Alternatives to High-VOC Chrome Coatings
Identification of Suitable Alternatives to Hexavalent Chrome in Conversion Coating Alodine 1200 on Aluminum 2024, 7075, and 6061
C3P Project

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Background
A common coating system for aerospace applications on aluminum substrates consists of a chromated conversion coating, a primer (typically chromated) and a topcoat. Chromate conversion coatings and primers offer excellent corrosion protection and adhesion characteristics. However, hexavalent chromium is a known carcinogen and is being regulated heavily in both the United States and the European Union. The identification of replacements for chromium containing coatings that offer similar corrosion protection is very important to the aerospace industry as a whole. Also, paints that contain high levels of volatile organic compounds (VOCs) are being regulated and are hazardous to the environment and to human health.

Through its European partnerships, notably the Portuguese Center for Pollution Prevention (C3P), TEERM and two Portuguese entities—TAP Portugal (the Portuguese national airline) and OGMA Indústria Aeronáutica de Portugal—targeted hexavalent chromium and VOCs as hazardous materials for possible elimination or reduction.

Objective
The objective of this project is to meet the challenges of the United States, European Union (EU) and Portuguese Directives to reduce and eliminate VOC emissions as well as reduce or eliminate the presence of hexavalent chromium in aircraft painting processes at TAP Portugal and OGMA. This is to be accomplished by testing and implementing alternative coating systems that have the desired performance characteristics and meet or exceed EU and Portuguese environmental objectives.

In November 2004, two coating systems that consisted of non-chromate pretreatments and low-VOC coatings were applied to the exterior of and Airbus A319 aircraft door for flight testing. Simultaneously, test panels were also prepared for a series of laboratory testing.

Period of Performance
- Jun-04 to Dec-07

Stakeholders
NASA (Kennedy Space Center, Marshall Space Flight Center), Portuguese Center for Pollution Prevention, OGMA (Aeronautic Industry of Portugal), TAP (Air Portugal), and Instituto de Soldadura e Qualidade (Institute of Welding and Quality) [ISQ]

Benefits
- Decreased risk of worker exposure to hexavalent chromium and hazardous volatile organics.
- Meet environmental regulatory goals.
- Prevent environmental releases of toxic and ozone depleting materials.

Document Status
- Joint Test Protocol – Complete
- Potential Alternatives Report – Complete

Recent Progress
- The follow-up reports of the aircraft door show that both painting systems to date are in perfect conditions:
  - No peeling-off;
  - No defects were observed;
  - Present high gloss and Distinctness of Image. To date there is no significant difference between the two paint schemes. The performance in the field remains encouraging, and the team shall continue to conduct periodic field inspections on the door.
- The following laboratory testing has been initiated.
  - Completed Gloss - ISO 2813 – NASA
  - Completed Initial Color - ISO 7724 - NASA
  - Completed Adhesion (Cross Hatch) - ISO 2409 – ISQ
  - Completed Impact (Reverse) - ISO 6272 – ISQ

- Completed Flexibility (Conical Mandrel) - ISO 6860 - ISQ
- Completed Flexibility (Cylindrical Mandrel) – ISO 1519 - NASA
- Competed Blistering - ISO 4628 – ISQ
- Completed Grade - ISO 2409 – ISQ
- Completed Penetration - ISO 1518 – ISQ
- Completed Fluid Resistance - ISO 1518 – ISQ
- Completed (1000 hours) Corrosion Resistance (Filiform) - EN 3665
- Completed (300 hours) Corrosion Resistance (Salt Spray) - ISO 7253 – ISQ
- Completed Artificial Weathering - ISO 2813 - ISO 7724 – NASA
- Completed Washability (Cleaning Efficiency) - ISO 2813 - ISQ
- Completed Strippability - AMS 3095 - ISQ
- Repeat all tests Restoration - AMS 3095 – ISQ
- Completed Heat Stability- ISO 1519 - ISO 3270- NASA.

Milestones

- Identified potential alternatives – September, 2004
- Developed Joint Test Plan and assigned testing to each stakeholder – October 2004 – February 2005
- Applied test coatings to access door on TAP aircraft for flight testing – November, 2004
- NASA completed its assigned testing from the JTP – February, 2007
- ISQ completed its assigned testing from the JTP – June, 2007
- Third evaluation of TAP Airbus A319 door after 2 years 8 months in service – June 27, 2007
- Draft Joint Test Report Completed - July 2007

Near-Term Goals

- Final Joint Test Report - (Data to be included with Non-Chrome Systems Project Final Report)

Link to C3P web site for more information (www.c3p.org)

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