AMTAS Structural Bonding Industry Feedback

31 October 2012
Current Working Group Projects-Feeback

- Effect of Surface Contamination on Composite Bond Integrity and Durability
  - Florida International University

- Improving Adhesive Bonding of Composites through Surface Characterization
  - Univ of Washington

- Durability of Adhesively Bonded Joints for Aircraft Structures (Metals)
  - Univ of Utah
Composite Bond Long-Term Durability Testing

**OBJECTIVES:**

- Assess the long term environmental durability performance of “good” composite adhesive bonds and “compromised” composite adhesive bonds
- Develop efficient, accelerated test methods that are predictive of long-term exposure behavior
- Mature in-line QC methods for assessment of prebond surface quality

### Materials
- CFRP fabric / tape substrates
  - Surf Preps:
    - Polyester peel ply
    - Grit blast
    - Manual Abrasion
    - Plasma
    - Peel ply + Plasma
    - Purposely contaminated peel ply
      - 1500, 2250, 3000, 5400, 6000 ppm

### Test Specimens
- 20 ply DCBs
- 4-ply DCBs with secondary bonded composite backers
- BAC5555 Wedge crack coupons 20 ply

### Aging Protocol
- No exposure
- 50% Moisture Saturation
- 100% Moisture Saturation
- RTA / Desk Drawer Environment
- Hot-Wet Environment

### In-Line QC
- Contact Angle (Surface Analyst)
- Fourier Transform IR Spectroscopy (FTIR)
- Inverse Gas Chromatography (IGC)
- TOF/SIMS

### Surface Analysis
- SEM
- XPS
- TOF/SIMS
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# QC Method Status - Comparison Table

<table>
<thead>
<tr>
<th>Method</th>
<th>Comments/Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual/Gloss</td>
<td>Can only detect gross defects. Not precise enough</td>
</tr>
<tr>
<td>Surface Texture/ Roughness</td>
<td>Surface Texture is only one factor for adhesion</td>
</tr>
<tr>
<td>Contact Angle</td>
<td>Need to relate process parameters to contact angle results</td>
</tr>
<tr>
<td>Infrared Spectroscopy</td>
<td>New tools maturing to meet multiple assessment needs</td>
</tr>
<tr>
<td>ESCA / XPS</td>
<td>Tools not yet suitable for factory use</td>
</tr>
<tr>
<td>Atomic Force Microscopy</td>
<td>Immature, tools not yet suitable for factory use</td>
</tr>
<tr>
<td>Electrochemical</td>
<td>Immature, need to relate to bond process parameters</td>
</tr>
<tr>
<td>Witness Panels</td>
<td>May not be exactly the same as part surface and give false readings</td>
</tr>
</tbody>
</table>
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Evaluation of Crack Growth Region

- Crack Growth Region Evaluation Guide
  - Rectangular crack growth region
  - Corresponding non-cohesion failure regions

Figure: Evaluation Guide
Evaluation of Failure Mode

- Failure Mode Evaluation Guide

1. Measurement Method

2. Grid Method with a 0.10 inch grid standard

Figure: Grid Method Evaluation Guide
Future Adhesive Bonding Working Group Collaboration Areas

- **Accelerated Durability Testing**
  - Composites
  - Metals

- **Lean, Efficient Test Methods**

- **Adhesive Properties Database for Analyses**
  - Test Methods
  - Database

- **Bond Process Monitoring**
  - Maturation of In-Line QC Processes
  - Vision Systems