Encapsulated Aluminum Pigments Improve Physical and Aesthetic Properties in Automotive and General Industrial Coatings.

Presented by David Stanko
Objective

Today’s coatings requirements (both Automotive OEM and the General Industrial Consumer Markets) have shown the need for metallic flakes that are alkali resistant, show improvement in acid resistance, improve the ability for touch up on OEM paint lines, while at the same time maintaining the desired aesthetics typical of metallic paints.
We chose two different technologies to test their performance for these areas

- Silica encapsulated Flakes
- Acrylic Resin encapsulated Flakes
Silica Technology

Features
- Non-Chromate Treatment
- Inorganic treatment
- Paste Form
- Propylene glycol ether solvent carrier

Benefits
- Excellent gassing & Stability in water
- Wide range of Styling effects
- Disperses easily in Water
- Excellent adhesion to plastic substrates
Polymer Encapsulated Products

Features
- Surface-treated aluminum pigments using an acrylic polymer
- Various Treatment levels
- Are available in a wide variety of non-leafing Aluminum Pigments

Benefits
- Alkali resistance
- Improved transfer efficiency
- Improved adhesion
- Reduction of “plate out” on calendaring equipment and extrusion screws (plastics)
- Electrically insulating
Project Review

Based on the needs of the market, we compared various Silica treated and Acrylic treated products for:

- Acid resistance
- Alkali resistance
- Recoatability after sanding
- Color
Improved acid and alkali resistance

Coatings that have been formulated with Organic (Polymer) encapsulated Aluminum, typically exhibit improved acid and alkali resistance when compared to coatings formulated with untreated aluminum coatings. Solutions of Sulfuric Acid and Sodium Hydroxide were used as the corrosive test chemicals.
Alkali (top) and Acid tested panels, encapsulated versus non-encapsulated
Alkali Resistance Test

- Coatings were made at the same metal loading in a solventborne acrylic resin along with transparent yellow and red colorants.
- Coatings were applied over Black ABS plastic and air dried for three days.
- Half of each panel was soaked in .1 N NaOH for 3 hours at 55 degrees C.
Acid Resistance Test

- Coatings were made at the same metal loading in a solventborne acrylic resin along with transparent yellow and red colorants.
- Coatings were applied over Black ABS plastic and air dried for three days.
- Half of each panel was soaked in .1 N H2SO4 for 3 hrs./ 55C + 21 hrs./ 25C.
Untreated 15 micron

Alkali Test

Acid Test
Silica treated 15 micron

Alkali Test

Acid Test
Silica treated Alkali Acid
15 micron Test Test
Polymer treated 15 micron
Alkali Test
Acid Test
Acrylic treated
15 micron

Alkali
Test

Acid
Test
Conclusions

- Untreated aluminum flakes exhibit very poor resistance to staining in an alkali environment.
- Silica treated flakes provide slightly better resistance to staining in an alkali environment, however it is still unacceptable.
- Silica treated flakes do not improve the resistance to staining in an acid environment.
- Polymer encapsulated flakes significantly improve the ability of the coating to resist staining in both alkali and acid environments.
Certain metallic coatings have exhibited a difficulty in their ability to be recoated after sanding.
Less marring from sandpaper abrasion

Coatings that have been formulated with Encapsulated Aluminums, typically exhibit improved abrasion resistance when compared to coatings formulated with untreated aluminum coatings.
Details of the Sandpaper Test

- Panels were sprayed with an automotive solventborne basecoat on a Spraymation machine.
- 400 grit sandpaper with a 1.5 kg weight.
- 10 automated rubs, wipe off, use new sandpaper, 10 more rubs, rinse and dry.
- Re-spray one half of panel on a Spraymation machine, then clear coated the panel.
Automated Sandpaper Rubs

An automated drawdown machine was used to insure the abrasions were close to equal.
Automated bar runs 19 cm/sec
Photos of sandpaper tested panels, recoated, non-encapsulated versus encapsulated
Untreated    Silica treated
22 micron   22 micron
Untreated  Silica treated
22 micron      22 micron
Untreated Silica treated
22 micron        22 micron
Untreated  
22 micron

Acrylic treated  
22 micron
Untreated
22 micron

Acrylic treated
22 micron
Conclusions

Coatings that have been formulated with Encapsulated Aluminums, typically exhibit improved abrasion resistance and recoatability when compared to coatings formulated with untreated aluminum flakes. Silica treated flakes outperformed the Acrylic treated flakes in this testing program.
What effect does the Silica and Acrylic treatments have on the color of the metallic coating?
Solventborne OEM Automotive Basecoat
Bell / Bell  Initial X-Rite  L-Values

