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Aspects of Coating Technology for Granular Fertilizers

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Overview

- 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

Types of Coating Materials

Type of Coating	Pros and Cons
• Particulates (sometimes called parting agents), clay, talc, etc	Good for flowability and caking, but Increases dust, high amount needed
• Coating oils (fuel oil, asphaltic oils, refined oils, natural oils, fats)	Good for dust, not so good for caking
• Thermoplastic mixtures (wax, waxy surfactants, sulfur, resins, polymers)	Good for dust and caking, somewhat higher cost
• Water-soluble liquids (glycerin, molasses, surfactant solutions, polymer solutions)	For special applications where solubility is needed
• Polymer systems (polymerized film via reaction with surface or crosslinking on top of surface)	Costly, difficult process, but high performance

Performance Examples

Dust Control, Granular Sulfur

Sample Name	mg dust/kg sample
Untreated	740
Light oil	150
Viscous oil	83
EP 533	84
EXP BSO1	31

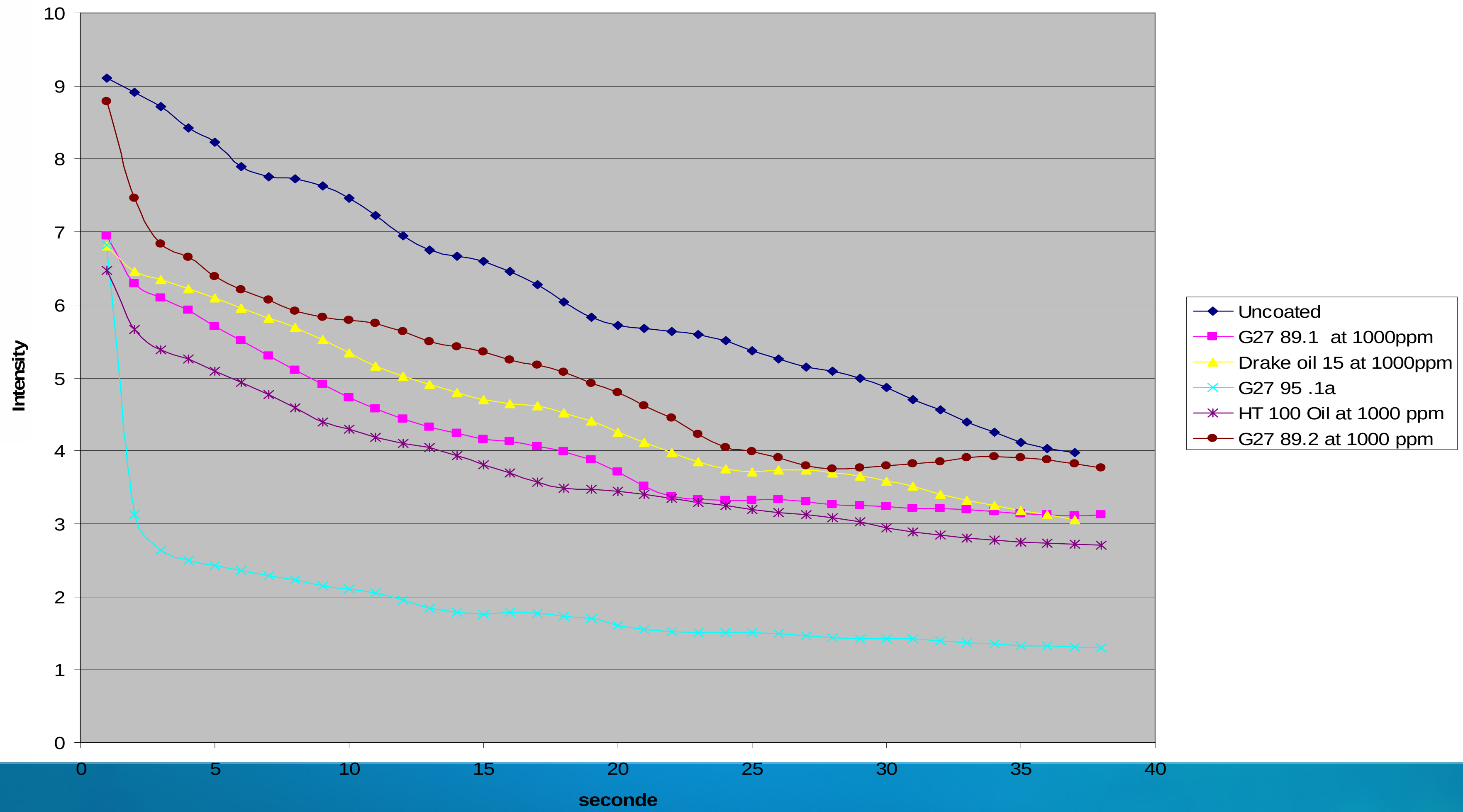
IFDC-type gravimetric test

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



Wax vs. Anti-caking Product, Effect on Caking tendency

Uncoated AS	15.2
wax only, 1000 ppm	7.4
Galoryl ATH 610, 500 ppm	0.15
Galoryl ATH 610, 1000 ppm	0.1
Galoryl ATH 632, 500 ppm	< 0.1

“Coating Oil” vs. an Anti-caking/Dust Control Product

Caking test results : August 1, 2003

Results after 14 days under 2 kg/cm² pressure			
Temperature of fertilizer : 40°C			
	Dosage (Kg/mT)	Temperature of coatings	**Crushing strength**
Viscous oil	2	Ambient	**13,2**
Viscous oil	2	90°C	**18**
Galoryl® ATH F 100	2	Ambient	**FF**
Galoryl® ATH 714	2	90°C	**FF**
Uncoated	------	------	**14,3**

Note: FF = free-flowing (no caking)

Dust test results: Galoryl Optical Dust Test Method

Temperature of fertilizer : 40°C. Temperature of coatings : ambient.			
	Dosage	**Dust index**	
	Kg/mT	**T0**	**T15 days**
Viscous oil	2	**3,75**	**8,5**
Galoryl® ATH F100	2	**7,5**	**8**
Galoryl® ATH 714	2	**4**	**5,5**
Uncoated	-----	**679**	**787**

Note: Samples aged 15 days @ 40C 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

Application Techniques

- 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.

Optimizing application efficiency

- 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

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

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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 → higher tech coatings
  - Higher prices for specialty fertilizers → more innovation
  - Increase in controlled-release development and use
  - S, H & E improvements may be needed → “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?

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Thank you!

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