Blending Compatibility Issues

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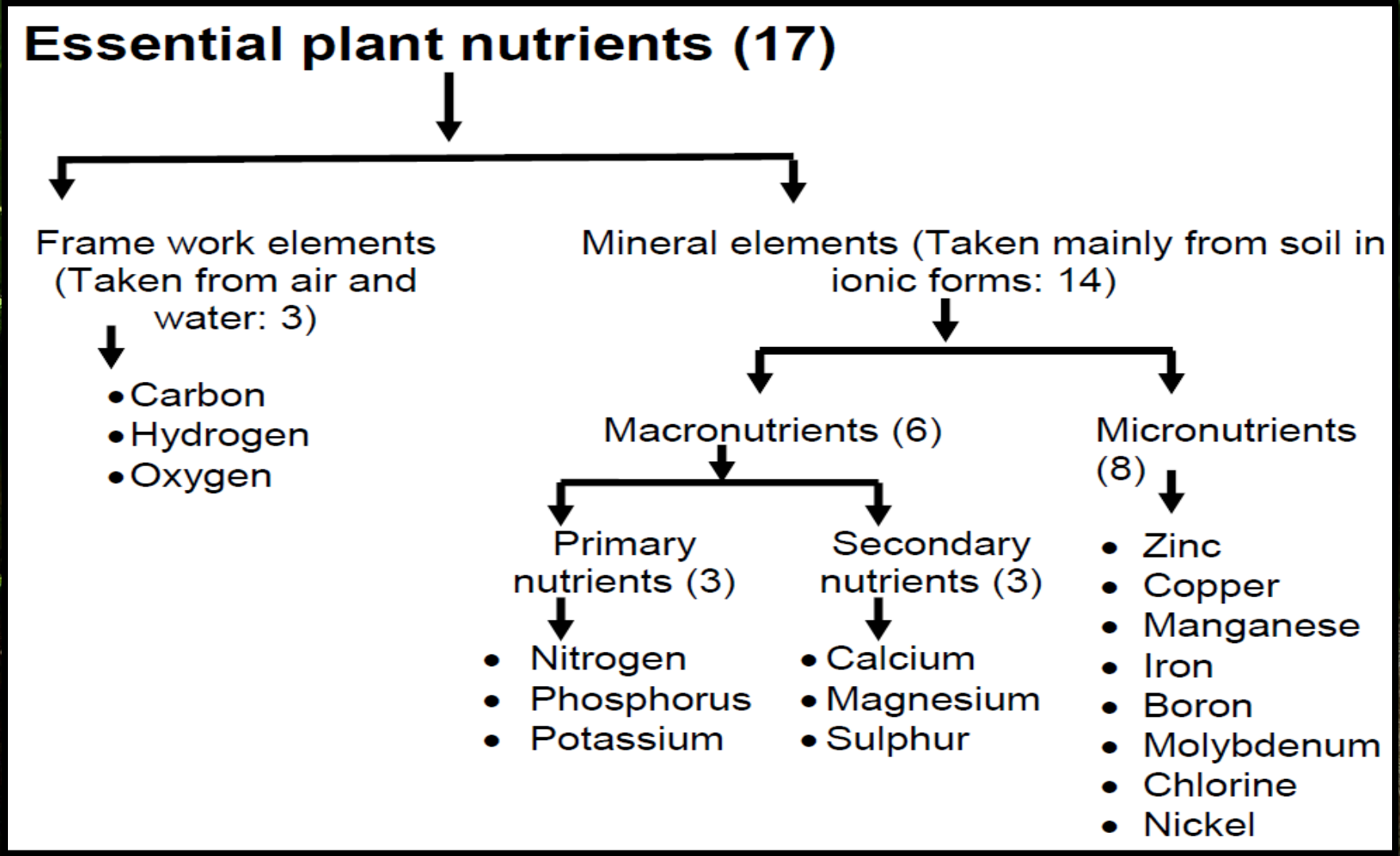
Reality

- Issues will occur – You will at some point make a “brick” or create a tub of “cottage cheese”.
- Improper mixing sequences or procedures will occur.
- You will rush the blending time.
- Physical incompatibility will sometimes arise and may create precipitates or “salting out”.
- pH concerns will arise.
- Ambient temperatures will make a difference.

Reality

- A combination that at first seems compatible sits for a few hours and a reaction occurs.
    - An example is CAN 17 mixed with Zinc EDTA- its produced pretty clear , but turns into a white paste looking mixture within 1 or 2 hrs.
- Water quality is your base.
    - It’s the building block that starts your blend.
    - Pay attention to salts, ph , and foreign material.
    - