BASIC N-P-K LIQUID ISSUES

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Fluid Fertilizer Foundation
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STOP
WRONG WAY
DO NOT ENTER

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))

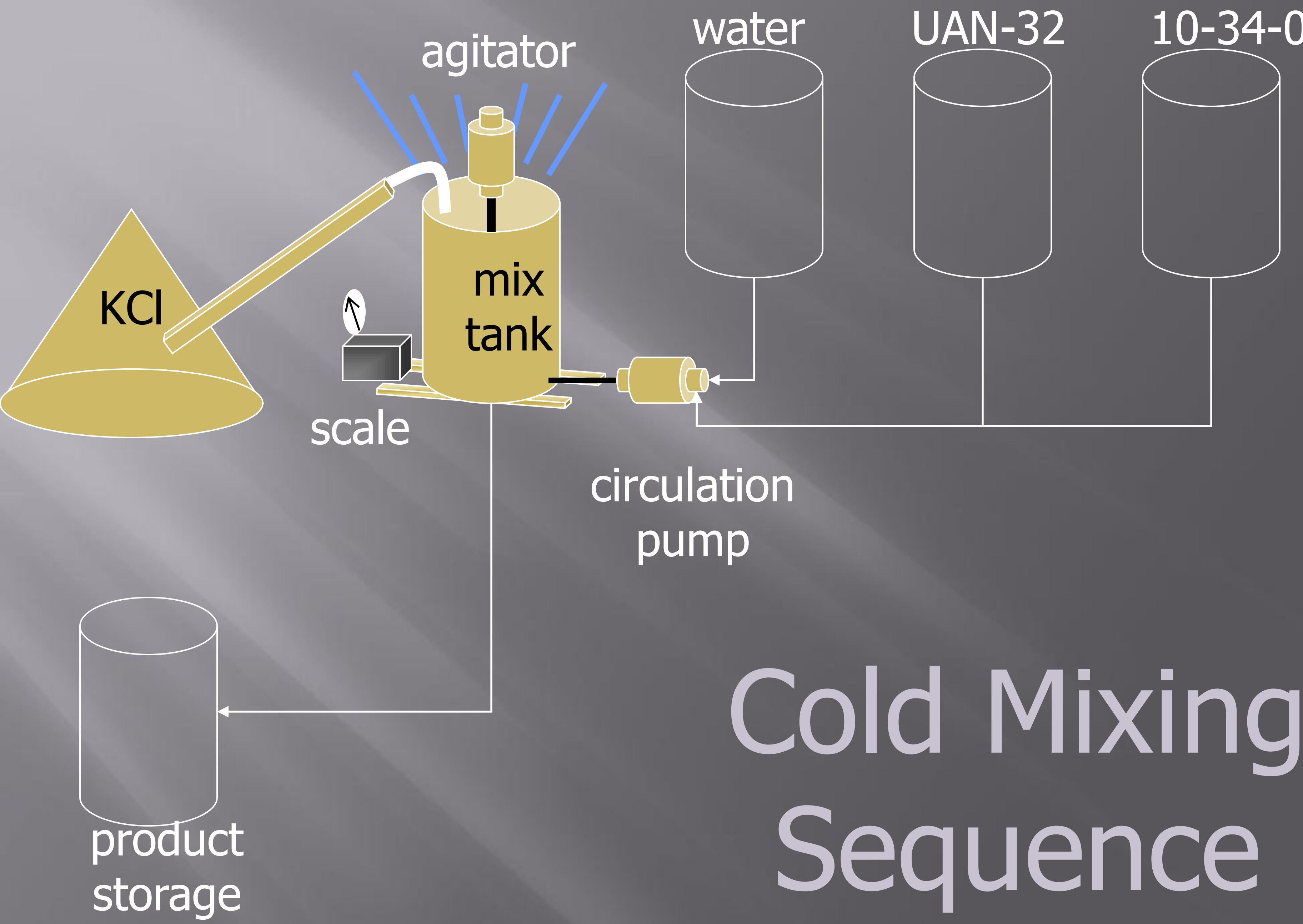
