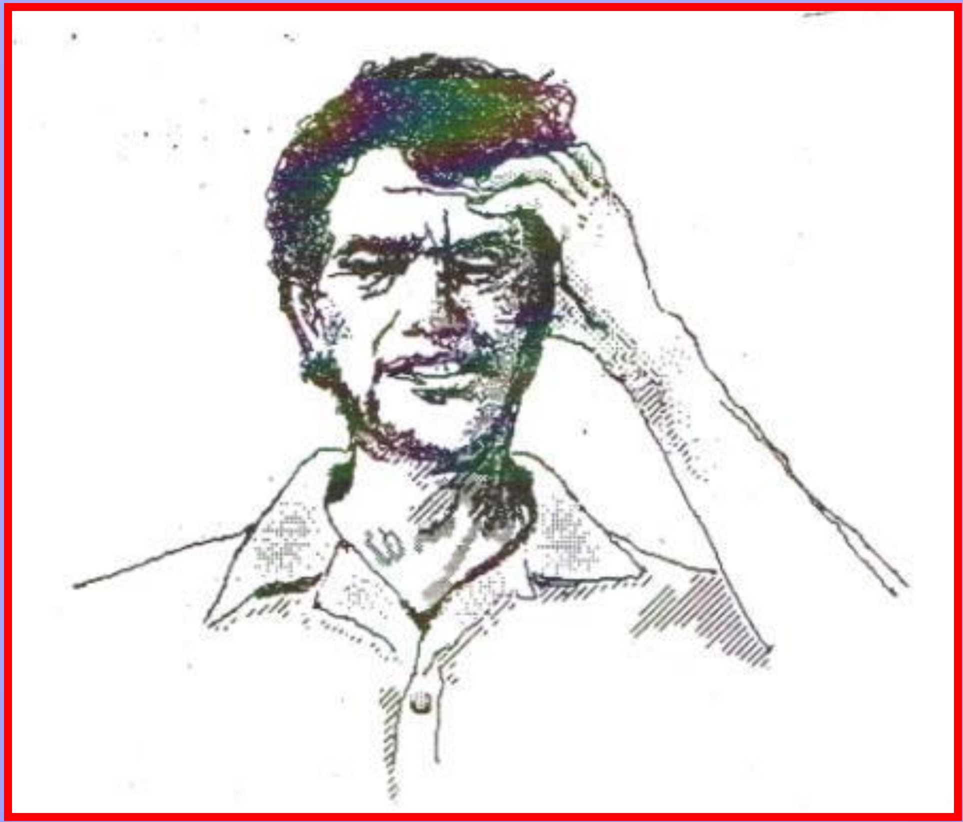
FORMULATION ISSUES



FLUID FERTILIZER FOUNDATION

Columbus, OH

Jim May

J. May Equipment/ ATA, Inc.

Arlington, TX

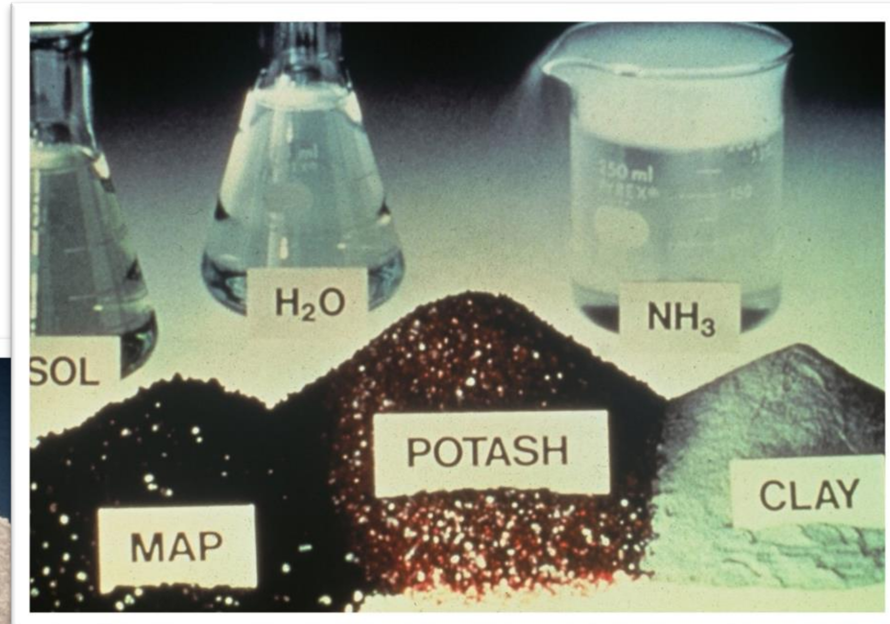
IT SETTLED OUT IN THE TANKER. THE APPLICATOR CAN'T APPLY IT, and **THE STORAGE TANK IS FULL OF CRYSTALS.**

