Regulations Drive New Advancements in Rust Preventives
Aqueous Low VOC Rust Preventive Solutions

Jennifer Ineman
March 8th, 2012
Agenda

• New regulations require innovative solutions
• Aqueous low Volatile Organic Compounds (VOC) rust preventive
  – Market drivers
  – Project scope
  – Rust preventive performance
    • Aqueous vs. solvent
    • Heavy duty
    • Moderate duty
  – Applications
  – Benefits
NEW VOLATILE ORGANIC COMPOUND (VOC) REGULATIONS
Regulation of VOC Content

Federal Government:
EPA Regulations

State/Regional Regulations

End user product needs

State/Regional regulations impact end user requirements

Federal government imposes regional regulations
Formulating VOC Compliant Products

End user needs

Formulators utilize registered chemistry to meet performance requirements

Chemicals meet country specific chemical inventories

Regional regulations restrict use of diluents and additives

Chemical inventories may not reflect regional regulations
Combining Regulations and Formulating

Federal Government:
EPA Regulations

State/Regional Regulations

Fluids meet performances and regulatory requirements

Formulators utilize registered chemistry to meet performance requirements

Chemicals meet country specific chemical inventories
Regulation of VOC Content

• Rule 1144 is a regional regulations to “reduce VOC emissions from the use of metalworking fluids”*
  – “South Coast AQMD is the air pollution control agency for all of Orange County and the urban portions of Los Angeles, Riverside and San Bernardino counties, the smoggiest region in the U.S.”*

• Compliance will require fluid suppliers provide VOC data for products marketed in this region
  – Products are sold regionally and nationally
  – Regional requirements can have a national impact

*http://www.aqmd.gov/Default.htm
AQUEOUS LOW VOC RUST PREVENTIVE
Rust Preventive Market Drivers

**Regulation of VOC content**
- Eliminate flashpoint concerns
- Minimize adverse health and environmental effects
- Sales restrictions in regulatory rich geographies

**Removal and cleaning**
- Heavy duty rust preventives are difficult to remove for further processing
  - May require solvent and/or abrasive methods
  - Desire to use water-based alkaline cleaners

**Multi-functional**
- Provides a range of product performance utilizing the same raw materials
Project Scope: Aqueous Low VOC Rust Preventive

<table>
<thead>
<tr>
<th>Flexibility</th>
<th>Market Solutions</th>
<th>End User Demands</th>
</tr>
</thead>
</table>
| • Range of surfaces to be protected  
  – Metals  
  – Pre-treatments  
• Multiple application methods  
• Diverse performance requirements | • Hazards and costs associated with heavy metal exposure/disposal  
• Cleaning time and cost  
• Number of additives  
  – To respond to global demands  
  – To deliver multiple performance levels | • Easier cleaning  
• Cold temperature storage  
• Long lasting film in extreme atmospheres  
• Spray control  
• Uniform film formation |
New Challenges to Aqueous Based Rust Preventives

- Application of Finished Film
  - Part geometry
  - Variable film weights
  - Contamination
  - Wetting
  - Drying times
Aqueous Based Rust Preventive

Desired Features

- Exceptional salt spray protection
- Excellent acid fume protection
- Non-staining
- Removable by alkaline cleaning methods (>50°C)
- Low VOC content
- Does not contain heavy metals
- Formulation flexibility
- Cold temperature film flexibility
- Lubricity properties
## Heavy Duty Comparison

<table>
<thead>
<tr>
<th></th>
<th>Aqueous Based</th>
<th>Solvent Based</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product</strong></td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Total solids content, %</strong></td>
<td>35%</td>
<td>55%</td>
</tr>
<tr>
<td><strong>VOC content (lbs/gal)</strong></td>
<td>&lt;0.3</td>
<td>3.34</td>
</tr>
<tr>
<td><strong>Dry film thickness</strong></td>
<td>2.3 mils</td>
<td>2.3 mils</td>
</tr>
<tr>
<td><strong>24 hours drying time</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Flash point</strong></td>
<td>N/A</td>
<td>40°C</td>
</tr>
</tbody>
</table>
# Heavy Duty Performance Comparison

<table>
<thead>
<tr>
<th></th>
<th>Aqueous Based</th>
<th>Solvent Based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt spray ASTM B117</td>
<td>1000+ hrs</td>
<td>1000+ hrs</td>
</tr>
<tr>
<td>Cold rolled steel</td>
<td>800 hrs</td>
<td>600 hrs</td>
</tr>
<tr>
<td>Electrogalvanized</td>
<td>800 hrs</td>
<td>800 hrs</td>
</tr>
<tr>
<td>Iron phosphate</td>
<td>250 hrs</td>
<td>100 hrs</td>
</tr>
<tr>
<td>Acid fume 4N HCl</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Cold temperature Flexibility -20°C</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Humidity cabinet ASTM D1748</td>
<td>60+ days</td>
<td>60+ days</td>
</tr>
</tbody>
</table>
Film Weight vs. Drying Times

