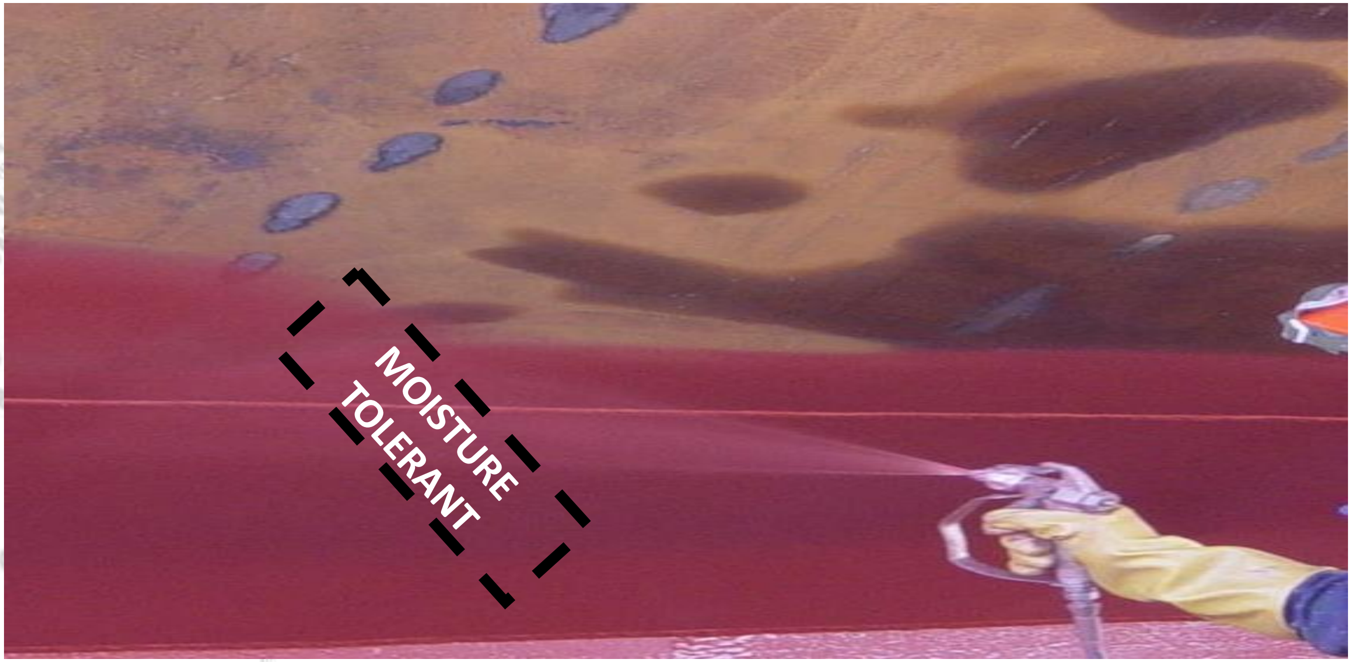
- Coating budget typically determines overcoat/removal
- Adhesion results of existing coating
- DFT of existing coating (< 20-25 mils)
- Is lead paint present?
- Environmental impact
- Bid Process: Time & Materials vs. Hard Dollar
- Scope of Work: Defining unforeseen conditions and events

Surface Tolerant Epoxy

- Tradition epoxy mastic
  - Aluminum filled
  - Slow, non-aggressive solvents
- Penetrating pre-prime epoxy
- New solvent-free technology
  - Developed for marine applications (immersion)
  - Applied without dew point restrictions
    and over damp steel surfaces
  - Very good chemical and abrasion resistance
  - Can be applied over hydro, abrasive, wet-abrasive, or power tool cleaning