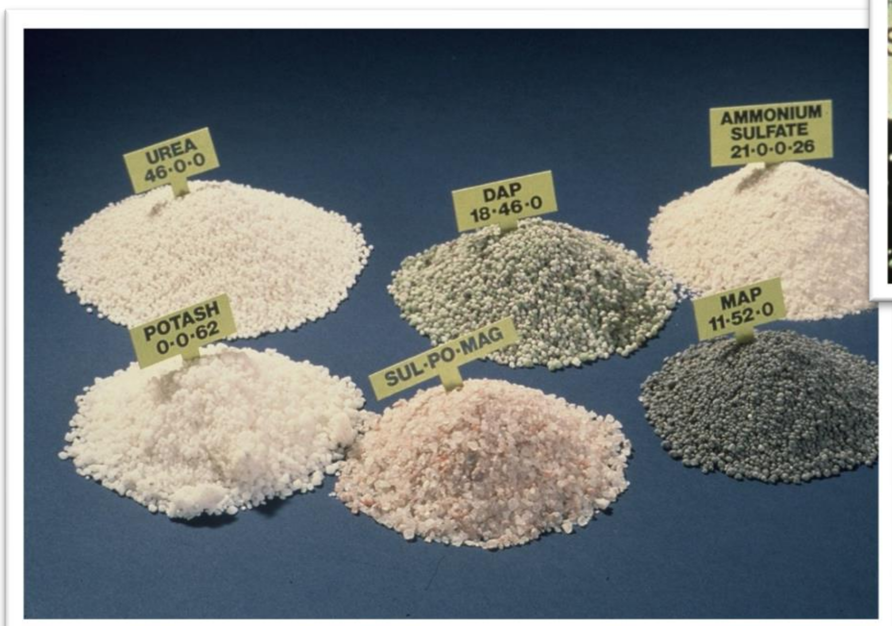
These statements are all common excuses for making an all day project out of 10 acres. The fact is that none of these things, tanks, tankers or applicators cause production problems.

All of these statements are complaints about a product that was improperly made. The product was bad when it came out of the mix system.

- **1. FORMULATION AND/OR SEQUENCE**
- **2. MECHANICAL LIMITATIONS**
- **3. RAW MATERIALS**
- **4. PEOPLE**
- ***These problems cannot be eliminated completely but can be minimized by proper formulation, mix sequence, working within the limitations of the equipment and the plant operators proficiency*.**

KNOW THE INGREDIENTS AND THEIR LIMITATIONS





KNOW THE BASICS OF FORMULATION

SIMPLE AS,
ADD,
SUBTRACT,
MULTIPLY &
DIVIDE

WHAT'S IN A DEFINITION?

Definition: *Cold Mix*

- Blending ingredients with no detectable reaction. Does not involve Anhydrous Ammonia or Aqua Ammonia reactions.

  Does not generate heat by reaction.
- Combining all liquid ingredients
- CLEAR LIQUIDS or SUSPENSIONS
- Combining liquid and dry ingredients
- Primary, secondary and micronutrients

COLD MIX !!!
DO NOT USE A"LITTLE BIT" OF AMMONIA TO GET A LITTLE HEAT!!!

DO NOT

Inject Anhydrous Ammonia or Aqua Ammonia into 10-34-0

Definition: *Hot Mix*

- The addition of Ingredients that have an Exothermic Reaction

Anhydrous Ammonia, Aqua Ammonia, KOH

Injecting Anhydrous or Aqua into,

Phosphoric Acid

Phosphoric Acid & DAP

MAP & Ammonia

UNDERSTANDING THE TERMS

FERTILIZER GRADE or ANALYSIS:

The plant nutrient content of the product expressed as a percent by weight.

N-P-K

3-9-27

3%Nitrogen, 9% Phosphorus (P_2O_5), 27% K-Potassium

Total 39% Plant Food

61% Non-Nutritive Materials

GET THINGS IN ORDER

JUST A LITTLE
"COMMON SENSE" BLENDING

Micronutrients are usually small amounts. Add immediately after the water, especially dry materials.

Best Through an Eductor

****Just the opposite with hot mixes, add last***

***All liquids*, Sequence is less important. Large ingredient amounts first & last. Small amounts may not completely clear the ingredient manifold.**

Reserve some water for flushing

MO' COMMON SENSE

All liquids, **Suspension,** sequence is important.

