BASIC N-P-K LIQUID ISSUES

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Fluid Fertilizer Foundation
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Outline

- Materials
- Cold vs. hot mixing
- Potential issues with liquid blends
- Example
Base Liquid Materials

- Water
- Urea Ammonium-Nitrate (UAN)
- Ammonium Polyphosphate (10-34-0)
- Solution grade muriate of potash (0-0-62)
**Additional Liquids**

- Wet process phosphoric acid
- Potassium thiosulfate (KTS)
- Aqua ammonia
- Urea
- Ammonium Thiosulfate (12-0-0-26(S))
Factors Affecting Blend Quality

- Desired salting out temperature
- Storage temperature desired
- Impurities in materials or storage tanks
- Polyphosphate content
Factors Affecting Cold Mixing

- Temperature of raw materials.
  - Colder materials take longer to mix.
  - Potash cools solution on addition.
  - Can use hot water to speed mixing times.

- Salting out temperature of final product.
  - Higher salting out temperature requires longer mix times.
Cold Mixing Sequence
Hot Mixing

- Heat supplied by chemical reaction:
  - Strong acid, phosphoric acid (merchant grade)
  - Strong base, aqua ammonia or anhydrous
- Must use 10-34-0 to supply polyphosphate
  - Without potash,
    - a blend requires 25% of $P_2O_5$ from 10-34-0
  - With potash
    - must have 35 - 45% of $P_2O_5$ from 10-34-0
Advantages of Hot Mixing

- No external heat source required.
- Faster mixes.
- Cheaper mixes made using merchant grade phosphoric acid and aqua ammonia than just 10-34-0.
- Can use dry urea as N source since heat will help dissolve urea.
Hot Mixing Sequence

- KCl
- scale
- agitator
- mix tank
- circulation pump
- product storage
Calculating Liquid Formulas

Cold mixing steps:

1. Determine application rate.
2. Calculate N:P:K ratio.
3. Convert fractional ratio to integer ratio.
4. Refer to table to determine grade.
5. Calculate formula.
6. Calculate application rate.
Desired application rate:

- **N** 60 lbs./acre
- **P₂O₅** 40 lbs./acre
- **K₂O** 40 lbs./acre

Using UAN-32, 10-34-0, 0-0-62 & water
Step 2: N: P$_2$O$_5$: K$_2$O Ratio

Divide smallest rate into other rates

- N: 60/40 = 1.5
- P$_2$O$_5$: 40/40 = 1.0
- K$_2$O: 40/40 = 1.0

Ratio is 1.5 : 1 : 1
In this case, multiply all numbers by 2

- $1.5 \times 2 = 3$
- $1.0 \times 2 = 2$
- $1.0 \times 2 = 2$

The resulting ratio is $3 : 2 : 2$
Refer to Cold Mix Table

- For 3:2:2 the grade that will have a salt out temperature of 32°F is:
  - 8.7% N
  - 5.8% P₂O₅
  - 5.8% K₂O
Step 5a: Calculate Lbs./Ton

Multiply all percentages by 20

- N: $8.7 \times 20 = 174$ lbs./ton
- P$_2$O$_5$: $5.8 \times 20 = 116$ lbs./ton
- K$_2$O: $5.8 \times 20 = 116$ lbs./ton
10-34-0:
- \( \text{(116 lbs./ton)} / 0.34 = 341 \text{ lbs. of 10-34-0/ton} \)

UAN-32:
- \( N \text{ required from UAN-32 after 10-34-0} \)
  \[ = 174 - (341 \times 0.10) = 139.9 \text{ lbs.} \]
- \( \text{Weight/ton} = 139.9 / 0.32 = 437 \text{ lbs./ton} \)

0-0-62:
- \( 116 / 0.62 = 187 \text{ lbs./ton} \)
Step 5c: Weight of Water

Subtract total weight of other materials from 2,000 lbs.

\[ 2,000 - (341+437+187) = 1,035 \text{ lbs. Water/ton} \]
For 8.7 - 5.8 - 5.8 grade liquid:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>1,035 lbs.</td>
</tr>
<tr>
<td>0-0-62</td>
<td>187 lbs.</td>
</tr>
<tr>
<td>10-34-0</td>
<td>341 lbs.</td>
</tr>
<tr>
<td>UAN</td>
<td>437 lbs.</td>
</tr>
</tbody>
</table>

**Total = 2,000 lbs.**
Step 6: Calc. Application Rate

Determine lbs. blend/acre

\[ \frac{60}{0.087} = 690 \text{ lbs. blend/acre} \]

Determine gallons/acre

Assume most blends weigh 10 lbs./gallon

\[ \frac{690 \text{ lbs./acre}}{10 \text{ lbs./gallon}} = 69 \text{ gpa} \]
Hot Mix Example

Step 1: Application rate

Desired application rate:

- N       25 lbs./acre
- P$_2$O$_5$ 75 lbs./acre
- K$_2$O   25 lbs./acre

Using Phos acid, aqua, UAN-32, 10-34-0, 0-0-62 & water
Step 2: \( N: P_2O_5: K_2O \) Ratio

