DTM Coatings for Rail

Polyaspartic Ester Technology
By
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Bayer MaterialScience
Polyaspartic Topics

• Resin Technology
• Use in Rail Market
• New Developments in Technology
Polyaspartic Coatings

• What is a Polyaspartic Coating
  – Aliphatic polyurea based on secondary aliphatic diamines (polyaspartic esters) cured with an aliphatic polyisocyanate

• Features
  – Fast cure - productivity improvements
  – DTM
  – Aliphatic (Color and UV stability)
  – Moderately high film build (up to 15 mils)
  – Near zero VOC possible, but can be solventborne
  – Variable cure speed
Technology for the Future

• Wide VOC range
  – Low viscosity
  – Most common 330-400 g/l
  – Capable of near zero

• Pot life
  – Adjustable
    • 5-120 minutes

• Dry time
  – Minutes to 2-3 hours
  – Fast dry – No bake
## Resin Family

<table>
<thead>
<tr>
<th>Properties</th>
<th>Resin A</th>
<th>Resin B</th>
<th>Resin C-1</th>
<th>Resin C-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Solids</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>90 (BuAc)</td>
</tr>
<tr>
<td>Eq. Wt.</td>
<td>229</td>
<td>277</td>
<td>291</td>
<td>323</td>
</tr>
<tr>
<td>cps @ 25°C</td>
<td>150</td>
<td>1500</td>
<td>1500</td>
<td>150</td>
</tr>
<tr>
<td>Amine</td>
<td>Linear</td>
<td>Cycloaliphatic</td>
<td>Cycloaliphatic</td>
<td>Cycloaliphatic</td>
</tr>
<tr>
<td>Reactivity</td>
<td>High</td>
<td>Mid-high</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Gel Time(^1)</td>
<td>&lt; 5 min</td>
<td>12-120 min</td>
<td>6-24 hrs</td>
<td>6-24 hrs</td>
</tr>
<tr>
<td>APHA Color</td>
<td>250 max</td>
<td>250 max</td>
<td>250 max</td>
<td>250 max</td>
</tr>
</tbody>
</table>
Polyaspartics are Adaptable to High Solids Coatings

<table>
<thead>
<tr>
<th></th>
<th>cps as supplied</th>
<th>cps @ 75% Weight Solids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resin A</td>
<td>150</td>
<td>15</td>
</tr>
<tr>
<td>Resin B</td>
<td>1,500</td>
<td>18</td>
</tr>
<tr>
<td>Resin C-1</td>
<td>1,500</td>
<td>18</td>
</tr>
</tbody>
</table>
Comparing Technologies

• Polyaspartics
  – DTM / 2 Coat System
  – Fast cure - productivity improvements
  – Aliphatic (Color and UV stability)
  – Thin to Moderate film build (up to 25 mils)
  – Near zero VOC possible, but often solventborne
  – Variable cure speed
  – Low Temperature Cure

• Conventional PUR
  – 2 Coat System
  – Moderate cure speed when catalyzed
  – Aliphatic (Color and UV stability)
  – Thin film build (up to 6 mils DFT)
  – Solventborne - 2.8 lb./gal (340 g/L)
  – One cure speed
  – Low Temperature Cure
Influence of Ambient Moisture on Cure Speed

- Increasing temperature
- Set-to-Touch
- Hard Dry

Increasing grains water/cubic ft. vs. Increasing temperature

Bayer MaterialScience
# Dry Time Comparison of Polyaspartic to a Commercial Acrylic Topcoat

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Polyaspartic B 100%</th>
<th>Polyaspartic Blend B &amp; C</th>
<th>Commercial Acrylic</th>
</tr>
</thead>
<tbody>
<tr>
<td>40ºF</td>
<td>0.17</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>77ºF</td>
<td>0.17</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>To Touch (hours)</td>
<td>1</td>
<td>16</td>
<td>10</td>
</tr>
<tr>
<td>To Handle (hours)</td>
<td>0.5</td>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>

Dry times depend on film thickness, and to some degree humidity and solvent blend.
Dirt Pick-up / Dry Time

Blast Grit Applied 30 Minutes After Application
## Hardeners

<table>
<thead>
<tr>
<th>Hardener</th>
<th>Type</th>
<th>% Solids</th>
<th>% NCO</th>
<th>Viscosity</th>
<th>Reactivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardener A</td>
<td>Biuret</td>
<td>100</td>
<td>23</td>
<td>2500</td>
<td>Faster</td>
</tr>
<tr>
<td>Hardener B</td>
<td>Trimer</td>
<td>90</td>
<td>19.6</td>
<td>550</td>
<td></td>
</tr>
<tr>
<td>Hardener C</td>
<td>Trimer</td>
<td>100</td>
<td>23.5</td>
<td>700</td>
<td></td>
</tr>
<tr>
<td>Hardener D</td>
<td>IPDI Prepolymer</td>
<td>86</td>
<td>10.4</td>
<td>2000</td>
<td>Slower</td>
</tr>
</tbody>
</table>
Polyaspartic Topics

