Advanced Tank Coating Solutions for the Marine Sector

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Introduction

- This webinar provides performance requirements for coatings and linings used in marine ballast and fuel tanks.
Presentation Overview

• Evolution of US Navy tank coating technology
  – Legacy MIL-DTL-24441
  – Ultra high solids
  – Single coat, rapid cure
  – Time and cost savings/avoidance

• Optically active pigments

• Cartridges

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U.S. DOD Corrosion Control

- U.S. Dept. of Defense 2014 cost of corrosion = $21.9 billion per year
- U.S. Navy annual corrosion costs $7.5 billion with vessel corrosion costs $3.2 billion
- Navy Corrosion Prevention and Control Executive appointed
- Preservation of tanks is the #1 U.S. Navy fleet maintenance cost
MIL-DTL-24441 (Mare Island)

- Solvent based polyamide epoxy
- Used extensively
- Average volume solids 67%
- Typical system 2 coats with total DFT 10-12 mils
- Non-edge retentive
- Dated technology
  - High in VOC
  - Better performing products desired
Condition of U.S.S. Ogden ballast tank after 36 months in service

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(Extreme condition)
Technology Shift in Coatings / Processes

- **Solvent Content**: Late 80's - 40%, 30%, 20% → Solvent Free
- **Pot Life**: 6 hr., 3 hr., 2 hr. → 30-45 Min.
- **Viscosity**: 45:1 → 66:1 → 74:1 → High Viscosity
- **Equip. Size**: → Plural Comp.
VOC Emission Comparison

MIL-DTL-24441 (67% volume solids, 2.8 lbs/gallon VOC, 10 dry mils) versus UHS (98% volume solids, 0.84 lbs/gallon VOC, 17 dry mils)

10,000 square foot tank, 30% loss factor
Ultra High Solids Primer & Topcoat

• Approved to MIL-PRF-23236, Type VII (<150 g/L)
  – Ballast, fuel, CHT, potable water
• Primer
  – Low viscosity penetrating primer
  – Applied at 4-8 mils DFT
• Stripe & Topcoat
  – High viscosity = edge retention
  – Stripe coat applied at 6-10 mils DFT
  – Topcoat applied at 10-12 mils DFT
• Flats are 14-20 mils, edges are 20-30 mils DFT
• Widely used on Navy ships and submarines from late 1990’s into the 2000’s

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Ballast Tank UHS Edge Retentive System

Condition after 5 years

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Edge Build Retention

MIL-PRF-23236 requires > 70%

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Increased Coating Life Cycles

- **CHT TANKS**
  - Traditional Life Expectancy
  - 100% Solids Life Expectancy

- **Ballast & Fuel Tanks**
  - Traditional Life Expectancy
  - 100% Solids Life Expectancy

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Single Coat, Rapid Cure Technology

• Next step in coating evolution
  – Equal or better performance
  – Apply quicker at reduced costs
  – Apply in single or reduced number of coats
• UHS, low VOC
• Edge retentive
• Short minimum recoat time (0-2 hours)
• Short cure to immersion time (24 hours)
• Plural pump application (short pot-life)
• Technology well received
USS Tortuga, LSD-46, September 2003
USS Tortuga, LSD-46, September 2003
Single Coat Rapid Cure Coating with Fluorescent Additive
Total Application Time – 35 Hrs *

Two Full Coats Rapid Cure Coating with Fluorescent Additive in base coat
Total Application Time – 70 Hrs *

*All times include touch-up

Application of Rapid Cure Coatings, 2 Full Coats & Stripe – est. 90 Hrs

Standard UHS Coating, NAVSEA Standard Item 009-32 (Prime, Stripe, Topcoat)
Total Application Time – 216 Hrs *

U.S.S. CARTER HALL LSD-50, PMA Fall 2006, Earl Industries Shipyard
Rapid Cure Coating Demonstration
Program Sponsor-ONR, Transition Authority-NAVSEA O5M.1, Tech Authority-NRL
NAVSEA Business Case

• Updated Business Case
  – Naval Shipyards Report 20% Total Paint Application Cost Reduction and 50% Schedule Savings (CWP Task Force)

• Material Cost Increased
  – 17 mil vs. 25 mil

• Facilities and Utilities Decreased
  – 12% reduction compared to UHS
  – 44% reduction compared to Legacy solvent coatings

• Labor Costs Decreased:
  – 58% reduction compared to UHS
  – 67% reduction compared to legacy solvent coatings

General Estimate: 20% Cost Savings & 50% Schedule Savings
NAVSEA Application Cost Comparison
(time savings also integral component)
USS WASP, Single Coat, Rapid Cure Coating Inspection
2 years, 2 months   (Tank 5-101-1-W, Aug 30 2005)
Tank And Void Cost Avoidance Metrics

Cost avoidance for UHS coatings due to increased service life through FY 2014

- Ballast Tanks = $956.18M
- Fuel/Comp Fuel Tanks = $241.2M
- Potable Water Tanks = $20.28M
- CHT Tanks = $79.31M

Total ≈ $1.297 B

- Additional cost avoidance from single coat application
  - ≈ $47.5M through March 31, 2015.
1997 plan to shift from a 3-5 year tank recoating periodicity for Mare Island to a 20 year service life (i.e., 80% of the population being in an EXCELLENT or GOOD condition at end of service period) by:
- Qualifying ultra-high solids, edge-retentive paints.
- Improving coating application process (e.g., surface cleanliness, profile, environment, and oversight).
Single Coat, Rapid Cure Markets

- US Navy
- Foreign Navies
- Commercial Marine
- Petrochemical Industry
- External Pipeline
- Municipal Water – NSF approved versions
- Derivations of base technology
  - Low temp application
  - High temp service
  - Glass flake and ceramic filled

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PetroBras, QWHI Shipyard in Qingdao, China
Holiday Detection Goals

• Navy shipboard tanks
  – Small spaces
  – Complex geometry

• Holiday detection in ship tanks
  – Visual inspection with flashlight
  – Non-line-of-sight with mirror

• Goal
  – Enhanced tools to guarantee uniform holiday-free film

• Critical with reduced # of coats
Enhancing Visual Inspection with Fluorescent Coatings

- Simple coating change to enhance defect contrast
  - Pigment addition
  - Illuminate with deep purple, eye safe light (> 400 nm)
- Implemented in coatings specification MIL-PRF-23236
- Detailed instructions in SSPC Technology Update Number 11 – Inspection of Fluorescent Coating Systems

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Imagine if you could walk into a tank...turn on a light and have holidays or pinholes simply show up
Topcoat over Fluorescent Primer
Holiday in Pit

White Light Inspection

Fluorescent Inspection

Topcoat holiday-blue crescent is prime coat fluorescence
- U.S.S. Carter Hall
- Rapid cure, single and double coat, OAP
- OAP light source

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Inspecting Fluorescent Coat

• Inspection protocol
  – Experienced coatings inspector
  – 1st pass: white light inspection
  – 2nd pass: purple light inspection

• Inspection Results
  – 50% to 75% faster area scan rate
  – 25% more defects found
  – Pinhole defects seen from 2X standoff
    • 2 ft. with white light
    • 4 ft. with purple light
  – Brightness did NOT vary with film thickness from 4 mil to 20 mil
Cartridge Touch-Up Equipment

• Ideal for short pot life materials
• Variety of mix ratios (300 x 300, 750 x 750 mL)
• Variety of MIL-Spec and commercial coatings
• Transportable
• Easy to use - productivity
• Minimize waste
• Ensure proper mixing

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Cartridge Systems
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Summary

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  – UHS
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