Fluid Fertilizer Foundation: Technology Roundup

11-37-0 vs 10-34-0,
Ortho vs Poly Products:
Production & Storage Characteristics

Del Butler
December 6, 2016
Process Overview

Phosphate Rock (Ore) Mined & Milled

Thermal Process
Reduced (Vaporized)

Elemental Phosphorus (P4)

PPA

Round Up

Wet Process
Reacted (Liquified)

Dihydrate

Hemihydrate

Evaporation

Granulation

SPA

MGA

MAP

DAP

APP

NH3 Supply

SSP

TSP

Dical

(Replacing)

“Rock Phosphate” (Organic?)

Evaporation

Granulation

SPA

MGA

MAP

DAP

APP

NH3 Supply

SSP

TSP

Dical

(Replacing)
High Quality Ammonium Polyphosphate: “The Goal”

- Non-Corrosive
  - Understanding Passivation
- Long Shelf Life / Storage Capacity
- Diverse Application Methods
  - Safe in Band Applications
  - Compatibility: Blending Potential
  - Ability to hold other Micronutrients
  - Ect.
## High Quality APP: Physical Properties

<table>
<thead>
<tr>
<th></th>
<th>10-34-0</th>
<th>11-37-0</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pH</strong></td>
<td>6.2</td>
<td>6.1</td>
<td></td>
</tr>
<tr>
<td><strong>% Ortho-Phos</strong></td>
<td>30</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td><strong>% Poly-Phos</strong></td>
<td>70</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td><strong>Salt Index</strong></td>
<td>20</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td><strong>Weight (lbs/gal)</strong></td>
<td>11.6</td>
<td>12.0</td>
<td></td>
</tr>
<tr>
<td><strong>Specific Gravity</strong></td>
<td>1.390</td>
<td>1.440</td>
<td></td>
</tr>
<tr>
<td><strong>Appearance</strong></td>
<td>Emerald Green</td>
<td>Emerald Green</td>
<td></td>
</tr>
<tr>
<td><strong>Odor</strong></td>
<td>Little to No Odor</td>
<td>Little to No Odor</td>
<td></td>
</tr>
<tr>
<td><strong>Non-Recommended Storage</strong></td>
<td>Aluminum</td>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td><strong>Freeze Point</strong></td>
<td>N.A.</td>
<td>N.A.</td>
<td></td>
</tr>
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</table>
11-37-0 Poly Degradation in Storage
(in a lab controlled environment)
IL-37-0 Product Solids Formation in Storage
(in a lab controlled environment)
Storage Temperature & Polyphosphate (field data)

Date

Temperature (°F)

Polyphosphate (%)

Poly's

Temperature
High Quality Low Salt Liquid (LSL) NPK’s: “The Goal”

- Seed Safe
- Foliar Applicable
- Low Salt Index
- Uniquely Targeted Ortho/Poly Content
  - (specific to the immediate agricultural need)
- Non-Corrosive
- Long Shelf Life / Storage Capacity
- Compatibility: Blending Potential
- Ability to hold other Micronutrients
  - (100% EDTA, EDDHA Chelated, and Sulfate forms of Micronutrients)
- Diverse Application Methods
Technical Review!
Salt Index & Calculations

- **SI** – Relation of the extent a fertilizer increases the osmotic pressure of a soil compared to Sodium Nitrate (NaNO$_3$).
  - Greater the SI value, the greater potential damage to the seed/plant
  - Fertilizer formulations &/or blends with **SI above 20** are **not recommended** near the seed

<table>
<thead>
<tr>
<th>SI Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-18-18</td>
</tr>
<tr>
<td>4-16-16</td>
</tr>
<tr>
<td>6-24-6</td>
</tr>
<tr>
<td>10-10-10</td>
</tr>
<tr>
<td>10-34-0</td>
</tr>
<tr>
<td>11-37-0</td>
</tr>
<tr>
<td>11-52-0</td>
</tr>
<tr>
<td>Ammonia</td>
</tr>
<tr>
<td>UAN 32</td>
</tr>
<tr>
<td>Urea</td>
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</table>
**High Quality NPK: Physical Properties**

