**Indianapolis Marriott East**

### Wednesday, December 8, 2010

<table>
<thead>
<tr>
<th>Time</th>
<th>Session A</th>
<th>Session B</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00</td>
<td>Storage Tank Inspection, Maintenance &amp; Failure (C. Brooks)</td>
<td>Use of VRT Programs In Dealer Research (M. Wiebers)</td>
</tr>
<tr>
<td>11:50</td>
<td>Lunch</td>
<td>Lunch</td>
</tr>
<tr>
<td>12:00</td>
<td>DOT Rail Tank Car Certification (M. Orr)</td>
<td>Urea Volatilization: How Large Is The Issue and Losses (D. Kissel)</td>
</tr>
<tr>
<td>1:50</td>
<td>New Technologies: Products and Additives (D. Leikam)</td>
<td>Statistics: How They Are Used and Mis-used (S. Staggenborg)</td>
</tr>
<tr>
<td>2:30</td>
<td>UAN Management: Corrosion, Composition, etc (R. Satterfield)</td>
<td>Fluid Starter Fertilizer Sources (D. Zabel)</td>
</tr>
<tr>
<td>6:00</td>
<td>Fluid Storage and Shelf Life Issues (J. Walker and Panel)</td>
<td>Social Time / Reception</td>
</tr>
</tbody>
</table>

### Thursday, December 9, 2010

<table>
<thead>
<tr>
<th>Time</th>
<th>Session A</th>
<th>Session B</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00</td>
<td>Announcements, Housekeeping</td>
<td>Announcements, Housekeeping</td>
</tr>
<tr>
<td>9:10</td>
<td>Micronutrient Compatibilities (A. Robinett)</td>
<td>High Yield Systems; Fertility Programs For The Future (M. Alley)</td>
</tr>
<tr>
<td>10:10</td>
<td>Break</td>
<td>Break</td>
</tr>
<tr>
<td>10:10</td>
<td>Regulatory Update and Other Issues (J. Payne)</td>
<td>Five Factors To Improve The Odds For High Yields (M. Bauer)</td>
</tr>
<tr>
<td>11:00</td>
<td>Fluid Storage and Shelf Life Issues (J. Walker and Panel)</td>
<td>High Yield Systems: Role of Placement and Timing (S. Murrell)</td>
</tr>
<tr>
<td>12:00</td>
<td>Social Time / Reception</td>
<td>Wrap-Up, Thank You, Have a safe trip home!!</td>
</tr>
</tbody>
</table>
Welcome to the Fluid Fertilizer Foundation Website!

Fluid Journal Articles

Fall 2010 Issue:

2011 Fluid Forum
February 20-22, 2011
Scottsdale Plaza Resort
Scottsdale, AZ
Phone: 480-948-6000

Fluid Technology Roundup
Indianapolis, IN.
December 8-9, 2010.
Wednesday, December 8, 5:00am -
Thursday, December 9th, 11:00 p.m.
Indianapolis Marriott East
7200 East 21st St.
Indianapolis, IN 46219.
Phone: 317-352-1231
Program - Letter - Registration

North Central Extension-Industry
Soil Fertility Conference
November 17-18, 2010
Holiday Inn Airport
Des Moines, IA
Are Current Fertilizer Recommendations Adequate?

Com being a primary responder, yield goals in the next 20 years are targeted at 250 to 300 bu/A by some in the seed industry.

Dr. Gyles Randall

Summary: Challenges including fiscal and environmental regulations continue to shape the fertilizer and nutrient management industry. The current recommendations for the future will they enable these ever-increasing yields to be reached or will they be facing limited yields? Do we have to live in a place that results in lower yields due to these high-yield stresses on our land? What is the environmental and economic consequence of these changes to the high-yield production system? Will time of application and placement method guidelines need to be reevaluated? How will the tills and capabilities of the farmer and the dealer fit into these "new" management guidelines?

Current status

Aging recommendations. Many of these recommendations are based on research conducted in the 70s and 80s, and earlier. Back in the day, when the average price of a bushel of soybeans ranged from 80 to 120 bu/A and it was likely that yields in many of the calibration research trials would exceed 175 bu/A, yields response probabilities and critical levels were based on these calibration studies. In some states, little (P) or potassium (K) calibration studies have been conducted since. In other states, notably Iowa, a project that has been the focus of interest over the University of Nebraska and the University of Minnesota. In Iowa, the University of Nebraska has changed its long-term fertilizer recommendations. The recommendation has been to increase the amount of P and K recommended for corn after corn, based on current high-yield data.