Add suspension base grades after water.

Add additional clay, if needed, before nitrogen solution.

Low "P" from 10-30-0, additional clay may not be necessary if good quality 10-30-0

"P" particles are so small that they can be sparged to limit settling. Apply very soon!

DO NOT make high potash base grades for storage !!!

THEY DO NOT STORE WELL, Add to the operators mix hours

Double mix time, Limit some formulas, low analysis

Add as a dry, 62% high concentration

LIQUID + DRY BLENDS

- Clear liquids with potash, add the potash as soon as possible.
- Watch liquid to dry ratio, make sure it will pump.
- Quick in with potash…. The agitator, pump impeller and fluid velocity are helping dissolve during the mixing cycle
- As additional liquid enters the final dissolving takes place
- *Dissolving solids requires one or all of the following:*
- Heat
- Agitation
- Pump Fluid Velocity
- More Liquid to Dissolve in, Lower Analysis

SOME RANDOM POINTS, LIQUID & DRY

For clear liquids add dry materials that create an endothermic reaction in order of highest minus BTU first

Example: Ammonium Nitrate, < 145 (1st)

Urea < 110 (2nd)

Ammonium Sulfate < 100 (3rd)

Potash < 100 (3rd)

All as soon as possible into liquid

*Add additional clay before Nitrogen Solution.

Dry clay it will not gel properly in the presence of Nitrogen Solution

Liquid clay will “clabber” when added to high Nitrogen Solution. Difficult to break up lumps.

SOME RANDOM POINTS, LIQUID & DRY

- HIGH NITROGEN GRADES,

- Supplemental Nitrogen Typically from, 32-0-0, 28-0-0
- Rule of Thumb: 50% of supplemental Nitrogen requirement can be from Urea
- About 40 pounds of urea per ton in clear liquid blends with micronutrients will sequester micronutrients and reduce settling or separation
- Remember, UREA is endothermic, get very cold quickly.
- Stops dissolving when it gets cold.

UREA – WATER SOLUTIONS							
GRADE	% UREA	Ton Formula Urea *	 Water	Specific Gravity	LBS/GALS	SALT OUT TEMP	MINIMUM HOT WATER TEMP.
14-0-0	30.43	610	1390	1.087	9.06	10°F	58°F
15-0-0	32.60	652	1348	1.092	9.10	14°F	67°F
16-0-0	34.78	696	1304	1.098	9.15	18°F	76°F
17-0-0	36.96	740	1260	1.105	9.20	23°F	88°F
18-0-0	39.13	783	1217	1.110	9.25	28°F	99°F
19-0-0	41.30	826	1174	1.117	9.31	33°F	110°F
20-0-0	43.47	870	1130	1.123	9.36	39°F	124°F
21-0-0	45.46	910	1090	1.129	9.41	45°F	137°F
22-0-0	47.82	957	1043	1.136	9.47	52°F	153°F
23-0-0	50.00	1000	1000	1.147	9.57	57°F	167°F

Heat to dissolve the Urea: Example calculation

957 Pounds X -110 BTU / Pound Urea = 105,270 BTU / Ton

105,270 BTU ÷ (1043 Pounds Water x 1 BTU/F°) = 101° the water will cool. 101° + cold water temp (or S.O.T.) = Temperature of water to mixer. 101° + 52° = 153° F. Water at 153° F should be adequate for total dissolution of the Urea.

It Happens Sometimes !!

- When making cold blends from 10-30-0 suspension and 32-0-0 OR 28-0-0, crystals form. Lots of crystals !!!
- These are usually clear, cubical DAP crystals.
- The cause is free ammonia in the Nitrogen Solution. Discuss with your supplier, usually does not do any good but you get to B_ _ _ _
- Over ammoniates the MAP, causes high pH and crystals form quickly.
- Can also create high viscosity

CRYSTAL CLEAR, *Not Exactly !*

Crystal Problems can usually be diagnosed

* Crystal Shapes:

MAP Crystals are Long Needle Like.

Usually Occurs When pH is less than 6.5

Cause: Under Ammoniation

DAP Crystals are Cubical.

Usually Occurs When pH is more than 6.5

Cause: Over Ammoniation

How To Cope
Breaking Up Crystals, Dissolving Solids

- Recirculate Through The Eductor

The Venturi in the base of the eductor will break down crystals or assist dissolving solids by fluid velocity.

Back pressure and time in the pump impeller will also break crystals, dissolve solids

High Speed Agitation.

Ammoniating MAP, DAP or PHOSPHORIC ACID

1 to 3 Ammonia Nitrogen To P_2O_5

DO NOT VARY

All the Nitrogen in MAP or DAP is Ammonia Nitrogen

Divide total P2O5 by 3= Total Ammonia Nitrogen

Deduct MAP or DAP Nitrogen.