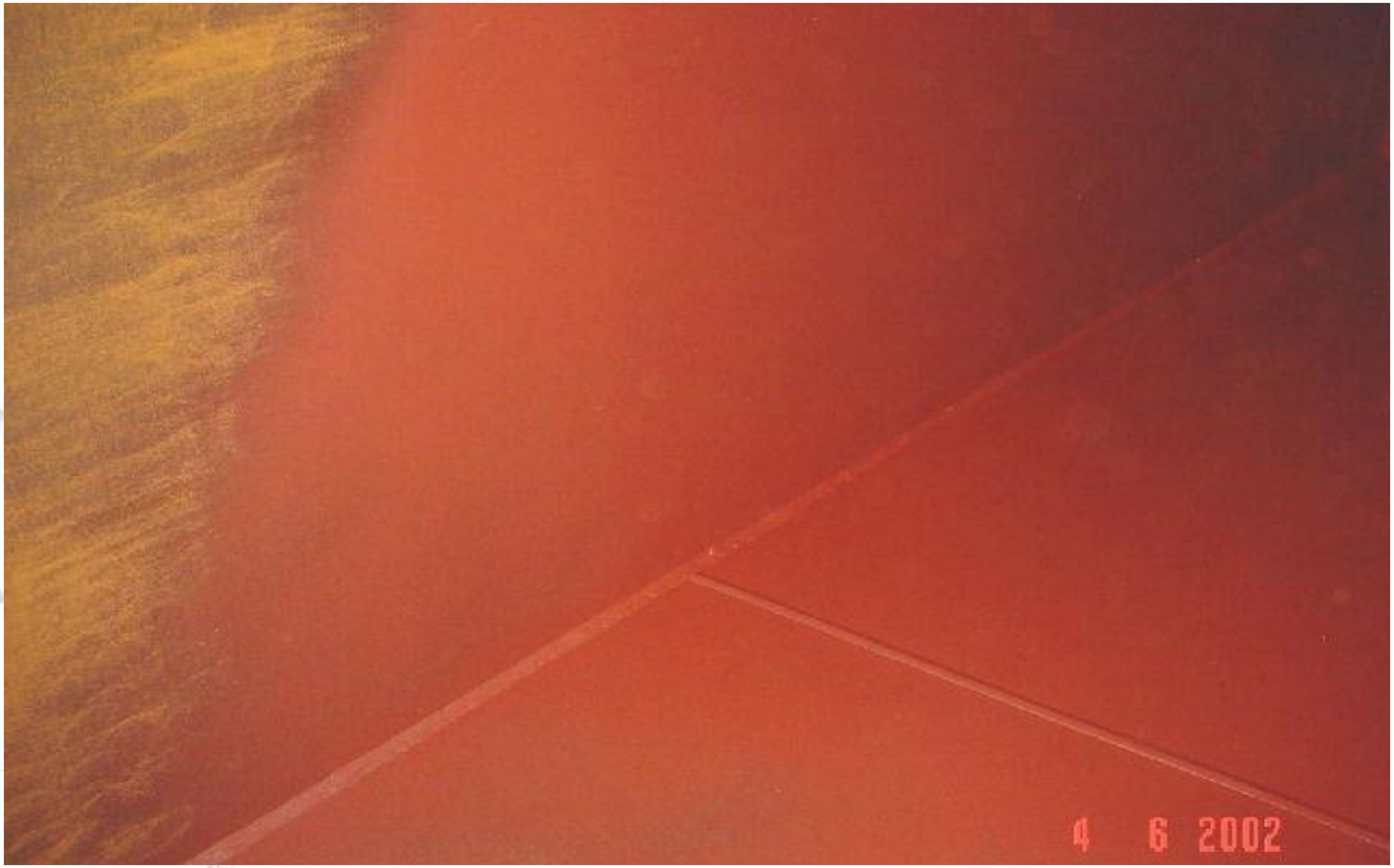
MOISTURE TOLERANT

- Can Be Applied Over Damp Surfaces
- No Dew Point Restrictions
-



SURFACE TOLERANT

- Can Be Applied Over Flash Rust



Solution for pipes where condensation is a problem.