The video of the current status serves as a reminder of the importance of nutrient management.

Variable rate application has come a long way since its inception. With limited technology and information, it will be desirable to apply variable rates of P and K to the soil to obtain very high and profitable yields with reduced risk of nutrient imbalances.

Time and labor are substantial issues facing farmers and fertilizer dealers. Corn and soybean treatments, especially those that use the soil to obtain very high and profitable yields with reduced risk of nutrient imbalances, are critical to maximize return on their fertilizer dollars.

As fertilizers are applied to the soil, and with the continued increase in fertilizer prices, it is critical to understand the effects of drought. Rainfall, which is not always reliable, can be a limiting factor in the decisions made regarding fertilizer applications.

Land tenure. The land to be fertilized is owned or rented. Land might be owned or rented, and a significant role in years 2001-2010 was that land tenure is a critical issue. Farmers who own land to be fertilized generally have a long-term vision for that land that requires consideration by the nutrient research community as research is developed and prioritized.

A further look into fertilizer recommendation adequacy regarding phosphorus and potassium:

Farmer-specific goals should be incorporated into the decision-making process.

Drs. Dele Lenker, Gyles Randall, and Antonio Mavirino

Summary: There are several logical and appropriate approaches to managing phosphorus (P) and potassium (K) fertility. Within the context of environmental stewardship, it should be up to the individual producers to determine the appropriate fertility approach suitable for their production system. Nutrient sufficiency programs generally minimize fertilizer inputs in the early years but increase rates of P or K limiting crop growth and long-term profitability. Build-in maintenance programs may cost more in the initial years if soil tests are built up, but they generally provide for maximum yield and long-term profitability, while increasing fertilizer management flexibility in the coming years. In addition, an individual producer’s attitude toward managing risk, the producer’s long-term view in making investments in soil fertility, expected land tenure, and other farmer-specific goals and objectives should be incorporated into the decision-making process for determining the P and K fertility management program that best suits an individual’s needs. To continue to increase crop yields in the future, it is important to note that research has shown that annual fertilizer applications may not fully substitute for high P and K fertility. Highest yield potential is often associated with soil tests greater than the established critical value. There may be a severe economic penalty associated with low P or K soil tests even when fertilizer is applied—especially in years when soil conditions are high.

Profitable crop production requires a balance of adequate crop nutrition and low-cost input levels. The decision must be made to achieve the desired level of nutrient application rate for optimum corn crop growth and high yields. In some cases, the soil test value and crop to be grown have been the main concern, and often on-farm testing is used to determine the appropriate nutrient rates. This practice is called testing the soil for the crop. The test results are then used to determine the appropriate nutrient rates for that specific crop.

The Soil Test Committee of the University of Nebraska has developed a soil fertility index that can be used to determine the appropriate nutrient rates for different crops. This index is based on the concentration of nutrients in the soil and is expressed as a number between 1 and 100. As the nutrient concentration increases, the soil fertility index also increases.

Nutrient recommendations. As crop production technology continues to change, more emphasis is being placed on the use of technology to improve nutrient recommendations. This technology includes the use of soil test information, which is critical for determining the appropriate nutrient rates for different crops.

In conclusion, it is important for farmers to understand the nutrient management program that best suits their needs. By incorporating farmer-specific goals and objectives, and by using the appropriate nutrient management program, farmers can achieve high yields and profitability while maintaining a sustainable agricultural system.
Fluid Fertilizers

- Increasing in popularity in U.S. and elsewhere
- **Advantages include**
  - Flexibility and versatility in application
  - Efficiency and adaptability
  - Benefits of continuous bands
  - Ease of handling
  - Does not segregate
  - Flexibility, etc.

- **Limitations**
  - Often higher purchase price than solid fertilizers **
  - Salt-out and precipitate formation potential with certain products and blends
USA fertilizer market share by class.

Data source: Commercial Fertilizers, AAPFCO & TFI

Dry 61.5%
Fluid 31.0%*
Ammonia 7.5%

*y = -0.013x^2 + 53.62x - 53654
R^2 = 0.98

*Excludes dir. appl. anhydrous ammonia

Data source: Commercial Fertilizers, AAPFCO & TFI
Fluid Fertilizers

Terminology, Solubility, Density and N Solutions

Solution – All salts totally dissolved in water. No solids allowed!