Factors Affecting Blend Quality

- 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



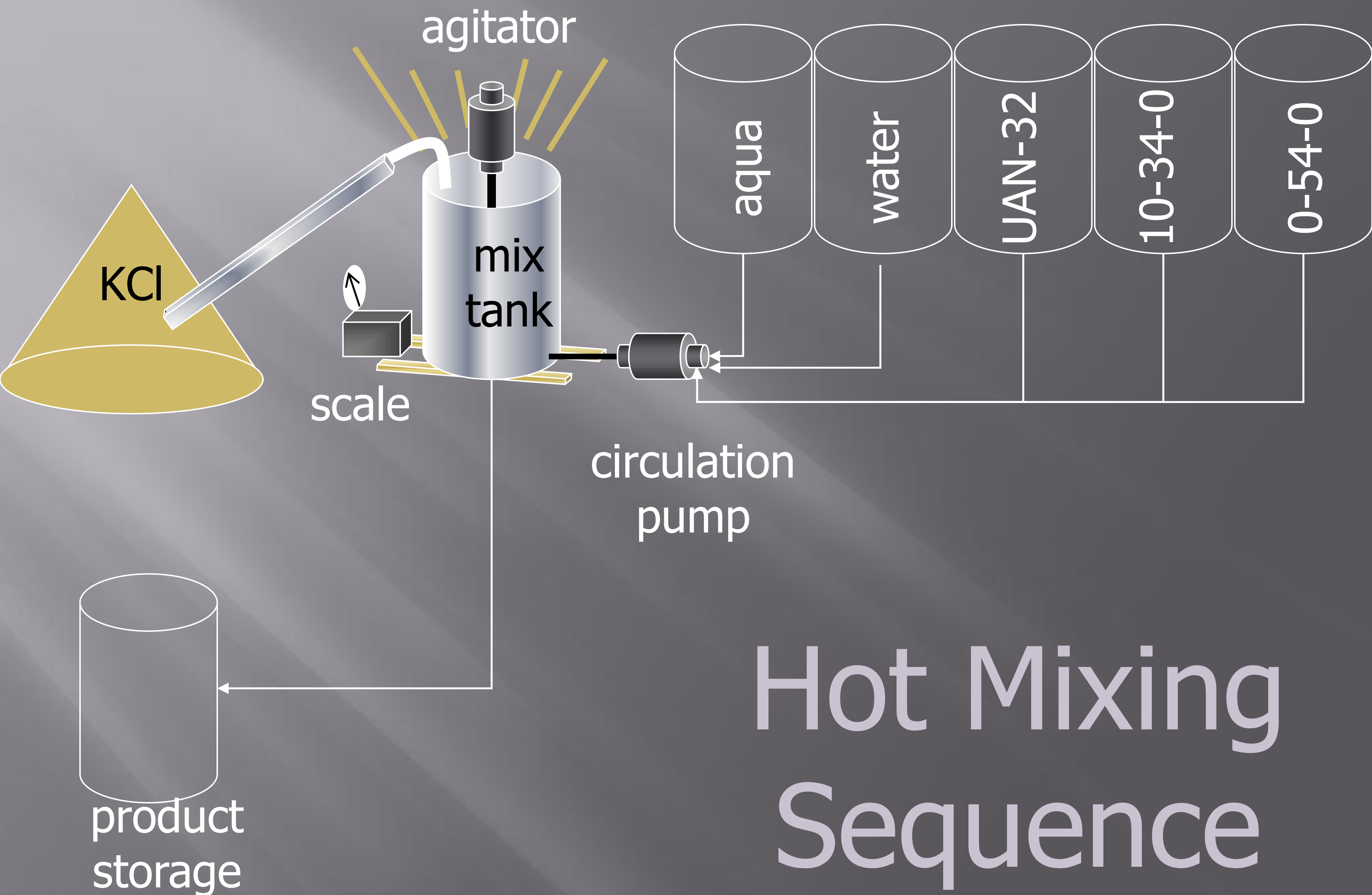
Hot Mixing

- 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



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.