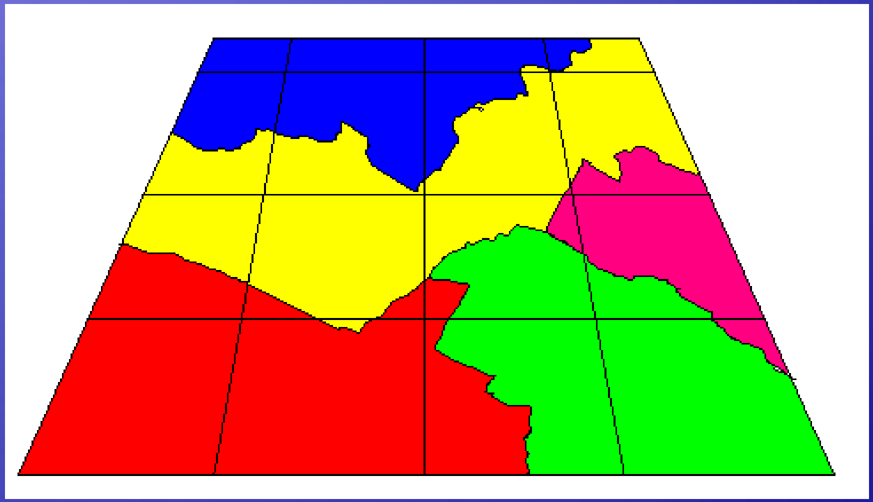
Balance will be from Anhydrous Ammonia or Aqua

“ It’s Like Being Pregnant You Are Or You Are Not”

PRECISION STARTS HERE !!

PRESCRIPTION FORMULATION AND PRODUCTION

The First Step In Precision, Site Specific Application Is To Produce a High Quality Prescription Blend.



The Correct Analysis and Quality Product

Repeated Stopping To Cleaning Nozzles or Strainers Defeats Precision Application

POOR FORMULATION PRODUCES POOR PRODUCT

Now That All That Is Out Of the Way,

GET STARTED !

FORMULATE TO A TON

- 1 TON, 2,000 POUNDS
- A TON FORMULA CAN BE EXTENDED OR REDUCED TO FIT ANY BATCH SIZE
- MIXERS READOUT IN POUNDS, BUT HAVE A TON RATING
- 10 TON BATCH IS 10 X EACH INGREDIENT
- IF YOU CALL ME WITH A PROBLEM, GIVE ME YOUR TON FORMULA, NOT BATCH POUNDS

USE A “FORMULATION SHEET”

- DO NOT “FORMULATE” ON A PIECE OF SCRATCH PAPER
- USE A DOUBLE CHECK FORM
- COPIES OF THE ONE WE USE ARE AVAILABLE ON REQUEST
- NO FORM, DRAW A TABLE FORM BEFORE STARTING
- DOUBLE CHECK YOUR MATH !!!

J. May *Equipment Group* **FORMULATION WORKSHEET** **Date:_______**

Customer: ________________________ **Field #/ Location**

Number of Acres	**X**	**Pounds Per Acre =**	**Total Pounds Required**	**1 to 3 Ammonia N to P_2O_5 Ratio**
Total Pounds Required	**÷ 2,000 =**	**Total Tons÷ Batch Size=**	**Number Batches**	

Total P_2O_5 ÷ 3=		**Total Ammonia N**	
Less MAP/DAP N			
Total		**N from NH_3/Aqua**	

		GRADE					**Total % Units**							
		N	**P**	**K**										
		%	%	%	%	%	%	*** Credit Equiv.**						
Material	**Pounds**	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	**Lb. H_2O**	**Lb. Clay**	**Cost/ Ton**	**Cost / Lb.**	**Total Cost**	**Pounds/ Batch**	**Scale Stop**
TOTALS														

TEMPERATURE CALCULATION

HEATERS				**VS**	**COOLERS**			
Pounds	**Product**	**BTU/ Lb.**	**Total BTU**		**Pounds**	**Product**	**BTU/ Lb.**	**Total BTU**
	NH_3	**1750**				**Urea**	**< 110**	
	Aqua	**1400 / Lb. NH_3**				**Ammonium Nitrate**	**< 145**	
	Phos Acid	**100**				**Ammonium Sulfate**	**< 110**	
	Steam	**1000**				**Potash**	**< 100**	
	160° Water	**120**						
		Total Heaters					**Total Coolers**	

Total Heaters		
Less Total Coolers		
Net BTU		
Net BTU ÷ (Batch Weight X .8) = Degrees Temperature Change		**° F**

Example: +16,000 Net BTU ÷ (2000x.8) 1600 = +10° F *Starting Water/ Batch Temp + Change = Final Temp. (55°+10°= 65°F)*

***H2O CREDIT % EQUIVALENT**

32-0-0 20%	**28-0-0 25%**	**Aqua 70%**	**10-34-0 25%**	**12-0-0-26 25%**
10-30-0 20%	**Phos Acid 15%**	**High K-Base Grades 15%**		

FIGURIN' IT OUT !!