Suspension – Fluid product containing water, dissolved salts, fine undissolved salt crystals and a suspending agent – normally attapulgite clay.

Muddy Water – Solutions with undissolved solids or suspensions containing too few undissolved salt crystals. Not a good range to try and operate in!!.

Falling Out Of Solution – No such thing.
Salt-Out — Crystals form as solution cools; goes back in solution as product is warmed. Example; UAN Solution.

Precipitate Formation — Non-crystalline mass forms which has much lower solubility than original ingredients in solution. Example; Improperly stored fluid phosphates
EFFECT OF SALTS ON FREEZING POINT

Order Of Effectiveness:
CaCl2 > NaCl > KCl > Urea

Urea is much less corrosive than others.
Urea Solutions

Salt-Out (F)

Density (Lb/Gal)

Percent N

Salt Out (F) Lbs/Gal.
To Make 32-0-0 UAN Solution - How Much Water Is Needed?
Eutectic Point – point of maximum solubility

32% UAN contains:
• approximately 35% ammonium nitrate, 45% urea and 20% water at eutectic point

28% UAN contains 30% water
To Make 32-0-0 UAN Solution - How Much Water Is Needed?

20% WATER
Urea - Ammonium Nitrate Solutions

Salt-Out (F)

Density (Lb/Gal)

Percent N

Salt Out (F) Lbs/Gal.
UAN Solutions

Water 100%

Urea 100%

10% 20% 30% 40% 50% 60% 70% 80% 90%

10% 20% 30% 40% 50% 60% 70% 80% 90%

100% Amm. Nit.
Salt-out is an issue in many environments

- There is very little water in UAN solution.
- Warm water has ability to dissolve more salts than cold water.
- Salt-out occurs when salt content exceeds solubility at a given product temperature.
- Crystals form on tank walls as temperature cools.
- Eventually salts accumulate at tank bottom.
- Salts will re-dissolve with sufficient heat and recirculation.
## Lowering Water Freezing Temperature With UAN Solution

<table>
<thead>
<tr>
<th>% N</th>
<th>Freezing Temperature F</th>
<th>28-0-0 (gal per 100 gal water)</th>
<th>32-0-0 (gal per 100 gal water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>32</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>27</td>
<td>6.1</td>
<td>5.2</td>
</tr>
<tr>
<td>4</td>
<td>23</td>
<td>13.1</td>
<td>11.2</td>
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<tr>
<td>6</td>
<td>18</td>
<td>21.5</td>
<td>18.2</td>
</tr>
<tr>
<td>8</td>
<td>14</td>
<td>31.5</td>
<td>26.2</td>
</tr>
<tr>
<td>10</td>
<td>9</td>
<td>43.7</td>
<td>35.6</td>
</tr>
<tr>
<td>12</td>
<td>5</td>
<td>59.0</td>
<td>47.2</td>
</tr>
<tr>
<td>14</td>
<td>0</td>
<td>78.7</td>
<td>61.2</td>
</tr>
</tbody>
</table>
Liquid Phosphate Products

Fluid Phosphate Products and Characteristics

[Flowchart diagram showing the process of producing phosphate products, including steps such as reaction, filtration, concentration, and the resulting products like granular, non-granular, and ammonium polyphosphate.]
SOLUBILITY OF AMMONIUM PHOSPHATES

(ORTHO-SOLUTIONS)

1.56 NH₃ : H₃PO₄
.307 N : P₂O₅

1.69 NH₃ : H₃PO₄
.333 N : P₂O₅

NH₃ : H₃PO₄ Ratio

MAP CRYSTALS
DAP CRYSTALS
MAP + DAP CRYSTALS
Phosphoric Acid

Wet-Process Acid

- Black, brown, green (calcined)
- Contains many rock impurities
- Used in fertilizer industry

Furnace, food-grade acid

- Clear
- No impurities
- Food and industrial processes
Orthophosphoric Acid Examples

