Aspects of Coating Technology for Granular Fertilizers

Victor Granquist, Nufarm Specialty Products, Inc.
Lobeco, South Carolina, USA
• The role of coatings in fertilizer performance
• Types of coatings
• Performance examples
• Application techniques
• Cost and selection criteria
• Fertilizer trends affecting coatings
• Conclusions
Role of Coatings on Granular Fertilizers

- A coating is a surface treatment applied to solid fertilizers
- Coatings can be liquid, solid, thermoplastic, reactive
- The function of a coating may be to:
  - Control dust emission
  - Minimize caking (bag set, pile set)
  - Enhance flowability
  - Minimize moisture pickup
  - To stabilize the surface
  - Improve compatibility in end uses
  - To enhance appearance
  - Modify nutrient release characteristics
Role of Coatings on Granular Fertilizers

- A coating is used to preserve the quality of manufactured fertilizer through shipping, storage and handling.
- Typically coatings cannot correct inherent problems in granule integrity or stability:
  - Poor shape and surface
  - Excessive porosity
  - Softening over time
  - High moisture content
  - Poor process control or excessive rates
- In some cases, process additives can help to mitigate the above problems, as well as process modifications.
<table>
<thead>
<tr>
<th>Type of Coating</th>
<th>Pros and Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particulates (sometimes called parting agents), clay, talc, etc</td>
<td>Good for flowability and caking, but Increases dust, high amount needed</td>
</tr>
<tr>
<td>Coating oils (fuel oil, asphaltic oils, refined oils, natural oils, fats)</td>
<td>Good for dust, not so good for caking</td>
</tr>
<tr>
<td>Thermoplastic mixtures (wax, waxy surfactants, sulfur, resins, polymers)</td>
<td>Good for dust and caking, somewhat higher cost</td>
</tr>
<tr>
<td>Water-soluble liquids (glycerin, molasses, surfactant solutions, polymer solutions)</td>
<td>For special applications where solubility is needed</td>
</tr>
<tr>
<td>Polymer systems (polymerized film via reaction with surface or crosslinking on top of surface)</td>
<td>Costly, difficult process, but high performance</td>
</tr>
</tbody>
</table>
### Dust Control, Granular Sulfur

<table>
<thead>
<tr>
<th>Sample Name</th>
<th>mg dust/kg sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>740</td>
</tr>
<tr>
<td>Light oil</td>
<td>150</td>
</tr>
<tr>
<td>Viscous oil</td>
<td>83</td>
</tr>
<tr>
<td>EP 533</td>
<td>84</td>
</tr>
<tr>
<td>EXP BSO1</td>
<td>31</td>
</tr>
</tbody>
</table>

**IFDC-type gravimetric test**
Optical Dust Test

- Rotating drum gives dust emission
- Measures absorbance of light source, output to computer or recorder
- Can differentiate “heavy” and “light” dust
- Can measure abrasion
Optical Dust Test Output

Dust from Dicalcium Phosphate 21P

Intensity vs. time graph showing the intensity of dust particles over time for different samples. The graph includes data points for:
- Uncoated
- G27 89.1 at 1000ppm
- Drake oil 15 at 1000ppm
- G27 95.1a
- HT 100 Oil at 1000 ppm
- G27 89.2 at 1000 ppm

The graph shows the intensity decreasing over time for all samples.
## Wax vs. Anti-caking Product, Effect on Caking tendency

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Caking tendency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncoated AS</td>
<td>15.2</td>
</tr>
<tr>
<td>wax only, 1000 ppm</td>
<td>7.4</td>
</tr>
<tr>
<td>Galoryl ATH 610, 500 ppm</td>
<td>0.15</td>
</tr>
<tr>
<td>Galoryl ATH 610, 1000 ppm</td>
<td>0.1</td>
</tr>
<tr>
<td>Galoryl ATH 632, 500 ppm</td>
<td>&lt; 0.1</td>
</tr>
</tbody>
</table>
**“Coating Oil” vs. an Anti-caking/Dust Control Product**