- ***BASIC MATH***
- **ADD**
- **SUBRTACT**
- **MULTIPLY**
- **DIVIDE**
- ***FORMULATION IS KNOWING WHEN TO DO WHICH***

DIVISION= A PILE OF SOMETHING

- PHYSICAL SIZE OF A MATERIAL USED IN THE FORMULA
- POUNDS OF PLANT FOOD, DIVIDED BY THE PRECENTAGE CONCENTRATION OF THE RAW MATERIAL= PHYSICAL POUNDS
- 75 K ÷ .62 (0-0-62) = 121 Pound Pile

MULTIPLYING=WHAT IS IN THE PILE

- YOU CAN NOT SEE THE PLANT FOOD IN THE PILE
- A PRECENTAGE OF THE PHYSICAL PILE IS THE ACTUAL NUTRIENT CONTENT
- .62 x 121= 75 K, Nutrient Pounds

SIMPLE FORMULA

CUT 32-0-0 TO 28-0-0

HOW MUCH WATER?

N-P-K (1 TON) 28% OF 2,000=560 Nitrogen

28-0-0

560-0-0 (560 ÷ .32 = 1,750 POUNDS)

WATER 250

32-0-0 1,750 *(2,000 MINUS 1,750= 250 POUNDS WATER)*

TOTAL 2,000

FORMULATE TO AN ANALYSIS

PREDETERMINED ANALYSIS

N	P	K
5	10	10

ANALYSYIS IS

5% NITROGEN

10% PHOSPHATE (P_2O_5)

10% K – POTASSIUM

FORMULATE TO A TON, 2,000 POUNDS

J. May ***Equipment Group***

FORMULATION WORKSHEET

Date: 12-6-2016

Customer: _Smith Farms____ Field #/ Location #5

Number of Acres 40 X 500 Pounds Per Acre = 20,000 Total Pounds Required Total Pounds Required 20,000 ÷ 2,000 = 10 Total Tons÷ Batch Size= 1 Number Batches	

1 to 3 Ammonia N to P_2O_5 Ratio		
Total P_2O_5 ÷ 3=		Total Ammonia N
Less MAP/DAP N		
Total		N from NH_3/Aqua

		GRADE						Total % Units						
		N	P	K										
		% 5	% 10	% 10	%	%	%	* Credit Equiv.						
Material	Pounds	Lb. 100	Lb. 200	Lb. 200	Lb.	Lb.	Lb.	Lb. H_2O	Lb. Clay	Cost/ Ton	Cost / Lb.	Total Cost	Pounds/ Batch	Scale Stop
Water	960												9600	9600
0-0-62	323			200									3230	12830
10-34-0	588	58.8	200										5880	18710
32-0-0	129	41.2											1290	20000
TOTALS		100	200	200									20000	20000

TEMPERATURE CALCULATION

HEATERS				VS	COOLERS			
Pounds	Product	BTU/ Lb.	Total BTU		Pounds	Product	BTU/ Lb.	Total BTU
	NH_3	1750				Urea	< 110	
	Aqua	1400 / Lb. NH_3				Ammonium Nitrate	< 145	
	Phos Acid	100				Ammonium Sulfate	< 110	
	Steam	1000				Potash	< 100	
	160° Water	110						
		Total Heaters					Total Coolers	

Total Heaters		
Less Total Coolers		
Net BTU		
Net BTU ÷ (Batch Weight X .8) = Degrees Temperature Change		° F

Example: +16,000 Net BTU ÷ (2000x.8) 1600 = +10° F *Starting Water/ Batch Temp + Change = Final Temp. (55°+10°= 65°F)*

$^*H_2O$ CREDIT % EQUIVALENT

32-0-0 20%	28-0-0 25%	Aqua 70%	10-34-0 25%	12-0-0-26 25%
10-30-0 20%	Phos Acid 15%	High K-Base Grades 15%		