<table>
<thead>
<tr>
<th>Source</th>
<th>Acid 1</th>
<th>Acid 2</th>
<th>Acid 3</th>
<th>Acid 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2O5</td>
<td>61</td>
<td>53.2</td>
<td>52.8</td>
<td>57</td>
</tr>
<tr>
<td>MgO</td>
<td>0.3</td>
<td>1.2</td>
<td>1.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Fe2O3</td>
<td>0.35</td>
<td>0.5</td>
<td>1</td>
<td>0.32</td>
</tr>
<tr>
<td>Al2O3</td>
<td>0.18</td>
<td>0.4</td>
<td>0.5</td>
<td>0.16</td>
</tr>
<tr>
<td>F</td>
<td>0.3</td>
<td>0.4</td>
<td>2.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Solids</td>
<td>0.5</td>
<td>0.1</td>
<td>0.1</td>
<td>Nil</td>
</tr>
<tr>
<td>Visc.@100F</td>
<td>40</td>
<td>90</td>
<td>100</td>
<td>27</td>
</tr>
<tr>
<td>P/F</td>
<td>89</td>
<td>58</td>
<td>46</td>
<td>248</td>
</tr>
</tbody>
</table>

Source: Texas Gulf
Ammonium Polyphosphate

- Primary P source for much of fluid industry
- Many NPKS products made from APP
- Produced from ammonia, superphosphoric acid and water
- Generally equal agronomic performance as compared to solid fertilizers
  - If applied at equal P rates in similar manner
  - Potentially superior to solids if discontinuous bands result from with solid fertilizer band applications
- Contains most P as polyphosphate
Heat links phosphates by removing chemically bound water

Heat comes from chemical reaction of reacting phosphoric acid with ammonia

Ortho

Pyro

Tri

Higher
Flow Diagram For Ammonium Polyphosphate Production
10-34-0 & 11-37-0
Why Do We Want Polyphosphates?

- Not necessarily for agronomic reasons
- Manage sludge problems in fluid P products
  - Polyphosphates sequester metal cation impurities in the product (especially Mg) to form relatively insoluble precipitates
  - Provides superior storage qualities
- Increased analysis compared to orthophosphate
- Provides ability to include higher amounts of micronutrients in product (not Ca or Mg)
## Hydrolysis Of Polyphosphate To Orthophosphate

<table>
<thead>
<tr>
<th>Soil Temperature</th>
<th>24 Hour Polyphosphate Hydrolysis (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>41 F</td>
<td>30-40 %</td>
</tr>
<tr>
<td>68 F</td>
<td>50-60 %</td>
</tr>
<tr>
<td>95 F</td>
<td>80-90 %</td>
</tr>
</tbody>
</table>

Chang and Racz, 1977

After application to soils, polyphosphate is quickly converted to orthophosphate by abundant soil enzymes.

Plants utilize orthophosphates.
Effect of Poly Content and N:P2O5 Ratio On Solubility

N:P2O5 Weight Ratio

Percent Total N + P2O5 Content

0% Poly

45% Poly

70% Poly
Why Do We Want Polyphosphates?

- Not necessarily for agronomic reasons
- Manage sludge problems in fluid P products
  - Polyphosphates sequester metal cation impurities in the product (especially Mg) to form relatively insoluble precipitates
  - Provides superior storage qualities
- Increased analysis compared to orthophosphate
- Provides ability to include higher amounts of micronutrients in product (not Ca\(^{++}\) or Mg\(^{++}\))
<table>
<thead>
<tr>
<th>Original Zinc Source</th>
<th>% Zinc Remaining As Original Source</th>
<th>% Zinc Sequestered By Polyphosphate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zn EDTA</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Zn Sulfate</td>
<td>4</td>
<td>96</td>
</tr>
<tr>
<td>Zn-NH3 Complex</td>
<td>8</td>
<td>92</td>
</tr>
<tr>
<td>Zn Phenolic Acid</td>
<td>11</td>
<td>89</td>
</tr>
<tr>
<td>Zn Citrate</td>
<td>8</td>
<td>92</td>
</tr>
<tr>
<td>Zn Nitrate + UAN</td>
<td>15</td>
<td>85</td>
</tr>
<tr>
<td>Zn HEIDA</td>
<td>19</td>
<td>81</td>
</tr>
</tbody>
</table>

Values Are For 4 Minutes After Mixing - U of Neb.
Temperature Effect On 10-34-0 Quality

Source: Farmland Industries
Polyphosphate Loss vs. Temperatures
Poly 11 - Geismar

Polyphosphate Content

Number of Days

140F 95F 75F

- 140F: Square dots
- 95F: Diamond dots
- 75F: Star dots

0 10 20 30 40 50 60 70 80

50 55 60 65 70
Factors Impacting Precipitate Formation In Storage

- Amount of polyphosphate initially present
- Amount of impurities in super-acid
- Other ‘impurities’ added to product
  - Zinc
  - Previous product sludge
- Temperature of stored product
- Length of time product stored
APP Storage and Housekeeping Suggestions

- Do not store longer than necessary
- Avoid storage in summer months
- Completely empty and clean tanks regularly
- Know the quality of remaining product before adding additional product to tanks
- Do not contaminate with products/impurities that may affect storage properties
- Never mingle any calcium or magnesium with product or mix plant
- Make sure that farmers and dealers lines, tanks and equipment are completely cleaned after use
• Final maximum grade May Contain 31 Total Plant Food Units.

