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# The Role of Coatings and Additives in Improving the Performance of Fertilizer Products of The Nufarm Group

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## **Fertilizer Characteristics Demanded by the Market**

- Narrow size distribution
- Shape: roundness and surface smoothness
- Hardness: high crush strength, resistance to attrition
- Free from excessive dust and caking
- Low moisture content
- Resistance to moisture absorption

## **Criteria for Quality Fertilizer**

- To deliver a high-quality product, the manufacturer must:
  - Produce a high-quality granule  
(the role of process and process additives)
  - Preserve the quality during storage, handling and shipping  
(the role of coatings and conditioning agents)

## **The Role of Fertilizer Coatings**

- Coatings can preserve quality by:
  - reducing caking tendency
  - delaying or preventing moisture pickup
  - minimization of dust generation
  - reduction of attrition during handling
  - improving flowability
- Key item: prevent caking and moisture pickup

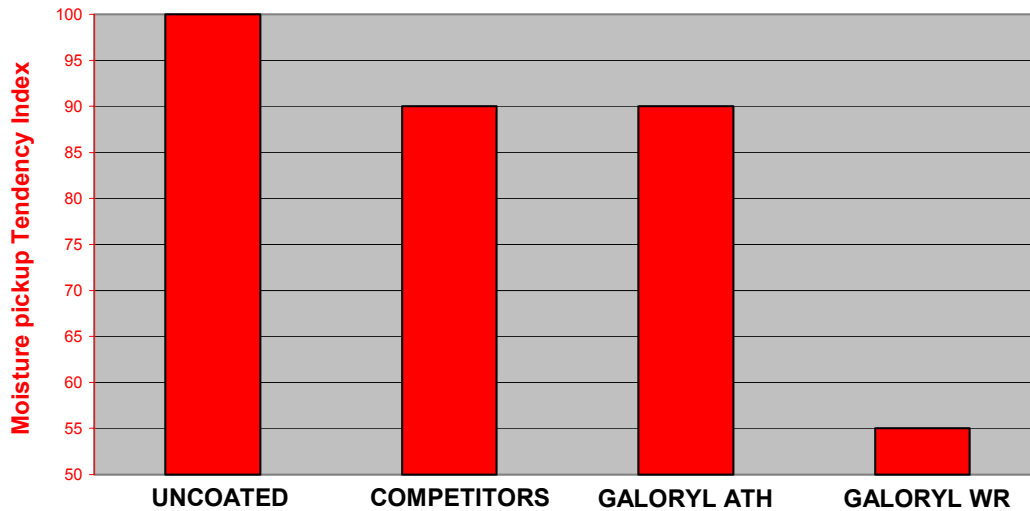
## **Prevention of Caking**

- Shape and smoothness of surface
- Narrow particle size distribution
- Hardness (avoid plastic deformation)
- Termination of crystal growth and modification of crystals formed (prevent crystal bridging)
- Low moisture absorption tendency
- Good Lubricity

## **The Development of Coatings**

- For crystal termination and modification, the technology has evolved over the years:
  1. Particulates (talc, clay, DE or keiselguhr)
  2. Water-soluble surfactant technology
  3. Coating oils
  4. Complex formulations with oil-soluble surfactants in oil and wax base
  5. Improved anti-caking and hydrophobic performance