SUSPENSIONS

- **SAME FORMULATION PROCEDURE**
- **THEY HAVE SOME SOLIDS THAT TEND TO SETTLE OUT**
- **REDUCE PARTICLE SIZE OR INCREASE VISCOSITY**
- **MOST DO BOTH**
- **SUSPENSION AGENT “ATTAPULGITE CLAY”**
- **SUSPEND THE SOLIDS WITH CLAY**
- **CLAY FORMS A MATRYX LIKE HAY STRAW**
- **PARTICLES SET ON THE “STRAWS”**
- **CLAY CONTENT DETERMINED BY PLANT FOOD CONCENTRATION AND EXPERIENCE**

CLAY RULE OF THUMB

Liquid clay is only 25% clay but twice as effective as dry clay

PERCENT PLANT FOOD	% DRY CLAY	% LIQUID CLAY
35% TO 40%	1%	2%
30% TO 34%	1.5%	3%
24% TO 29%	2%	4%

COLD MIX SUSPENSION

- USE A 10-30-0 PHOSPHATE BASE GRADE
- A SUSPENSION AGENT IS REQUIRED, CLAY DRY OR LIQUID
- TAKE CREDIT FOR THE BASE GRADE CLAY CONTENT
- CLAY BEFORE NITROGEN SOLUTION

J. May *Equipment Group*

FORMULATION WORKSHEET

Date: 12-6-2016

Customer: Charles Smith Field #/ Location Field #7,

Number of Acres 40 X 600 Pounds Per Acre = 24,000 Total Pounds Required

Total Pounds Required 24,000 ÷ 2,000 = 12 Total Tons÷ Batch Size= 1 Number Batches

1 to 3 Ammonia N to P_2O_5 Ratio		
Total P_2O_5 ÷ 3=		Total Ammonia N
Less MAP/DAP N		
Total		N from NH_3/Aqua

		GRADE						Total % Units 36%						
		N	P	K										
		% 10	% 8	% 18	%	%	%	* Credit Equiv.						
Material	Pounds	Lb. 200	Lb. 160	Lb. 360	Lb.	Lb.	Lb.	Lb. H_2O	Lb. Clay	Cost/ Ton	Cost / Lb.	Total Cost	Pounds/ Batch	Scale Stop
WATER	406							406					4872	4872
10-30-0	533	53.3	160					106	8				6396	11268
CLAY	22												264	11532
32-0-0	458	146.7						92					5496	17028
0-0-62	581			360									6972	24000
TOTALS	2000	200	160	360				604						24000

TEMPERATURE CALCULATION

HEATERS				VS	COOLERS			
Pounds	Product	BTU/ Lb.	Total BTU		Pounds	Product	BTU/ Lb.	Total BTU
	NH_3	1750				Urea	< 110	
	Aqua	1400 / Lb. NH_3				Ammonium Nitrate	< 145	
	Phos Acid	100				Ammonium Sulfate	< 110	
	Steam	1000				Potash	< 100	
	160° Water	110						
		Total Heaters					Total Coolers	

Total Heaters	
Less Total Coolers	
Net BTU	
Net BTU ÷ (Batch Weight X .8) = Degrees Temperature Change	° F

Example: +16,000 Net BTU ÷ (2000x.8) 1600 = +10° F *Starting Water/ Batch Temp + Change = Final Temp. (55°+10°= 65°F)*

$^*H_2O$ CREDIT % EQUIVALENT

32-0-0 20%	28-0-0 25%	Aqua 70%	10-34-0 25%	12-0-0-26 25%
10-30-0 20%	Phos Acid 15%	High K-Base Grades 15%		

HOT MIX SUSPENSION

- 10-30-0 PHOSPHATE BASE GRADE
- DRY CLAY, 1 ½%
- ***CAUTION,*** 1 TO 3 AMMONIA NITROGEN TO P_2O_5 RATIO APPLIES
- BEST SEQUENCE
- CALCULATE THE HEAT OF REACTION

J. May *Equipment Group* **FORMULATION WORKSHEET** Date: 12-6-2016

Customer: INVENTORY Field #/ Location

Number of Acres	X	Pounds Per Acre =	Total Pounds Required
Total Pounds Required	÷ 2,000 =	Total Tons÷ Batch Size=	Number Batches

1 to 3 Ammonia N to P_2O_5 Ratio		
Total P_2O_5 ÷ 3=	200	Total Ammonia N
Less MAP/DAP N	126	
Total	74	N from NH_3/Aqua