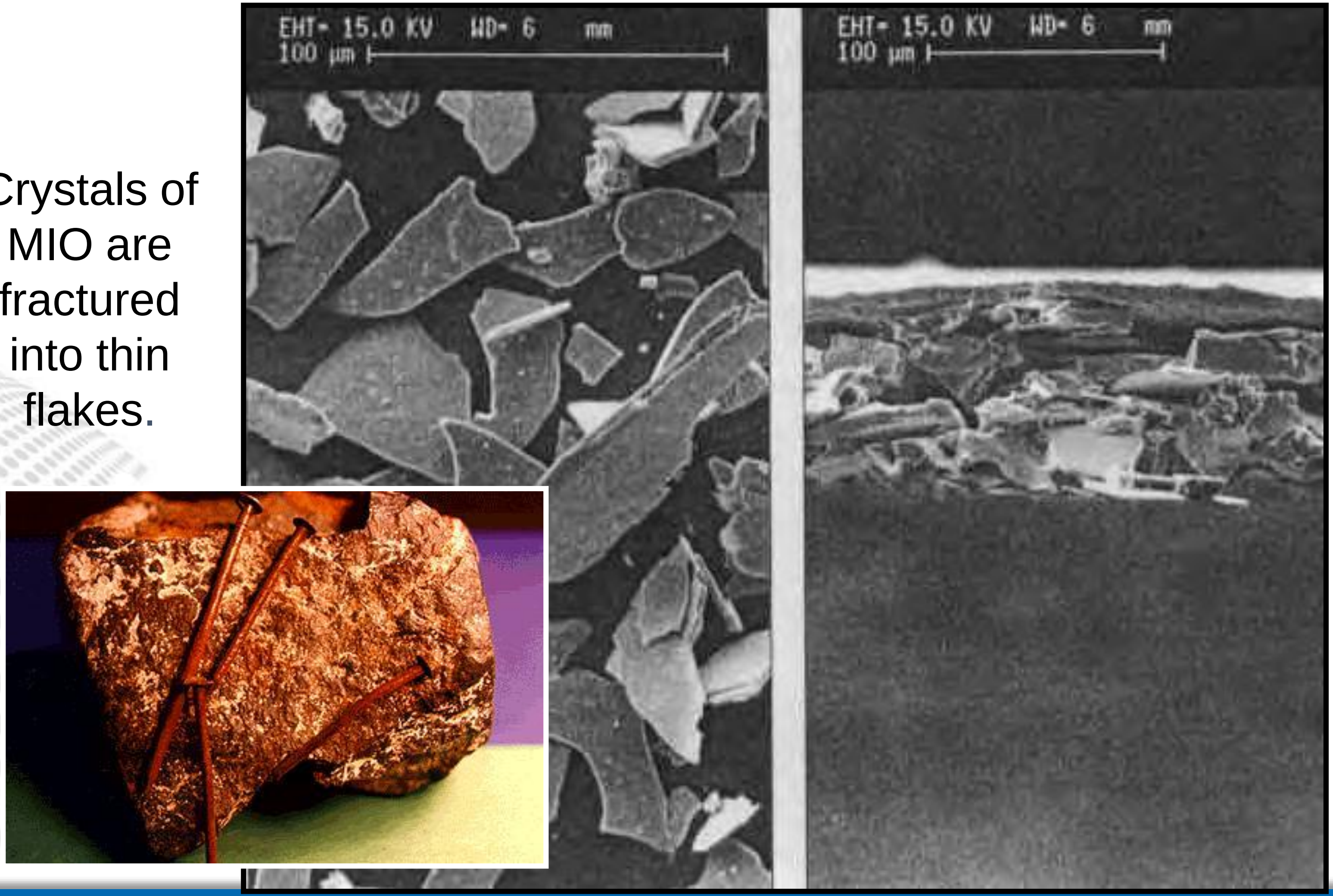
EDP (Europe) The main Portuguese power company uses this technology in both fossil fuel and hydro power plants.