**Caking test results:** August 1, 2003

<table>
<thead>
<tr>
<th>Dosage (Kg/mT)</th>
<th>Temperature of coatings</th>
<th>Crushing strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscous oil</td>
<td>2</td>
<td>Ambient</td>
</tr>
<tr>
<td>Viscous oil</td>
<td>2</td>
<td>90°C</td>
</tr>
<tr>
<td>Galoryl® ATH F100</td>
<td>2</td>
<td>Ambient</td>
</tr>
<tr>
<td>Galoryl® ATH 714</td>
<td>2</td>
<td>90°C</td>
</tr>
<tr>
<td>Uncoated</td>
<td>-----</td>
<td>-----</td>
</tr>
</tbody>
</table>

**Note:** FF = free-flowing (no caking)

**Dust test results:** Galoryl Optical Dust Test Method

<table>
<thead>
<tr>
<th>Dosage Kg/mT</th>
<th>Dust index T0</th>
<th>Dust index T15 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscous oil</td>
<td>2</td>
<td>3,75</td>
</tr>
<tr>
<td></td>
<td>8,5</td>
<td></td>
</tr>
<tr>
<td>Galoryl® ATH F100</td>
<td>2</td>
<td>7,5</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Galoryl® ATH 714</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5,5</td>
<td></td>
</tr>
<tr>
<td>Uncoated</td>
<td>-----</td>
<td>679</td>
</tr>
<tr>
<td></td>
<td>787</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Samples aged 15 days @ 40°C for final test
Moisture Protection on Ammonium Nitrate

Uncoated  700 ppm Galoryl  1200 ppm Galoryl
Moisture Absorption Test on Compacted Ammonium Sulfate

Coating 1  Coating 2  Uncoated
Coating drums: spray inside drum
Blenders: Spray or inject coating during blending (paddle, ribbon, etc.)
Screw conveyors: Cut-flight and live-bottom conveyors sometimes used
Spraying at drop point in conveyor system using some type of enclosure
Specialized processes such as Wurster, TVA system for sulfur-coated urea, etc.
• Maximize surface area exposure, while minimizing void space
• Matching rate of coating application to rate of surface area exposure
• Selection of coating
  • Viscosity/temperature curve
  • Spreadability during application
• Nozzle type, number, concentration, temperature
Application Techniques:

Spray Chamber Operation for Truck Loading
Coating cost per ton of fertilizer

- Low end of range, dust control only, byproduct materials: $0.50 - 1.00/ton
- Middle of range, dust and anti-caking, other performance criteria: $1 - 3 /ton
- High end of range: Special compositions, completely soluble in salt solutions, controlled release, food-grade, etc.: $3 - 10+/ton
Coating selection criteria

• Reasonable cost per ton of product
• Reliable supply/reliable supplier
• Safety, toxicity, environmental fate
• Service/knowledge of supplier
• Performance criteria: Does it work in the field?
• Customer acceptance
Trends affecting fertilizer coatings

• Increase in imports, blends & liquid fertilizers puts pressure on price, **AND** spurs the need to differentiate products via quality
• Quality of imports likely to improve
• Blended fertilizer demands quality improvements for size, compatibility, flowability, dust and abrasion control
• High-performance specialty products will increase due to producer’s need to survive in today’s market
• Government regulation trends:
  • Reduction/ Elimination of petroleum oils for dust control: Europe
  • Control of nutrient run-off and percolation into groundwater
  • Control of toxic compounds
Trends affecting fertilizer coatings

- Drive toward quality has increased the use of coatings
- Slim margins limit price, thus limiting technological advancement
- High performance at low cost demanded (cheaper and better)
- Factors such as import pressure, regulations, agronomic need and need to differentiate fertilizer products resulting in:
  - Higher tech fertilizer products $\rightarrow$ higher tech coatings
  - Higher prices for specialty fertilizers $\rightarrow$ more innovation
  - Increase in controlled-release development and use
  - S, H & E improvements may be needed $\rightarrow$ “Green products”
- Few coating suppliers exist that can respond effectively to changes in technology
Conclusions

• Low end coatings offer good dust control performance at a low price for row crop fertilizers
• Cannot deliver advanced technology at these prices
• High technology coatings (controlled-release, etc.) available but used only for horticulture, orchards, etc.
• Will the market evolve to allow value-added coating technology use in annual row crop fertilizers?
• Can coating technology adapt such that higher technology will be more economical?

Can we meet in the middle?
Thank you!