• Resin Technology

• Use in Rail Market

• New Developments in Technology
Railcar Study

- Single Coat Application
- 52 Hopper Cars
- Airless Application
  - Two Applicators
    - ~16 mils WFT
    - 20 min/car
- Surface Prep SSPC SP-6
  - 2-3 mil profile
Railcar Study

- Coatings Properties
  - 2 hr Pot Life
  - 2 hr Dry Time
    - Cars moved to next station
  - 9 mils DFT
- Stenciled with 3-4 hrs
  - Moved outdoor
• Excellent application in hard to coat areas
• ~30% Savings in time and labor

<table>
<thead>
<tr>
<th>Coating System</th>
<th>Material Usage</th>
<th>Labor Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTM Polyaspartic</td>
<td>36 Gallons</td>
<td>10.5 Hours</td>
</tr>
<tr>
<td>2 Coat Epoxy/Urethane</td>
<td>35 Gallons</td>
<td>15.5 Hours</td>
</tr>
</tbody>
</table>
Industrial Examples

Three (3) Coat vs. Two (2) Coat System,
Bridge No. 1199 over I-84
Cost Per Square Foot Comparison

<table>
<thead>
<tr>
<th>Item</th>
<th>3-Coat</th>
<th>2-Coat</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance &amp; Protection of Traffic</td>
<td>$9.26</td>
<td>$5.97</td>
<td>$3.29</td>
</tr>
<tr>
<td>Traffic Control Devices</td>
<td>$6.55</td>
<td>$5.63</td>
<td>$0.92</td>
</tr>
<tr>
<td>Containment (Rig./DeRig.)</td>
<td>$1.71</td>
<td>$0.99</td>
<td>$0.72</td>
</tr>
<tr>
<td>Equipment (Mob./Demob.)</td>
<td>$0.91</td>
<td>$0.70</td>
<td>$0.21</td>
</tr>
<tr>
<td>Abrasive Blasting</td>
<td>$0.38</td>
<td>$0.00</td>
<td>$0.38</td>
</tr>
<tr>
<td>Primer Coat</td>
<td>$0.60</td>
<td>$0.67</td>
<td>($0.07)</td>
</tr>
<tr>
<td>Intermediate Coat</td>
<td>$0.05</td>
<td>$0.04</td>
<td>$0.01</td>
</tr>
<tr>
<td>Top Coat</td>
<td>$1.97</td>
<td>$1.74</td>
<td>$0.23</td>
</tr>
<tr>
<td>Contractor QC</td>
<td>$0.56</td>
<td>$0.47</td>
<td>$0.09</td>
</tr>
<tr>
<td>Inspection (Owner's Consultant)</td>
<td>$1.28</td>
<td>$1.04</td>
<td>$0.24</td>
</tr>
<tr>
<td>Owner's Oversight</td>
<td>$78.89</td>
<td>$60.27</td>
<td>$18.62</td>
</tr>
<tr>
<td>Lead Health Protection</td>
<td>$102.16</td>
<td>$77.52</td>
<td>$24.64</td>
</tr>
</tbody>
</table>

As a result, energy consumption at the facility has been reduced by 75 percent. Time savings have been impressive as well, with poles being moved off the line nearly 70 percent faster.
Four Years into Service
Polyaspartic Topics

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Improved Water Resistance with New Hardener

Hardener A

Hardener D
Improved Recoat

• Touch-up

<table>
<thead>
<tr>
<th></th>
<th>Hardener A</th>
<th>Hardener D</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 days</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>7 days</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1 day</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3 days</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

1 day 3 days 7 days 14 days 28 days
Improved Cure Response

STT

Hardener D with increasing amounts of Resin B
Improved Cure Response
Hard Dry

Hardener D with increasing amounts of Resin B

Coatings Composition

Coating 1 Hardener A
Coating 1 Hardener D
Coating 3 Hardener D
Coating 4 Hardener D
Coating 5 Hardener D
DTM Railcar Coating Summary

• Mature resin technology
• Robust spray properties
• Proven productivity enhancement
• Demonstrated service life
• Next Generation Technology
  – Increased open time
  – Improved water resistance
  – Improved recoat / touch-up