Moisture Cured Urethanes

- Can be surface tolerant
- Penetrating pre-prime MCU
- Can be applied during high humidity
- Ease of application
- Fast cure / fast recoat
- Low temperature application to 20 F.
- Single component
- Reinforce with micaceous iron oxide

Micaceous Iron Oxide (MIO)

Crystals of MIO are fractured into thin flakes.



Flakes then align in parallel fashion.

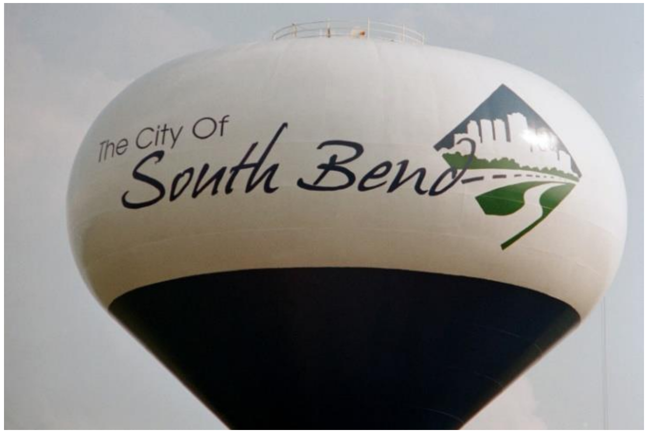
Intermediate Barrier Coats

- Epoxy
- Moisture Cured Urethanes (MCU)
- Acrylic
- Alkyd

High Performance Steel Topcoats

Polyurethanes

- A polyurethane coating is that derived from the reaction product of an isocyanate component and a resin blend component.
- Polyol + Isocyanate = Polyurethane + CO_2
- Good Chemical Resistance
- Hard, Yet Flexible Films
- Excellent Color and Gloss Retention
- Low-Temp, Formula Dependent Application
- No Sweat-In Time Required



Types of Polyurethanes

Aliphatic

- Excellent Color Retention
- Excellent Gloss Retention
- Primarily Used as Finish Coats
- More Expensive than Aromatics

Aromatic

- Yellows & Chalks in Sunlight
- Yellows & Chalks in Bright Artificial Light
- Used as Primers & Intermediate Coat
- Less Expensive than Aliphatics

High Performance Aliphatic

- SSPC Paint 36
- "2K UV-Stable Polyurethane topcoats"

- ASTM D4587 Level — Standard of Measurement

ASTM D4587	Level	Standard of Measurement
500h	Level I	"color change less then 2 delta E and gloss loss less then 30 units"
1000h	Level II	ASTM D2244 & ASTM D523
2000h	Level III	

Two component, limited pot life.
Sensitive to moisture during application & cure.

Mildew Resistant Polyurethane

- Mildew Resistant aliphatic acrylic polyurethane
- Excellent color and gloss retention

Aliphatic Moisture Cured Urethane

Isocyanate + Humidity = Amine + CO2
Amine + Isocyanate = Polyurethane (Urea Linkage)