- N = 25% of 31 = .25 X 31 = 7.75% N
- P$_2$O$_5$ = 50% of 31 = .50 X 31 = 15.5% P$_2$O$_5$
- K$_2$O = 25% of 31 = .25 X 31 = 7.75% K$_2$O
## Solution Grades For UAN Solution (28-32% N), Potassium Chloride (0-0-62) and Ammonium Polyphosphate (10-34-0, 11-37-0) System

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>1-0-1</td>
<td>7-0-7</td>
<td>3-0-1</td>
<td>13.5-0-4.5</td>
</tr>
<tr>
<td>1-0-2</td>
<td>5.5-0-11</td>
<td>3-0-2</td>
<td>8.4-0-5.6</td>
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<tr>
<td>1-0-3</td>
<td>4.3-0-12.9</td>
<td>3-0-4</td>
<td>6.6-0-8.8</td>
</tr>
<tr>
<td>1-1-0</td>
<td>19.5-19.5-0</td>
<td>3-1-0</td>
<td>24.6-8.2-0</td>
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<tr>
<td>1-1-1</td>
<td>7.3-7.3-7.3</td>
<td>3-1-1</td>
<td>12.6-4.2-4.2</td>
</tr>
<tr>
<td>1-1-2</td>
<td>5.3-5.3-10.6</td>
<td>3-1-2</td>
<td>8.7-2.9-5.8</td>
</tr>
<tr>
<td>1-1-3</td>
<td>4.2-4.2-12.6</td>
<td>3-1-3</td>
<td>6.9-2.3-6.9</td>
</tr>
<tr>
<td>1-1-4</td>
<td>3.5-3.5-14</td>
<td>3-1-4</td>
<td>6-2-8</td>
</tr>
<tr>
<td>1-1-5</td>
<td>2.9-2.9-14.5</td>
<td>3-2-0</td>
<td>21.6-14.4-0</td>
</tr>
<tr>
<td>1-2-0</td>
<td>15.3-30.6-0</td>
<td>3-2-1</td>
<td>12-8-4</td>
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<tr>
<td>1-2-1</td>
<td>7.7-15.4-7.7</td>
<td>3-2-2</td>
<td>8.7-5.8-5.8</td>
</tr>
<tr>
<td>1-2-2</td>
<td>5.1-10.2-10.2</td>
<td>3-2-3</td>
<td>6.9-4.6-6.9</td>
</tr>
<tr>
<td>1-2-3</td>
<td>3.8-7.6-11.4</td>
<td>3-2-4</td>
<td>6.3-4.2-8.4</td>
</tr>
<tr>
<td>1-2-4</td>
<td>3.2-6.4-12.8</td>
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<td>1-2-6</td>
<td>2.3-4.6-13.8</td>
<td>3-3-2</td>
<td>8.4-8.4-5.6</td>
</tr>
<tr>
<td>1-3-0</td>
<td>12.5-37.5-0</td>
<td>3-3-3</td>
<td>6.3-6.3-8.4</td>
</tr>
<tr>
<td>1-3-1</td>
<td>7.4-22.2-7.4</td>
<td>3-3-5</td>
<td>5.7-5.7-9.5</td>
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<td>1-3-2</td>
<td>4.7-14.1-9.4</td>
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<td>3.5-10.5-10.5</td>
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<td>9-12-6</td>
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<tr>
<td>1-3-4</td>
<td>2.9-8.7-11.6</td>
<td></td>
<td></td>
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<tr>
<td>1-3-5</td>
<td>2.5-7.5-12.5</td>
<td></td>
<td></td>
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<tr>
<td>1-3-6</td>
<td>2.2-6.6-13.2</td>
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## Typical Characteristics Of Several Fluid Fertilizer Products