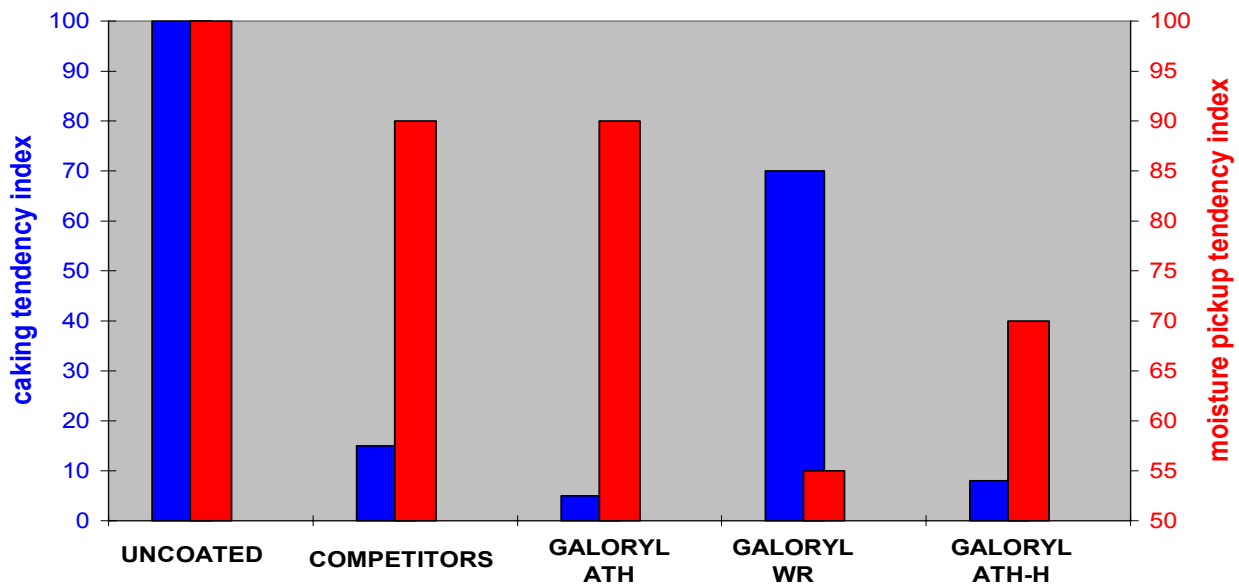
## Hydrophobic Performance Patent EP 692468 Galoryl WR Product Range



### Anti-caking vs Hydrophobic Performance

- There is a compromise between optimum hydrophobic performance and anti-caking performance
- CFPI was able to find a good compromise, but only after developing new formulation technology, patented under: EP 702999

### Anti-caking vs. Hydrophobic Performance Compromise Patent EP 702999



### Fertilizer Problems that Coatings Cannot Solve

- Problems specific to the granule itself cannot be solved by coatings, such as:
  - Poor hardness
  - Bad size distribution

- Irregular shape, rough surface
- Poor plant efficiency or yield
- High moisture content

### **The Role of Process Additives**

- Process additives can often help to improve physical characteristics or yield
- Where a process additive is successful, often several parameters can be improved at the same time
- Older plants can improve the process without capital expenditure
- Process additives are very specific to a particular process

### **Examples of Current Additives**

- Formaldehyde (UF85) for urea hardening
- Inorganics in ammonium nitrate (AN)
  - Magnesium nitrate
  - Ammonium or Aluminum sulfate
  - Permalene
  - Clays
- Lignosulfonate used as a binder and granulation aid in DAP production

