The VOC Voyage: An Enigmatic Journey

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Overview

• VOCs and Challenges
• Strategies to Comply with VOCs
• Surface Preparation
• Equipment and Training
Scientists and Soothsayers
VOC’s and Smog

Transportation 55%

Industry 16%

Solid Waste Disposal 2%

Other Fuel Combustion 21%

Miscellaneous 6%

From www.nbci.com
“Road to Recovery - The Angelinos Guide to Smog”
### Atmospheric Ozone Chemistry
(courtesy Clive Hare)

| 1. | $O_2 + NO_2 \xrightarrow{hv} NO + O_3$ |
| 2. | $R-H + OH\cdot \xrightarrow{} H_2O + R\cdot$ |
| 3. | $R\cdot + O_2 \xrightarrow{} R-O-O\cdot$ |
| 4. | $R-O-O\cdot + NO \xrightarrow{} RO\cdot + NO_2$ |
| 5. | $O_2 + hv \xrightarrow{} O\cdot + O\cdot$ |
| 6. | $O\cdot + O_2 + M \xrightarrow{} O_3 + M$ |
| 7. | $O_3 + hv \xrightarrow{} O\cdot + O_2$ |
| 8. | $O\cdot + O_3 \xrightarrow{} O_2 + O_2$ |
| 9. | $Cl\cdot + O_3 \xrightarrow{} ClO\cdot + O_2$ |
| 10. | $ClO\cdot + O\cdot \xrightarrow{} Cl\cdot + O_2$ |
Effects of VOC regulation on coatings industry have been both positive and negative

Negative effects have been more widely publicized than positive effects
Strategies to Comply with VOC Compliance

- Exempt Solvents
- Waterborne Coatings
- High Solids Coatings
- Solventless Coatings
- Powder Coatings
- Radiation Cured Coatings
# Strategy 1 – Exempt Solvents

<table>
<thead>
<tr>
<th>Solvent</th>
<th>Solvency</th>
<th>Evaporation</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>Excellent</td>
<td>Fast</td>
<td>Low</td>
</tr>
<tr>
<td>Tertiary Butyl Acetate</td>
<td>Good</td>
<td>Fast</td>
<td>Moderate</td>
</tr>
<tr>
<td>Parachlorobenzotrifluoride</td>
<td>Good</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Volatile Methyl Cyclosiloxane</td>
<td>Very Poor</td>
<td>Slow</td>
<td>Very High</td>
</tr>
</tbody>
</table>
Strategy 2 - Waterborne Coatings

- Environmentally Friendly
- Low Odor
- Thin with water
- Cannot be applied at Low Temps
- High Film Build - Adverse Effects
- Slow dry in High RH (keep < 80%)
(a) Single Component Waterborne
(Courtesy DOW)

Polymer

Composite particle formation

Pigment

C3/C4 < 100g/l
G, B, C, H
(b) Two Component WB Epoxies

Features:

- Low VOC < 100 g/L
- Excellent Salt Fog Resistance >1000 Hrs
- Good Early Water Resistance
- Excellent Hardness Development
- Excellent Chemical Resistance
- Fast Dry to Recoat
- Recoat with Solvent Borne & Waterborne
Coalescence Properties
(Courtesy HEXION)

Type 2 System
Avg. surface roughness = 25X

Type 5 System
Avg. surface roughness = 1.25X

SB Epoxy
Avg. surface roughness = 1X
Strategy 3 – High Solids Coatings

- Usually Epoxies and Urethanes
- Low Molecular Weight Resins
- Polysiloxanes and Polyaspartics
- Novolacs
- Excellent Performance
- High Build Capabilities
- Shorter pot life
- May require HD spray equipment
High Solids Epoxy - Low VOC HAPS Free
Organic Zinc
Solvent Free Epoxy for Decks
High Solids Epoxy LOW VOC HAPS Free
Organic Zinc
Solvent Free Epoxy for Decks
Acrylic Polysiloxane
Strategy 4 - 100% Solids Coatings

- Zero or minimal VOCs
- 1 coat
- Thick and Ultra Thick Films
- No risk of solvent entrapment
- Quick return to service
- Save time and labor
- Minimal OH&S issues
  - No worker exposure to solvents (no LEL)
  - No flash points (possible)
Solvent Free Epoxy (SFE) – Offshore Deck Coating

- Offshore rigs have typically used traditional 3 coat glass flake epoxy systems.
- SFE Provides a durable non-skid surface with appropriate aggregate
- SFE can be spray applied in a single coat.
Surface Preparation
- Abrasive blast clean (Sa 2½ / SSPC-SP10)
- Ultra high pressure / Water Jetting @ 40,000 psi

Spray Application
- In situ application possible
- Conventional Air spray
Critical Parameters for Low VOC Coatings

• Proper Surface Profile and Substrate Cleanliness

• New low VOC coatings often require higher pressure pumps

• Viscosity control best with heat
The Importance of Surface Profile

A abrasive G24 Grit Blasted
A abrasive G55 Grit Blasted
The Importance of Surface Profile

Abrasives S330 and S460 Shot Blasted
Corrosion Resistance

Corrosion creep versus abrasive type for System 2

Test Method

Corrosion Creep / mm

B117  20340 - A  20340 - B  NACE  D5894

G55  G24  S460  S330
Equipment and Training
Conclusions

- VOC strategies are sound and evolving
- Significant technical advancements for single component and two component WB technologies
- Significant technical advancements with High Solids Coatings and Solvent-Free linings
- Surface Profile and cleanliness is very important for Low VOC coatings
- Proper Spray Equipment and Training are important to successfully transfer Low VOC coatings
Thank You

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