Cold Mix Example
Step 1: Application rate

Desired application rate:

- N 60 lbs./acre
- P_2O_5 40 lbs./acre
- K_2O 40 lbs./acre

Using 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: 60/40 = 1.5
- P_2O_5: 40/40 = 1.0
- K_2O: 40/40 = 1.0

Ratio is 1.5 : 1 : 1

Step 3: Convert to Integer

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

Step 4: Determine Grade

Refer to Cold Mix Table

- For 3:2:2 the grade that will have a salt out temperature of 32ºF is:
- 8.7% N
- 5.8% P_2O_5
- 5.8% K_2O

Step 5a: Calculate Lbs./Ton

Multiply all percentages by 20

- N: $8.7 \times 20 = 174$ lbs./ton
- P_2O_5: $5.8 \times 20 = 116$ lbs./ton
- K_2O: $5.8 \times 20 = 116$ lbs./ton

Step 5b: Weight of Material/ton

10-34-0:

- (116 lbs./ton)/0.34 = 341 lbs. of 10-34-0/ton

UAN-32:

- N required from UAN-32 after 10-34-0

  = 174 – (341 x 0.10) = 139.9 lbs.
- Weight/ton = 139.9/0.32 = 437 lbs./ton

0-0-62:

- 116/0.62 = 187 lbs./ton

Step 5c: Weight of Water

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

2,000 – (341+437+187)

= 1,035 lbs. Water/ton

Step 5d: Summary Formula

For 8.7 - 5.8 - 5.8 grade liquid:

Water	1,035 lbs.
0-0-62	187 lbs.
10-34-0	341 lbs.
UAN	437 lbs.
Total =	2,000 lbs.

Step 6: Calc. Application Rate

Determine lbs. blend/acre

60/0.087 = 690 lbs. blend/acre

Determine gallons/acre

Assume most blends weigh 10 lbs./gallon

(690 lbs./acre)/(10 lbs./gallon) = 69 gpa

Hot Mix Example
Step 1: Application rate

Desired application rate:

- N 25 lbs./acre
- P_2O_5 75 lbs./acre
- K_2O 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: 25/25 = 1
- P_2O_5: 75/25 = 3
- K_2O: 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 % P_2O_5
- 7.4 % K_2O

Step 5: Calculate Lbs./Ton

Multiply all percentages by 20

- N: 7.4 x 20 = 148 lbs./ton
- P_2O_5: 22.2 x 20 = 444 lbs./ton
- K_2O: 7.4 x 20 = 148 lbs./ton

Step 6: Weight of 10-34-0

Need to have 45% of P_2O_5 from 10-34-0

Total P_2O_5 x 0.45 = weight of polyphosphate P_2O_5

444 x 0.45 = 200 lbs.

10-34-0 is 70% polyphosphate so:

200/0.70 = 286 lbs. of P_2O_5 from 10-34-0

Now calculate Lbs./ton of 10-34-0

286/34 = 841 lbs./ton

Step 7: Lbs. P_2O_5 from phos acid

Need a total of 444 lbs. P_2O_5

10-34-0 supplies 286 lbs. P_2O_5

444 – 286 = 158 lbs. P_2O_5Lbs./ton

158/0.54 (54% acid) = 293 lbs. Phos acid

Step 8: Weight of aqua

Need to ammoniate acid to N: P_2O_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 x 0.1)] = 16.5 lbs. N