<table>
<thead>
<tr>
<th>Source</th>
<th>Analysis</th>
<th>Density (Lbs/gal)</th>
<th>Salt-Out (°F)</th>
<th>General Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>UAN</td>
<td>28-0-0</td>
<td>10.67</td>
<td>0</td>
<td>~ 30% water</td>
</tr>
<tr>
<td>UAN</td>
<td>32-0-0</td>
<td>11.06</td>
<td>28 - 32</td>
<td>~ 20% water</td>
</tr>
<tr>
<td>ATS</td>
<td>12-0-0-26S</td>
<td>11.04</td>
<td>&lt;20</td>
<td>Fluid S Source of Choice</td>
</tr>
<tr>
<td>APP</td>
<td>10-34-0</td>
<td>11.65</td>
<td>&lt;10</td>
<td>11-37-0 grade also</td>
</tr>
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Temperature Effect On Fluid Fertilizers Density

<table>
<thead>
<tr>
<th>Product Temperature</th>
<th>28-0-0</th>
<th>32-0-0</th>
<th>10-34-0</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>10.78</td>
<td>11.17</td>
<td>11.76</td>
</tr>
<tr>
<td>30</td>
<td>10.76</td>
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<td>40</td>
<td>10.73</td>
<td>11.12</td>
<td>11.72</td>
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<tr>
<td>50</td>
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<tr>
<td>100</td>
<td>10.55</td>
<td>10.92</td>
<td>11.6</td>
</tr>
</tbody>
</table>
Salt-out – Crystals form as solution cools; goes back in solution as product is warmed. Example; UAN Solution.

Precipitate formation – Non-crystalline mass forms which has much lower solubility than original ingredients in solution. Example; Improperly stored fluid phosphates

Heat generator – Generates chemical heat when producing solutions. Examples; ammonia + phosphoric acid; dilution of sulfuric acid)

Fume generator – Generates fumes which can be safety hazard. Example; UAN solution + Potassium carbonate → ammonia fumes.

\[
2\text{NH}_4\text{NO}_3 + \text{K}_2\text{CO}_3 \rightarrow 2\text{KNO}_3 + (\text{NH}_4)_2\text{CO}_3
\]

UAN in Irrigation Water?
UAN in Irrigation Water?

Urea N Volatilization?

\[ 2\text{NH}_4\text{NO}_3 + \text{CaCO}_3 \rightarrow \text{Ca(NO}_3\text{)_2} + (\text{NH}_4\text{)}_2\text{CO}_3 \]

\[ 2\text{NH}_3 + \text{H}_2\text{CO}_3 \rightarrow \text{H}_2\text{O} + \text{CO}_2 \]
Caution: This chart contains information based on the opinions of people in the fluid fertilizer industry. This information has been compiled as a general guide only. Neither the Fluid Fertilizer Foundation or contributors guarantee the accuracy of the information. Please refer to manufacturer/supplier product information and also perform a small jar compatibility test prior to final mixing.

- 'Compatible', results in relatively stable mixture.
- 'Limited Compatibility', generally compatible within solubility limits.
- 'Very Limited Compatibility', generally unsuitable mixtures.
- 'Incompatible', unsuitable mixture and/or hazardous combination.
- Significant heat generated.

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**Anhydrous Ammonia**
- Aqua Ammonia; 20-0-0

**Urea Solution**
- 23-0-0
- 20-0-0
- Ammonium Nitrate Solution; UAN 28/32-0-0
- 8-0-0-9S
- 10-34-0
- Ammonium Chloride Solution; 6-0-0-16Cl
- 12-0-0-26S
- Potassium Thiosulfate; KTS 0-0-25-17S
- Calcium Thiosulfate; CaTS, 6%Ca 10%S
- Magnesium Thiosulfate; MgTS, 10%S 4%Mg
- Calcium-Ammonium Nitrate Solution; 17-0-0 8.8Ca
- Calcium Nitrate Solution; 9% N, 11% Ca
- Potassium Carbonate Solution; 0-0-32
- N-pHuriic 28/27; 28-0-0 9S
- N-pHuriic 15/49; 15-0-0 16S
- N-pHuriic 10/55; 10-0-0 18S
- Water
- Nitric Acid
- Phosphoric Acid (white)
- Phosphoric Acid (green)
- Sulfuric Acid
- Urea; 46-0-0
- Ammonium Nitrate; 34-0-0
- Calcium Nitrate; 15.5-0-0-19Ca
- Potassium Chloride; 0-0-62
- Potassium Nitrate; 13-0-46
- Magnesium Nitrate; 10%N 9%Mg

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Thank You And Enjoy The Roundup

Dale F. Leikam

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