ESTTCP Project WP-0801, UV Curable Powder Coatings for Military Applications

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Outline

- UV-Curable Powder Coatings Overview
- Robotics as an aid to Curing
- Current Status of ESTCP Project WP-0801
- Future UVCPC efforts
UV-Curable Powder Overview

- Previous ways of thinking about powder
  - Coating cure temperatures – typically above 428°F
  - Prohibitive for use on tempered metals (Al, Mg, Ti)
  - Prohibitive to use on composites
  - Powder coatings were designed as barrier protection
UV-Curable Powder Overview

- Modern powder coatings can be formulated to have:
  - Lower melt & flow temperatures (< 225°F)
  - UV or EB cure functionality can be added
  - Various advanced non-chrome corrosion inhibitors
Advantages of UV-cure powder coating:

- Elimination of volatile organics (VOC)
- Elimination of hazardous air pollutants (HAP)
- Reduction/elimination of hazardous waste
- Transfer efficiencies as high as 95% (w/reclaim)
- Decrease in thermal exposure.
- Large bulky parts that cannot fit into existing ovens can be coated and cured.
- UV-cure powder requires less energy because the energy is focused to a specific part only as long as needed.
Robotics as an Aid to Curing

- Why Use Robots?
Robotics as an Aid to Curing

- Light tunnel approach using various size UV lamps to optimize cost and exposure
Robotics as an Aid to Curing

- **Drawbacks of fixed lamp approach**
  - High Capital Costs
    - Lamps, cooling, fixtures, integration
  - High Operating Costs
    - Replacement parts
    - Energy
    - Downtime
  - Technical Adequacy
    - Complete cure
    - Proper Re-alignment
    - Mixed product
Robotics as an Aid to Curing

Advantages of Robotic Curing

- Robots ensure repeatability
- Robots with UV sources can maintain extremely close target distances
- Robots can be re-programmed in seconds
- Robotic curing is well suited to large or complex parts
- Robots eliminate need for many lights
The Problem:

- DoD spends millions of dollars annually on solvent-based coatings
- Hexavalent chrome primer use still very widespread
- Contains or requires volatile solvent use
- Significant hazardous waste costs
- Hazardous materials pose risks to human health and environment
- Process times measured in hours to days
- Transfer rates are less than 60%
Current Status of ESTCP Project
WP-0801

The WP-0801 Objectives are:

- Demonstrate a VOC/HAP-free, Ultraviolet cure powder coating (UVCPC) on DoD hardware
- Demonstrate state-of-the-art robotics for curing
Current Status of ESTCP Project
WP-0801

- Requirements of a UVCPC for military use:
  - Must perform at least as well as MIL-PRF-23377 primer
  - Must also perform as well as MIL-PRF-85285 topcoat
  - Can be prepared in gloss, semi-gloss, and flat finishes
Current Status of ESTCP Project

WP-0801

- Planned demonstration weapon systems:
  - EA-6B wheels, landing gear
  - HH-65 helicopter
  - P-3 wheels, landing gear, radomes
  - Mk-48 ADCAP torpedo
  - HC-130 main landing gear doors
  - KC-135 wing flap, refueling boom
Current Status of ESTCP Project

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- Planned demonstration weapon systems (cont.):

  - Submarine icecaps
  - EA-18G wheels, landing gear
  - Ammunition and storage cases
  - Submarine communication buoys
  - Submarine interior components
Current Status of ESTCP Project
WP-0801

- **Powders:**
  - Currently considering two vendors
  - Two colors, gloss white, semi-gloss gray
  - All will undergo strict validation testing at CTIO

- **Robotics system:**
  - Robot carries the IR and Hg vapor UV lamps
  - Evaluation of alternative UV sources continue
  - Evaluation of alternative application methods continue
Current Status of ESTCP Project
WP-0801

- Major Program Milestones:
  - Joint Test Protocol submitted Sept 2008
  - Robot acquired and integration underway
  - Component identification complete
  - Powder and substrates order Jan 2009
  - Validation testing starts Feb 2009
  - Draft Demonstration Plan June 2009
  - Field Service/Demonstration begins Mar 2010
  - Joint Test Report draft Sept 2010
  - Final Report Mar 2012
Future UVCPC Efforts

- Future follow on efforts include large marine applications
Future UV CPC Efforts

Future efforts in alternative UV light sources

- High Energy UV LEDs
- Pulsed Xenon lamps
Thank You!

Points of contact for UV-curable Powder Coatings ESTCP Project WP-0801:

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