Lbs. UAN/ton

16.5/0.32 = 52 lbs. UAN/ton

Step 10: Weight of KCl per ton

Require 148 lbs K_2O 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

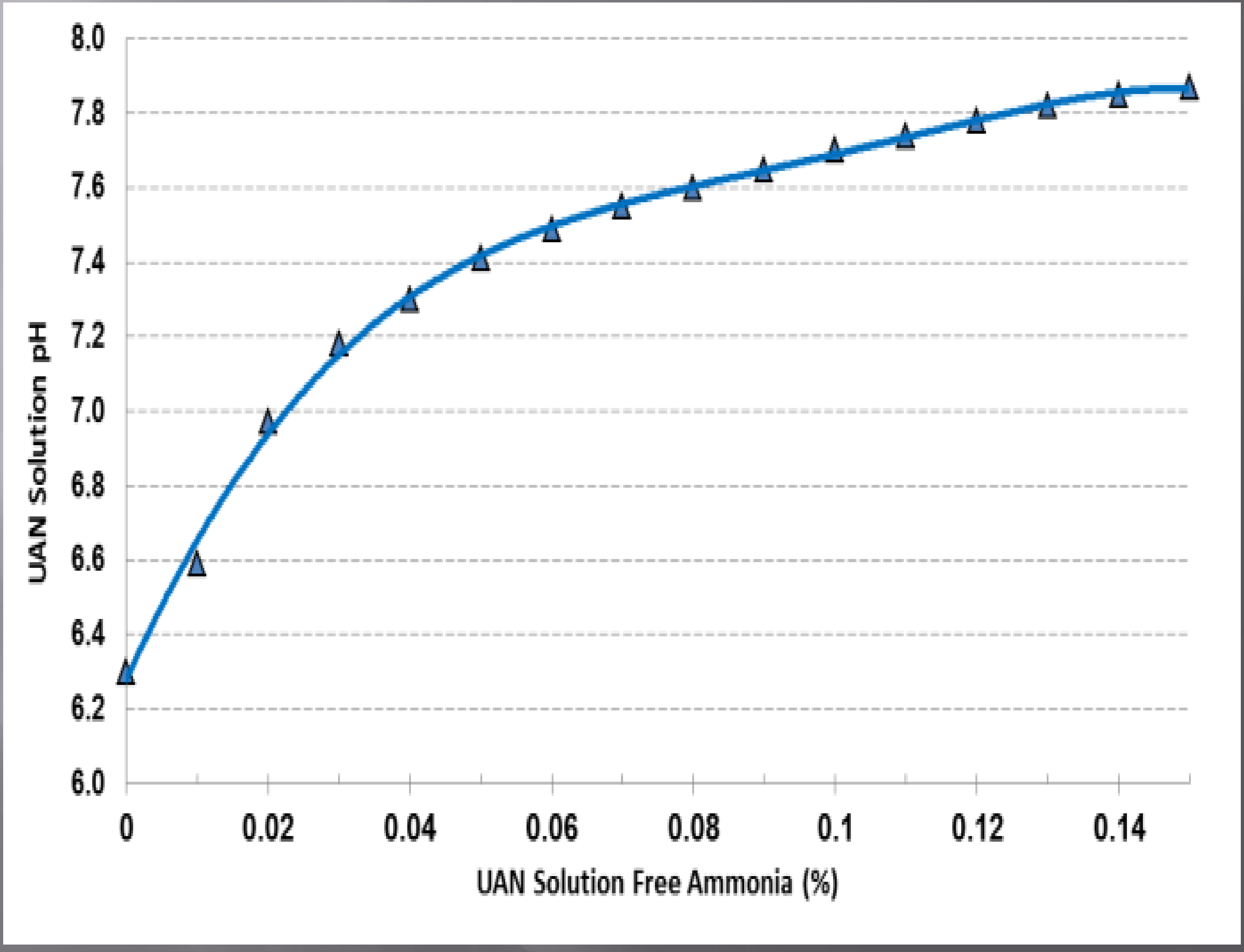
Summary Formula

For 7.4 – 22.2 – 7.4 grade liquid:

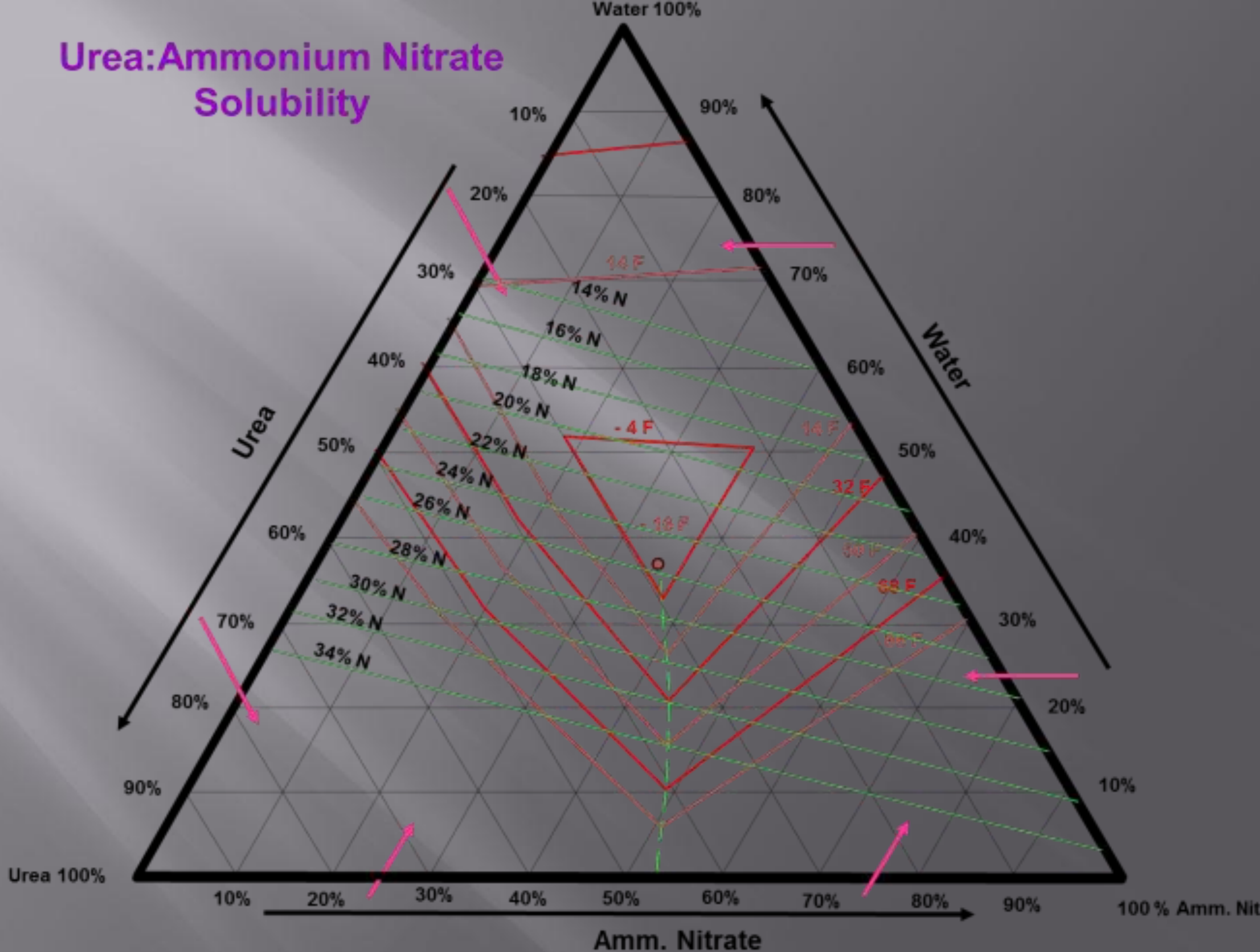
Water	339 lbs.
Phos acid	293 lbs.
Aqua	237 lbs.
UAN	52 lbs.
10-34-0	841 lbs.
0-0-62	238 lbs.
Total =	2,000 lbs.

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


UAN Solution pH
8.0
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
UAN Solution Free Ammonia (%)