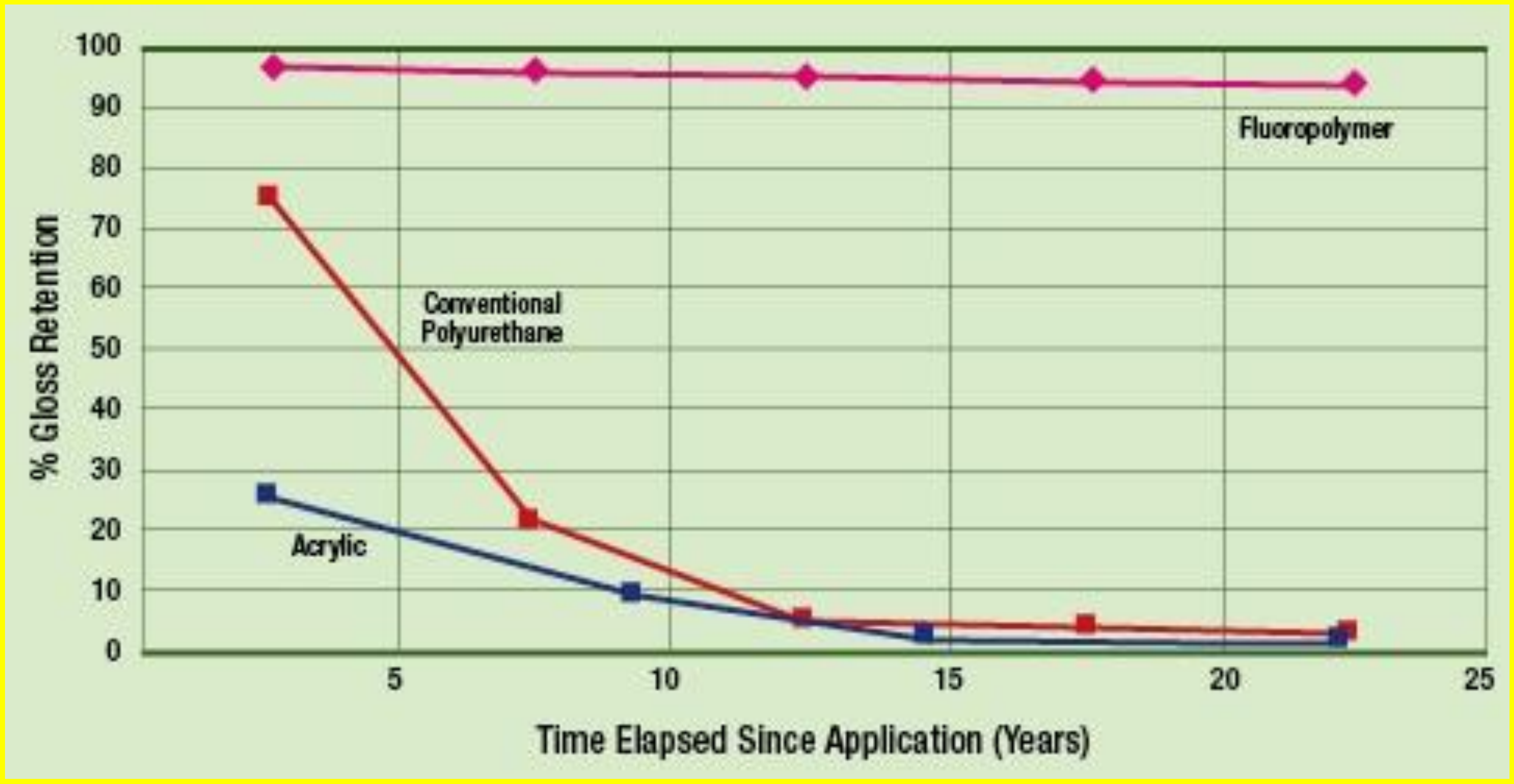
Fluoropolymer Urethane

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

Like Liquid Kynar

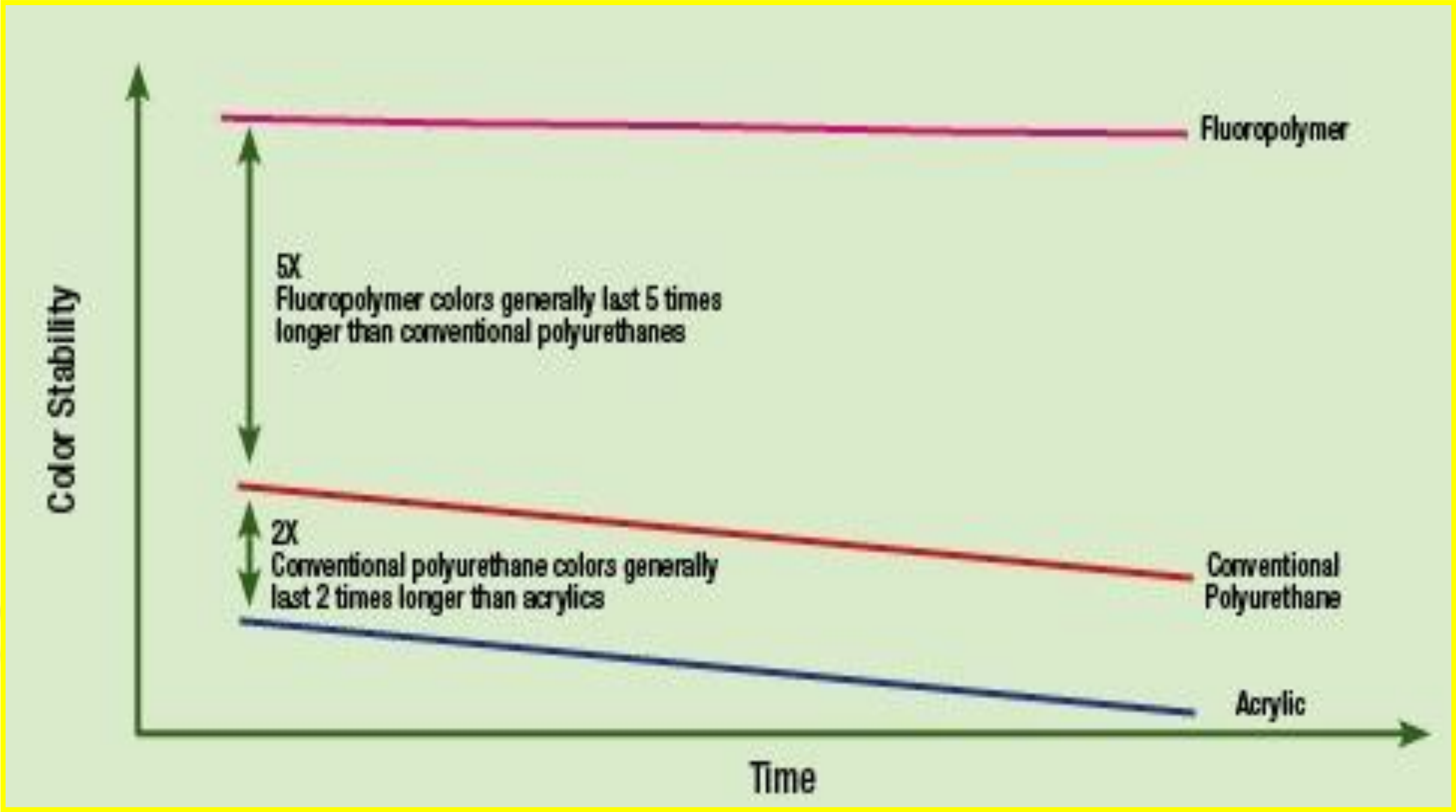
FluoroUrethane

Gloss Retention



FluoroUrethane

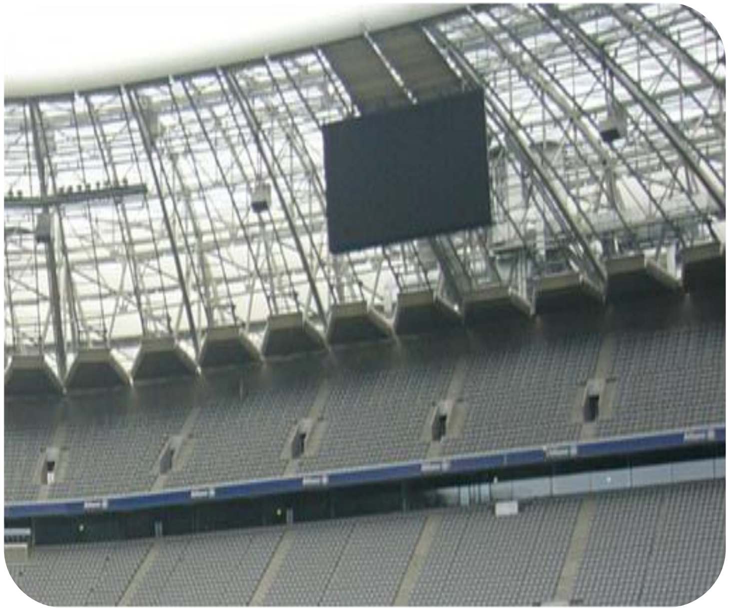
Color Retention



Polyaspartic Urethane

- One or Two Coat System
- High throughput applications
- High humidity & blushing resistant
- High build with good color/gloss retention
- Corrosion protection
- Low temperature (35ºF) application

Polyaspartic Urethane



Polysiloxane

Polysiloxanes have dual reactivity:

Siloxane component – reaction with atmospheric moisture. Imparts exterior durability and chemical resistance to the coating.