<table>
<thead>
<tr>
<th>Grade</th>
<th>15°</th>
<th>25°</th>
<th>45°</th>
<th>75°</th>
<th>110°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Untreated</td>
<td>126.92</td>
<td>104.88</td>
<td>65.44</td>
<td>41.79</td>
<td>35.54</td>
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<tr>
<td>Acrylic treated</td>
<td>110.47</td>
<td>100.11</td>
<td>74.22</td>
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<td>102.13</td>
<td>72.52</td>
<td>45.71</td>
<td>35.78</td>
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<tr>
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<td>102.27</td>
<td>68.77</td>
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<tr>
<td>Silica treated</td>
<td>107.57</td>
<td>95.73</td>
<td>70.32</td>
<td>48.39</td>
<td>39.20</td>
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### Waterborne OEM Automotive Basecoat

**Bell / Bell**  
Initial X-Rite  
L-Values

<table>
<thead>
<tr>
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<th>45°</th>
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<tr>
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<td>101.49</td>
<td>67.31</td>
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A PLEASANT SURPRISE!
Degradation Resistance Test

We tested both the Silica and Acrylic treated grades in a Solventborne system for Degradation Resistance.

We also tested the Silica treated grades in a Waterborne system for Degradation Resistance.
## Solventborne OEM Automotive Basecoat L-Value Changes after Blender Mix

<table>
<thead>
<tr>
<th>Grade</th>
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<tbody>
<tr>
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<td>-10.38</td>
<td>-6.44</td>
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<td>Silica treated-16</td>
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<td>0.26</td>
<td>0.13</td>
<td>0.90</td>
<td>1.54</td>
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Untreated Control
Control Blender (-26.36)
Acrylic treated
Control  Blender (-12.15)
Acrylic treated
Control  Blender (-11.40)
Acrylic treated
Control Blender (-10.38)
Silica treated
Control  Blender (-6.67)
Silica treated  
Control  Blender (0.66)
# Waterborne OEM Automotive Basecoat L-Value Changes after Blender Mix

<table>
<thead>
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<th>Grade</th>
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<th>25°</th>
<th>45°</th>
<th>75°</th>
<th>110°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated Control16</td>
<td>-16.08</td>
<td>-8.06</td>
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<td>4.95</td>
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<tr>
<td>Untreated Control21</td>
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<td>Silica treated 16</td>
<td>-5.78</td>
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<td>Silica treated 21</td>
<td>-3.30</td>
<td>-0.49</td>
<td>2.15</td>
<td>1.44</td>
<td>0.87</td>
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<tr>
<td>Silica treated 21</td>
<td>-3.40</td>
<td>0.06</td>
<td>2.56</td>
<td>1.70</td>
<td>1.19</td>
</tr>
</tbody>
</table>
Untreated Control (16)
Control Blender (-16.08)
Silica Treated (16)  
Control   Blender (-8.04)
Silica treated (16)
Control  Blender (-5.78)
Untreated Control (21)
Control  Blender (-9.72)
Silica treated (21)
Control
Blender (-3.30)
Silica treated (21)
Control   Blender (-3.40)
Conclusions

Color:
In solventborne systems both Silica and Acrylic treated products lost varying degrees of brightness.
In waterborne systems Silica treated flakes improved in brightness versus Control.
Conclusions

- **Degradation resistance**
- In **Solvenborne** systems both the **Acrylic** and **Silica** treated flakes improved the degradation resistance of the Control.
- **Silica** treatment improved the Degradation Resistance more so than the **Acrylic** treated flakes did.
- In **Waterborne** systems **Silica** treated flakes vastly improved the Degradation Resistance of the flakes versus the Control.
Review

- Acid and Alkali resistance—Polymer treated flakes improve resistance—Silica treated flakes showed a slight improvement
- Abrasion recoatability—Silica treated flakes greatly improved the ability to recoat an OEM coating—Acrylic treated flakes showed a slight improvement
Review

- In our Solventborne system both Silica and Acrylic treated flakes lost varying degrees of brightness.
- In our Waterborne system Silica treated flakes improved the brightness of the coating.
- Both Silica and Acrylic treated flakes improved the degradation resistance of a coating.
Thank You!!