Divide smallest rate into other rates

- \( N: \frac{25}{25} = 1 \)
- \( P_2O_5: \frac{75}{25} = 3 \)
- \( K_2O: \frac{25}{25} = 1 \)

Ratio is \( 1 : 3 : 1 \)
Step 4: Determine Grade

Refer to Hot Mix Table

- For 1:3:1 the grade that will have a salt out temperature of 32°F is:
  - 7.4 % N
  - 22.2 % P₂O₅
  - 7.4 % K₂O
Step 5: Calculate Lbs./Ton

Multiply all percentages by 20

- **N:** \(7.4 \times 20 = 148\text{ lbs./ton}\)
- **P_2O_5:** \(22.2 \times 20 = 444\text{ lbs./ton}\)
- **K_2O:** \(7.4 \times 20 = 148\text{ lbs./ton}\)
Need to have 45% of P$_2$O$_5$ from 10-34-0
Total P$_2$O$_5$ x 0.45 = weight of polyphosphate
P$_2$O$_5$
444 x 0.45 = 200 lbs.
10-34-0 is 70% polyphosphate so:
200/0.70 = 286 lbs. of P$_2$O$_5$ from 10-34-0
Now calculate Lbs./ton of 10-34-0
286/34 = 841 lbs./ton
Need a total of 444 lbs. P$_2$O$_5$

10-34-0 supplies 286 lbs. P$_2$O$_5$

444 - 286 = 158 lbs. P$_2$O$_5$

Lbs./ton

158/0.54 (54% acid) = 293 lbs. Phos acid
Need to ammoniate acid to N: P$_2$O$_5$ ratio of 3:10.

Phos acid added at 158 lbs./ton

158 x 0.3 = 47.4 lbs. N

Lbs. Aqua/ton

47.4/0.2 = 237 lbs aqua/ton
Step 9: Weight of UAN per ton

Total N – (N from aqua + N from 10-34-0)

148 – [47.4 + (841 \times 0.1)] = 16.5 \text{ lbs. N}

Lbs. UAN/ton

16.5/0.32 = 52 \text{ lbs. UAN/ton}
Step 10: Weight of KCl per ton

Require 148 lbs K₂O per ton

148 lbs./0.62 = 238 lbs. KCl/ton
Step 11: Weight of water

2000 lbs. – (weight of other materials)

2,000 – (841 + 293 + 237 + 52 + 238)

= 339 lbs. Water/ton
For 7.4 – 22.2 – 7.4 grade liquid:

Water  339 lbs.
Phos acid  293 lbs.
Aqua  237 lbs.
UAN  52 lbs.
10-34-0  841 lbs.
0-0-62  238 lbs.

Total = 2,000 lbs.
GENERAL BLENDING PARAMETERS

- MAXIMUM N-P-K IN SOLUTION 35%
- MICROS MAXIMUM IN SOLUTION 6%
- POLY/ORTHO PHOSPHATE BLENDS?
- LOW SALT BLENDS 35% DEPENDING ON RATIO
10-34-0, UAN-32, Muriate of Potash and water at 32°F system

Contours = \( (N + P_2O_5 + K_2O) \)
that remain in solution at 32°F.

Crystallization zones
NITRATE/ NO₅

NO WITH ACIDS
SIGNS REDDISH/BROWN GAS
NERVE GAS/DEADLY
NITRATE NOT HIGHLY SOLUBLE WITH POTASSIUM
WILL COMPETE WITH OTHER ANIONS IN SOLUTIONS
KEEP IN MIND WITH UAN SOLUTION MIXING
Good Quality Micro Products Improve Blending
Pay Attention to Order Of Addition, pH, etc
Be Careful Of Point Introduction Precipitation
Make Sure Adequate Mixing Time Prior To Loading
? Truck Mixing Of Blends
Receiving and Unloading Materials Into the PLANT

- HAVE ALL PERTINENT SHIPPING INFORMATION, BOLs, DOT requirement, etc.
- REVIEW AND UNDERSTAND MSDS AND RMP/PSM REQUIREMENTS
- HAZARDOUS MATERIALS RECEIVING
Filling Liquid Storage Tanks

- Make Sure Inbound Transport Is Connected to the Correct Storage Tank
- Open All Appropriate Valves and Close Others
- Contain All Leaks
- Check Tank Inventory Prior To Transfer
- Wear Proper PPE
- Close All Appropriate Valves Upon Completion Of Transfer
- Complete All Documentation and Record Ending Inventory
COMMON MICRONUTRIENTS

- Zinc
- Manganese
- Copper
- Iron
- Magnesium (Mg)
- Boron
Oxides, Sulfates, and Chelates

- Zinc Oxide, Zn Sulfate, Zinc Citrate, and Zinc EDTA
- Manganese Dioxide, Manganese Sulfate, and Manganese EDTA
- Copper Sulfate, Copper Citrate, and Copper EDTA
- Ferrous Sulfate, and Iron EDTA
- Manganese EDTA
- Boric Acid
Conclusion

- Wide range of blends possible!
- Pull away from the pack!

Use soil and tissue tests to optimize your liquid program to the crop.

QUESTIONS