		GRADE						Total % Units 40%						
		N	P	K										
		% 10	% 30	% 0	%	%	%	* Credit Equiv.						
Material	Pounds	Lb. 200	Lb. 600	Lb. 0	Lb.	Lb.	Lb.	Lb. H_2O	Lb. Clay	Cost/ Ton	Cost / Lb.	Total Cost	Pounds/ Batch	Scale Stop
WATER	726													
11-52-0	577	63	300											
NH3	45	37												
11-52-0	577	63	300											
NH3	45	37												
CLAY	30													
TOTALS	2000	200	600	0										

TEMPERATURE CALCULATION

HEATERS				VS	COOLERS			
Pounds	Product	BTU/ Lb.	Total BTU		Pounds	Product	BTU/ Lb.	Total BTU
90	NH_3	1750	157500			Urea	< 110	
	Aqua	1400 / Lb. NH_3				Ammonium Nitrate	< 145	
	Phos Acid	100				Ammonium Sulfate	< 110	
	Steam	1000				Potash	< 100	
	160° Water	110						
		Total Heaters	157500				Total Coolers	

Total Heaters	157500
Less Total Coolers	-----
Net BTU	157500
Net BTU ÷ (Batch Weight X .8) = Degrees Temperature Change	+98 ° F

Example: +16,000 Net BTU ÷ (2000x.8) 1600 = +10° F *Starting Water/ Batch Temp + Change = Final Temp. (55°+10°= 65°F)*

***H2O CREDIT % EQUIVALENT**

32-0-0 20%	28-0-0 25%	Aqua 70%	10-34-0 25%	12-0-0-26 25%
10-30-0 20%	Phos Acid 15%	High K-Base Grades 15%		

FORMULATE TO AN ACRE

- EVERYTHING IS STILL %
- SIMPLE STEPS
- #1 ADD UP THE PLANT FOOD (N+P+K)
- #2 PICK A CONCENTRATION
- #3 TOTAL PLANT FOOD ÷ CONCENTRATION = RATE PER ACRE
- #4 EACH NUTRIENT (N-P-K) ÷ RATE PER ACRE= ANALYSIS
- #5 FORMULATE TO THE ANALYSIS, 1 TON

QUICK WITH CUSTOMER, EASY FOR THE MIX PLANT

- SOIL TEST CALL FOR:
- 180 Pounds Of N
- 90 Pounds Of P
- 130 Pounds Of K
- 400 Nutrient Pounds Per Acre
- 40% Concentration
- 400 ÷ .40 = 1000P/A

- 180 ÷ 1000 P/A= .18N
- 90 ÷ 1000 P/A =.09P
- 130 ÷ 1000 P/A =.13K
- Analysis To Formulate
- 18-9-13
- Every pound of the product will contain
- 18%N-9%P-13%K

J. May *Equipment Group*

FORMULATION WORKSHEET

Date: 12-6-2016

Customer: Billy Williams **Field #/ Location #10**

Number of Acres 25 X 1000 Pounds Per Acre = Total Pounds Required
Total Pounds Required 25000 ÷ 2,000 = 12.5 Total Tons÷ Batch Size= 1 Number Batches

1 to 3 Ammonia N to P_2O_5 Ratio		
Total P_2O_5 ÷ 3=		Total Ammonia N
Less MAP/DAP N		
Total		N from NH_3/Aqua

		GRADE						Total % Units 40%						
		N	P	K										
		% 18	% 9	% 13	%	%	%	* Credit Equiv.						
Material	Pounds	Lb. 360	Lb. 180	Lb. 260	Lb.	Lb.	Lb.	Lb. H_2O	Lb. Clay	Cost/ Ton	Cost / Lb.	Total Cost	Pounds/ Batch	Scale Stop
WATER	92												1150	1150
32-0-0	960	307.1											12000	13150
0-0-62	419			260									5237	18387
10-34-0	529	52.9	180										6613	25000
TOTALS	2000	360	180	260										25000

TEMPERATURE CALCULATION

HEATERS				VS	COOLERS			
Pounds	Product	BTU/ Lb.	Total BTU		Pounds	Product	BTU/ Lb.	Total BTU
	NH_3	1750				Urea	< 110	
	Aqua	1400 / Lb. NH_3				Ammonium Nitrate	< 145	
	Phos Acid	100				Ammonium Sulfate	< 110	
	Steam	1000				Potash	< 100	
	160° Water	110						
		Total Heaters					Total Coolers	

Total Heaters		
Less Total Coolers		
Net BTU		
Net BTU ÷ (Batch Weight X .8) = Degrees Temperature Change		° F

Example: +16,000 Net BTU ÷ (2000x.8) 1600 = +10° F *Starting Water/ Batch Temp + Change = Final Temp. (55°+10°= 65°F)*