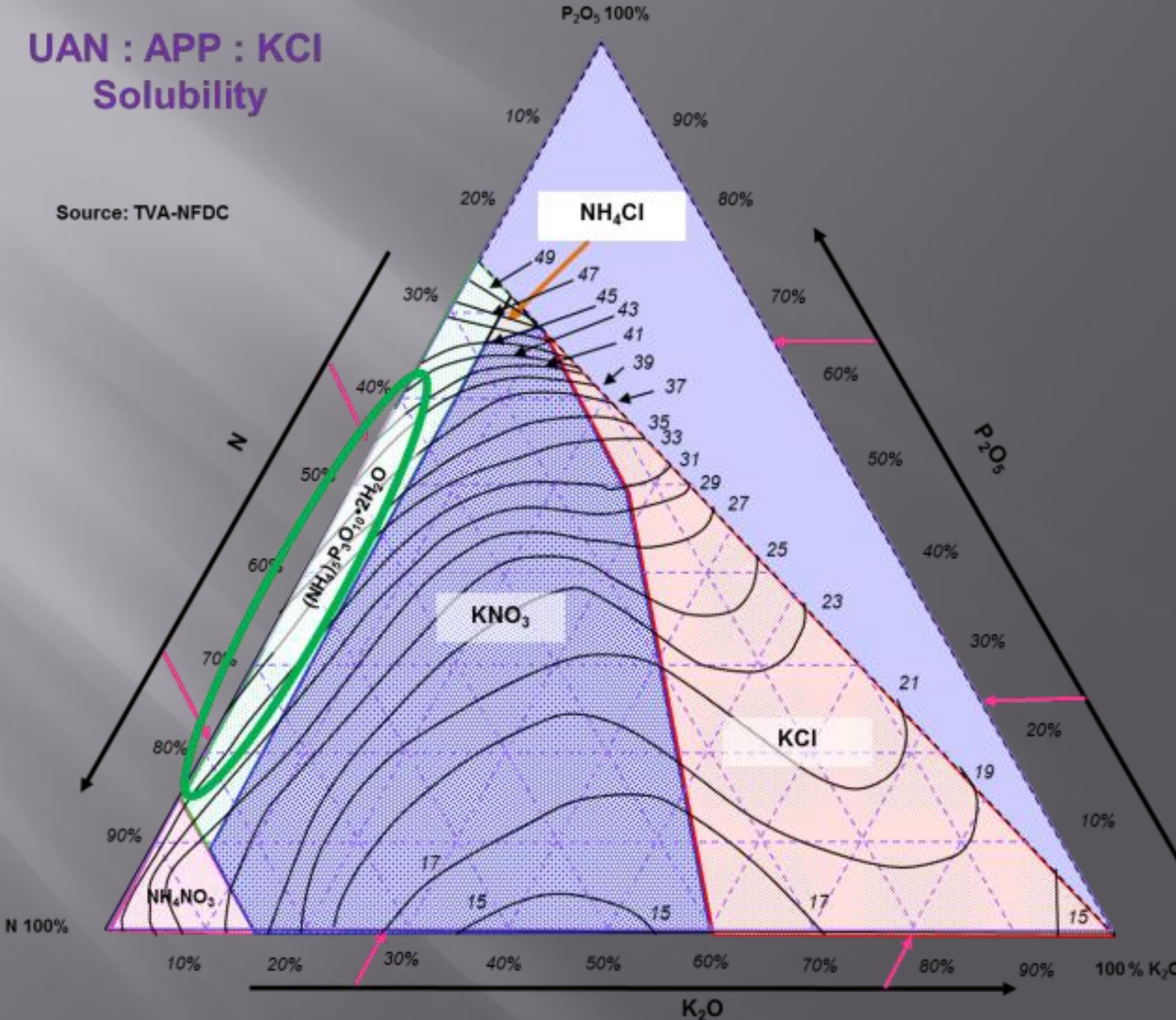
Urea:Ammonium Nitrate Solubility



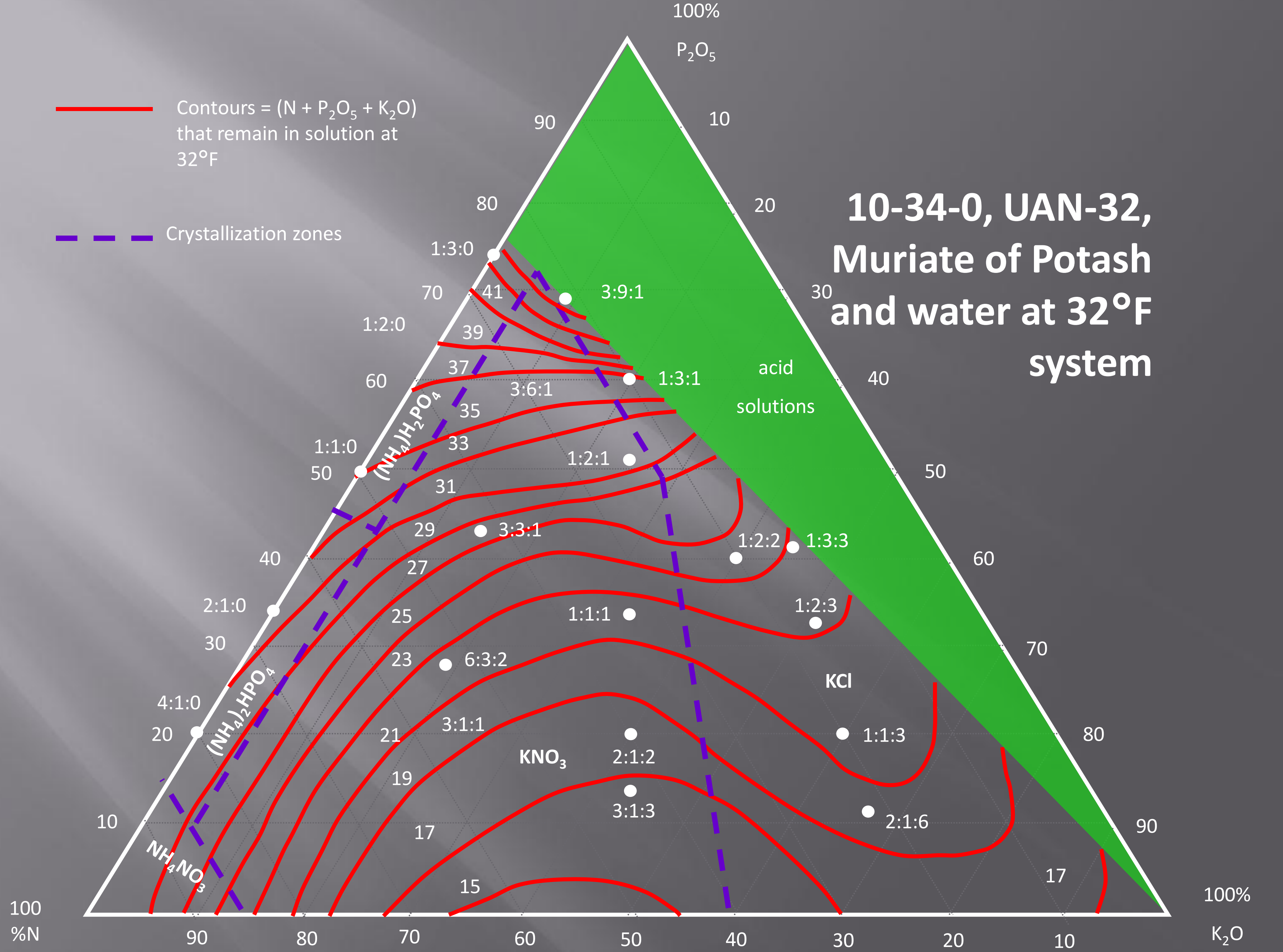
UAN/10-34-0 BLEND

UAN : APP : KCl Solubility

Source: TVA-NFDC



10-34-0, UAN-32, Muriate of Potash and water at 32°F system



NITRATE/ NO_x

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

Secondary and Micro Nutrients

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

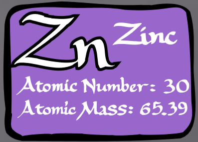
- HAVE ALL PERTINENT SHIPPING INFORMATION, BOLs, DOT requirement, etc.
- REVIEW AND UNDERSTAND MSDS AND RMP/PSM REQUIREMENTS
- HAZARDOUS MATERIALS RECEIVING

Filling Liquid Storage Tanks

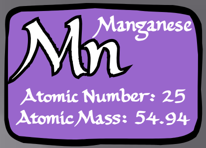
- Make Sure Inbound Transport Is Connected to the Correct Storage Tank
- Open All Appropriate Valves and Close Others
- Contain All Leaks
- Check Tank Inventory Prior To Transfer
- Wear Proper PPE
- Close All Appropriate Valves Upon Completion Of Transfer
- Complete All Documentation and Record Ending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

COMMON MICRONUTRIENTS

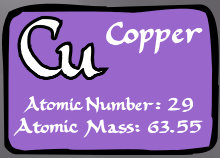
- Zinc



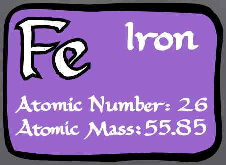
- Manganese



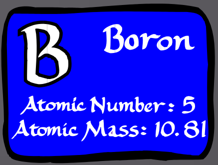
- Copper



- 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