Drying = ambient temperature, relative humidity

Heavy Duty Performance Comparison

Aqueous Based
Solvent Based
Cleanability

- 15 minute static soak in 5% industrial cleaner at 50°C
- Follow with rinse and 30 second soak in 5% CuSO₄ solution for plating
- Copper plating indicates clean surface
- 2.3 mL dry film thickness
# Moderate Duty Comparison

<table>
<thead>
<tr>
<th></th>
<th>Aqueous Based</th>
<th>High Performance Solvent Based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>49%</td>
<td>20%</td>
</tr>
<tr>
<td>Total solids content, %</td>
<td>18*</td>
<td>20</td>
</tr>
<tr>
<td>VOC content, lbs/gal</td>
<td>&lt;0.15</td>
<td>5.21</td>
</tr>
<tr>
<td>Dry film thickness</td>
<td>0.5 mils</td>
<td>0.12 mils</td>
</tr>
<tr>
<td>24 hours drying time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dipping application</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flash point</td>
<td>N/A</td>
<td>40°C</td>
</tr>
</tbody>
</table>

*1% wetting agent added
## Moderate Duty Performance Comparison

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>Aqueous Based</th>
<th>High Performance Solvent Based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt spray ASTM B117 Cold rolled steel</td>
<td>500 hrs</td>
<td>175 hrs</td>
</tr>
<tr>
<td>Acid Fume 4N HCl</td>
<td>200 hrs</td>
<td>100 hrs</td>
</tr>
<tr>
<td>Humidity cabinet ASTM D1748 Cold rolled steel</td>
<td>60+ days</td>
<td>60+ days</td>
</tr>
<tr>
<td>Cold temperature Flexibility -20°C</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Stack stain, 1008 carbon steel MIL-C-22235A</td>
<td>Pass</td>
<td>Pass</td>
</tr>
</tbody>
</table>
Film Weight vs. Drying Times

Drying = ambient temperature, relative humidity
Cleanability

- 15 minute static soak in 5% industrial cleaner at 50°C
- Follow with rinse and 30 second soak in 5% CuSO₄ solution for plating
- Copper plating indicates clean surface
- Dry film after dip application
Aqueous Based Rust Preventive

- Salt spray results
- Comparison: neat and diluted in water

![Diagram showing corrosion protection times for different dry film thicknesses.](Image)
Aqueous Rust Preventive: Applications

- Tube and pipe
- Construction equipment
- Farm machinery
- Sound dampening
- Truck and trailer frame
- Wire rope and cable
Aqueous Rust Preventive: Applications

- Parts and equipment shipped overseas
- Rust preventive pre-lube
- Long term indoor parts and equipment storage
- Thin film blank wash

Moderate Duty Film
# Aqueous Low VOC Rust Preventive: Summary

<table>
<thead>
<tr>
<th>Desired features lead to…</th>
<th>Desired benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Exceptional salt spray protection</td>
<td>Added assurance that parts will not rust or stain when shipped or stored</td>
</tr>
<tr>
<td>• Excellent acid fume protection</td>
<td></td>
</tr>
<tr>
<td>• Non-staining</td>
<td></td>
</tr>
<tr>
<td>• Removable by alkaline cleaning methods (&gt;50ºC)</td>
<td>Reduce work-place hazards by utilizing water based cleaners</td>
</tr>
<tr>
<td>• Low volatile organic compound content (VOC)</td>
<td>Responsive to low VOC and heavy metal regulations</td>
</tr>
<tr>
<td>• Calcium based</td>
<td></td>
</tr>
<tr>
<td>• Hard water stability</td>
<td>Formulation flexibility that enables multiple performance levels while reducing complexity</td>
</tr>
<tr>
<td>• Cold temperature film flexibility</td>
<td></td>
</tr>
<tr>
<td>• Lubricity properties</td>
<td></td>
</tr>
</tbody>
</table>
Aqueous Based Rust Preventive: It can be done!

Responsive to regulatory issues
- Low VOC content
- No heavy metals

Performance = Protection
- Extreme atmosphere
- Non-staining

Formulation flexibility
- Multiple performance levels
- Reduced complexity
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