Epoxy component – reaction with amine. Imparts toughness and corrosion resistance to the coating.

Polysiloxane Technology

- High solids epoxy siloxane combines the properties of both a high performance epoxy and a polyurethane in one coat
- Isocyanate-free
- Replaces a two coat epoxy/polyurethane system alone or over zinc-rich primer
- High-gloss, self-priming coating
- High solids, low VOC
- Long term color and gloss performance
- Corrosion and chemical resistant
- Outstanding application properties

Also Available as Single-Component with Acrylic

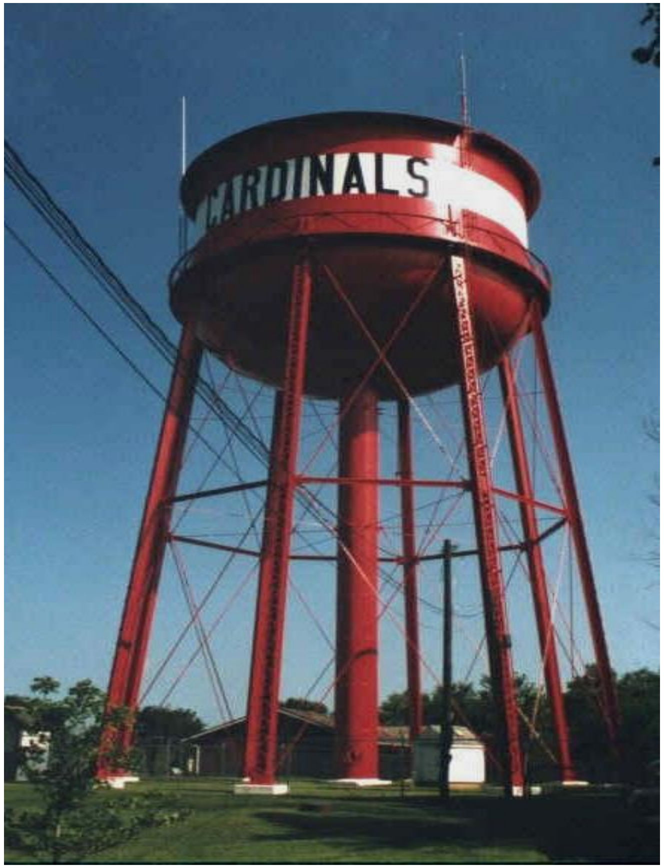
Polysiloxane Topcoat

High Performance Acrylics

- Ambient Cure
- Cross-linking / branching
- Superior Color & Gloss Retention

Modified Alkyd Topcoats

- Silicone
- Urethane
- Acrylic



Summary

- Explain why paints and coatings are used
- Identify basic components of coatings
- Explain how coatings protect
- Describe how coatings cure
- Describe the risks and considerations when overcoating
- Identify basic aboveground coatings including their
  - Benefits
  - Limitations
  - Uses

Above Ground Coatings

- Primers
  - Zinc (IOZ, MCU, Epoxy)
  - Epoxy
  - Acrylic
  - Alkyd
- Surface Tolerant Epoxies
- Moisture Cured Urethanes (MCU)

Intermediate Barrier Coats

- Topcoats
  - Polyurethane
  - FluoroUrethane
  - Polyaspartic Urethanes
  - Polysiloxane
  - Acrylic
  - Alkyd

QUESTIONS ??????

www.SSPC.org
www.Sherwin-Williams.com