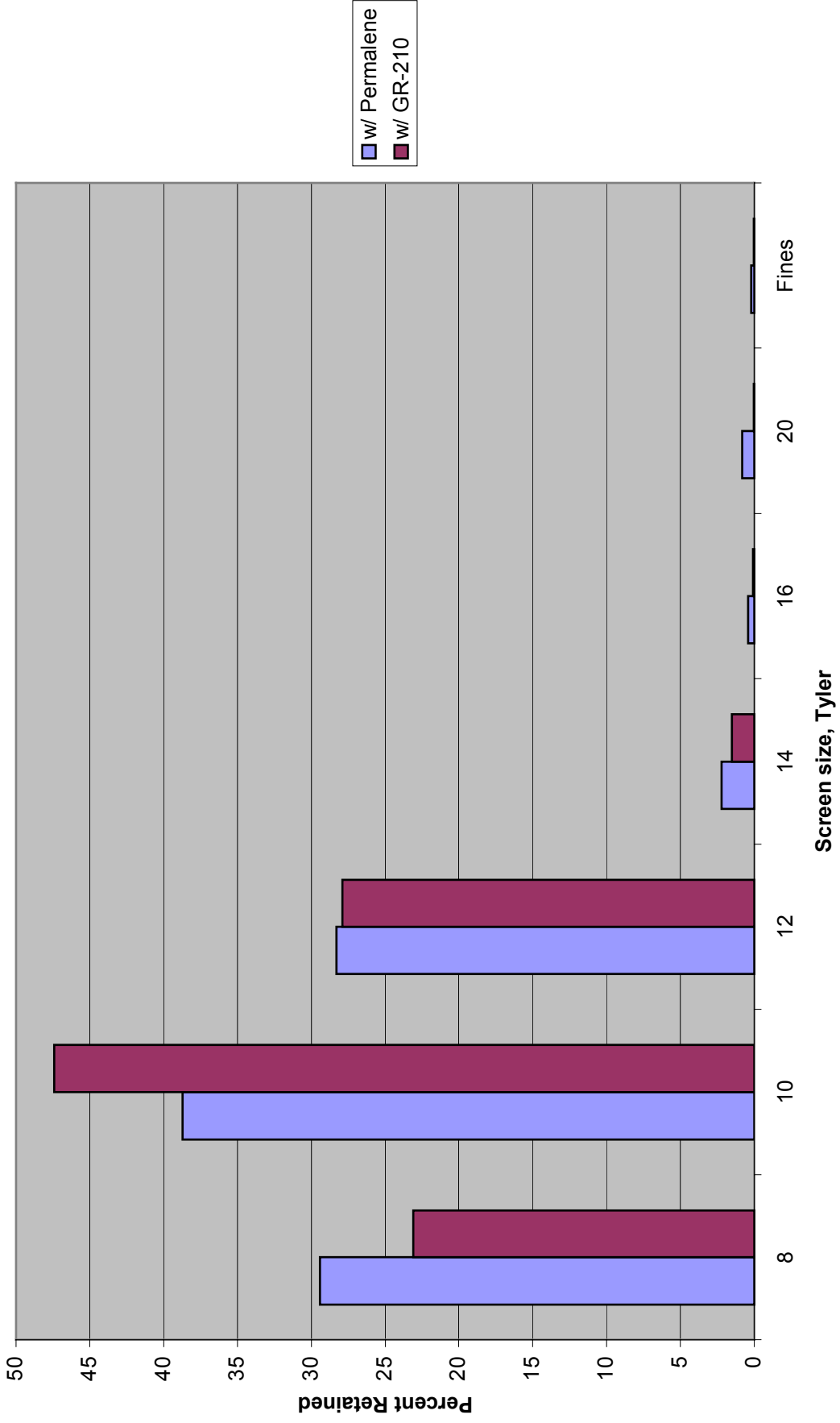
### **Examples of Current Additives 2**

- Nufarm's Galoryl AT for industrial-grade AN (Kaltenbach-Thuring process)
- Nufarm's Galoryl GR for fluidized-bed granulation and fattening
- Clay for use in granulation of fines (AJ Sackett patent no)

### **Drum Granulation of HDAN**

- A new Nufarm Galoryl GR product is in commercial use for drum granulation of high-density ammonium nitrate
- Benefits include:
  - Improved hardness
  - Greatly reduced recycle, better size distribution
  - Much more spherical and smooth granules
  - Lower moisture content

### HDAN Prill, Size distribution, Permalene vs. Galoryl GR 210



**Galoryl GR Additives for High-Density Ammonium Nitrate**

*Results from production of granular HDAN using Galoryl GR*

<b>Parameter (Plant no. 1 production)</b>	<b>No GR</b>	<b>With GR</b>
<b>Size on +8 mesh, % (see note 1)</b>	<b>57</b>	<b>80</b>
<b>Impact hardness test, % breakage</b>	<b>68</b>	<b>25</b>
<b>Hardness, crush test, lb</b>	<b>4</b>	<b>6.5</b>
<b>Sphericity test, % (see note 2)</b>	<b>78</b>	<b>88</b>
<b>Product moisture, %</b>	<b>0.09</b>	<b>0.06</b>