<table>
<thead>
<tr>
<th></th>
<th>3-18-18</th>
<th>4-16-16</th>
<th>LP 6-24-6</th>
<th>MP 6-24-6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pH</strong></td>
<td>7.4-7.8</td>
<td>7.6-7.8</td>
<td>6.3-7.0</td>
<td>6.3-7.0</td>
</tr>
<tr>
<td><strong>% Ortho-Phos</strong></td>
<td>100</td>
<td>100</td>
<td>80</td>
<td>50</td>
</tr>
<tr>
<td><strong>% Poly-Phos</strong></td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td><strong>Salt Index</strong></td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td><strong>Weight (lbs/gal)</strong></td>
<td>11.7</td>
<td>11.4</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td><strong>Specific Gravity</strong></td>
<td>1.410</td>
<td>1.360</td>
<td>1.340</td>
<td>1.330</td>
</tr>
<tr>
<td><strong>Appearance</strong></td>
<td>Water White</td>
<td>Water White</td>
<td>Translucent Green</td>
<td>Translucent Green</td>
</tr>
<tr>
<td><strong>Odor</strong></td>
<td>No Odor</td>
<td>No Odor</td>
<td>No Odor</td>
<td>No Odor</td>
</tr>
<tr>
<td><strong>Prohibited Storage</strong></td>
<td>Aluminum</td>
<td>Aluminum</td>
<td>Aluminum Mild Steel</td>
<td>Aluminum Mild Steel</td>
</tr>
<tr>
<td><strong>Freeze Point</strong></td>
<td>-2°F</td>
<td>0°F</td>
<td>5°F</td>
<td>5°F</td>
</tr>
</tbody>
</table>
Fundamental Chemistry: “Water White LSL”

Base chemical reactions:

1) \[ 2\text{H}_3\text{PO}_4 + 3\text{KOH} \rightarrow \text{KH}_2\text{PO}_4 + \text{K}_2\text{HPO}_4 + 3\text{H}_2\text{O} + \text{Heat} \]

| PPA        | Potassium Hydroxide | Mono Potassium Phosphate | Di Potassium Phosphate | Water | Heat |

2) \[ \text{NH}_3 + \text{KH}_2\text{PO}_4 \rightarrow \text{KNH}_4\text{HPO}_4 + \text{Heat} \]

| Ammonia | Mono Potassium Phosphate | Di Basic Potassium Ammonium Phosphate | Heat |

Note! Dissolution of Urea:

- The addition of Urea does not participate in the chemical reaction.
- The dissolution of Urea is slightly endothermic.
- Once dissolved, the Urea will remain in solution regardless of pH or temperature.
Salting Potential (if misformulated)

Salting (Mono Potassium Phosphate Crystals)
Over Ammoniation

Ammonia Sparger: Salting - Ammonium Phosphate Crystals
Keeping the System Clean

- Bag Filters catch any solids, particulates or contaminants that are typically introduced from the dry urea source.
Correlation: Low Polys & Storage

If the mass temperature of LP 6-24-6 is allowed to climb and then be held above ~100°F, the material will become a soft-set jell and increasing take a harder set over time.

Even with aggressive agitation, once this material jells, it will not return to a full fluid state.
Low Poly 6-24-6 Degradation

% Polyphosphate vs. Aging Days at 70F, 90F, and 120F.
Low Poly b-24-b Viscosity

Material Gelled

Viscosity (cP)

Aging Days

70F
90F
120F
What's the Data Telling Us?

There are similar and yet different conditions that should not be overlooked!
Superior MP 6-24-6

High Quality NPK: (when properly formulated)

Stored in North Dakota in excess of 2½ Years

Mid-Poly 6-24-6
Bottom

Top
3-18-18
Questions