***H2O CREDIT % EQUIVALENT**

32-0-0 20%	28-0-0 25%	Aqua 70%	10-34-0 25%	12-0-0-26 25%
10-30-0 20%	Phos Acid 15%	High K-Base Grades 15%		

ONE MORE ACRE FORMULA

- SOYBEAN BLEND
- 15 Pounds Of N
- 45 Pounds Of P
- 110 Pounds Of K
- 170 Nutrient Pounds Per Acre
- 40% Concentration
- 170 ÷ .40 = 425P/A

- 15 ÷ 425 P/A= .035N
- 90 ÷ 425 P/A =.106P
- 110 ÷ 425 P/A =.259K
- Analysis To Formulate
- 3.5-10.6-25.9
- Every pound of the product will contain
- 3.5%N-10.6%P-25.9%K

EASY BLEND

- ROUND OFF THE 3.5-10.6-25.9
- FORMULATE TO 4-11-26
- REAL FORMULATORS GO FOR THE DECIMAL POINTS
- IT IS JUST AS EASY TO FORMULATE TO THE EXACT NEED
- PRECISION AGRICULTURE STARTS AT THE FORMULATION SHEET

J. May *Equipment Group* **FORMULATION WORKSHEET** **Date:12-6-2016**

Customer: Ted Johnson Field #/ Location Soybeans

Number of Acres	X	Pounds Per Acre =	Total Pounds Required
Total Pounds Required	÷ 2,000 =	Total Tons÷ Batch Size=	Number Batches

1 to 3 Ammonia N to P_2O_5 Ratio		
Total P_2O_5 ÷ 3=		Total Ammonia N
Less MAP/DAP N		
Total		N from NH_3/Aqua

		GRADE						Total % Units 40%
		N	P	K				
		% 3.5	% 10.6	% 25.9	%	%	%	* Credit Equiv.

Material	Pounds	Lb. 70	Lb. 212	Lb. 518	Lb.	Lb.	Lb.	Lb. H_2O	Lb. Clay	Cost/ Ton	Cost / Lb.	Total Cost	Pounds/ Batch	Scale Stop
WATER	438													
10-30-0	707	70.7	212											
CLAY	20							10						
0-0-62	835			518										
TOTALS	2000	70.7	212	518										

TEMPERATURE CALCULATION

HEATERS				VS	COOLERS			
Pounds	Product	BTU/ Lb.	Total BTU		Pounds	Product	BTU/ Lb.	Total BTU
	NH_3	1750				Urea	< 110	
	Aqua	1400 / Lb. NH_3				Ammonium Nitrate	< 145	
	Phos Acid	100				Ammonium Sulfate	< 110	
	Steam	1000				Potash	< 100	
	160° Water	110						
		Total Heaters					Total Coolers	

Total Heaters		
Less Total Coolers		
Net BTU		
Net BTU ÷ (Batch Weight X .8) = Degrees Temperature Change		° F

Example: +16,000 Net BTU ÷ (2000x.8) 1600 = +10° F *Starting Water/ Batch Temp + Change = Final Temp. (55°+10°= 65°F)*

***H2O CREDIT % EQUIVALENT**

32-0-0 20%	28-0-0 25%	Aqua 70%	10-34-0 25%	12-0-0-26 25%
10-30-0 20%	Phos Acid 15%	High K-Base Grades 15%		

REVIEW FOR PER ACRE

- EVERYTHING IS STILL %
- SIMPLE STEPS
- #1 ADD UP THE PLANT FOOD (N+P+K)
- #2 PICK A CONCENTRATION
- #3 TOTAL PLANT FOOD ÷ CONCENTRATION = RATE PER ACRE
- #4 EACH NUTRIENT (N-P-K) ÷ RATE PER ACRE= ANALYSIS
- #5 FORMULATE TO THE ANALYSIS, 1 TON

WHEN IN DOUBT
LAB BATCHES
(Little Bitty Batches)

- What you need:
- Postage scale or high tech gram scale
- Inexpensive “Milk Shake” mixer.
- *Not A blender.*
- *Make a Top for Container*
- Empty Containers for pre weighing products
- Raw Materials
- Sample Jars with Labels

Same As The Big Stuff

Analysis	10-6-8	Batch Size: 16 Oz		Date: 12-6-16
		10	6	8
Ingredients	Ounces	1.6	.96	1.28
Water	7.00			
0-0-62	2.06			1.28
32-0-0	4.12	1.318		
10-34-0	2.82	.282	.96	
Total	16.00	1.6	.96	1.28
Comments				

FORMULATION FOR SUCCESSFUL CROPS

Just when you think you will never get it,

It just comes to you!!!!

FLUID FERTILIZER FOUNDATION

Columbus, OH

Thank You!!