<b>Parameter (from plant trial, Plant no. 2)</b>	<b>No GR</b>	<b>With GR</b>
<b>Average hardness, crush test, lb</b>	<b>3.6</b>	<b>6.4</b>
<b>Impact hardness test, % breakage</b>	<b>5.8</b>	<b>0.0</b>

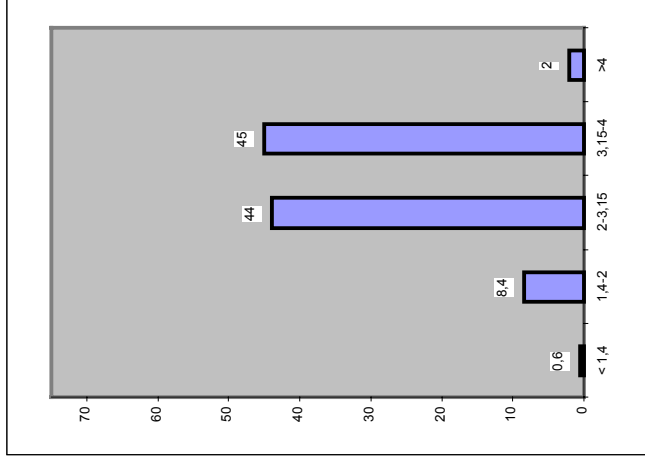
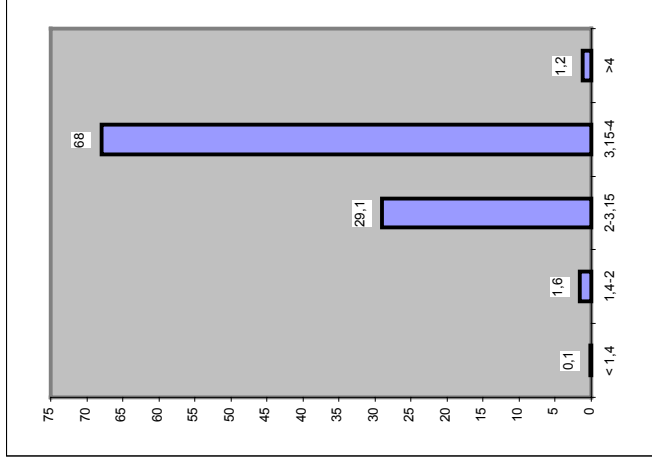
*Results from production of prilled HDAN*

<b>Parameter (Plant 3 trial)</b>	<b>With Permalene</b>	<b>With GR 210</b>
<b>Friability index, % (5% max.)</b>	<b>3.5</b>	<b>2.5</b>
<b>Fines, %</b>	<b>0.2</b>	<b>0.03</b>

**PUG-MILL GRANULATION OF CAN**

**WITH GALORYL GR**

**WITHOUT GALORYL GR**



**Sizes of granules**

<b>Hardness Size 2-4mm</b>	<b>4,22 kgf</b>	<b>3,69 kgf</b>
<b>Caking results</b>	<b>11 kgf</b>	<b>15,3 kgf</b>
<b>Sphericity</b>	<b>good</b>	<b>less</b>

### **Process Additive Implementation**

- Process additives are very specific and can be difficult to implement:
  - The producer should have good, experienced technical assistance from the supplier
  - Supplier and producer must work together as partners, with careful consideration
  - Initial application cannot be done haphazardly, as this could break granulation

### **Future Developments**

- The Nufarm Group will continue granulation additives development. Anticipated future applications include:
  - Shape modifiers for DAP and MAP
  - Granulation aids for NPK
  - Hardeners and shape modifiers for urea
  - Granulation additive for industrial-grade AN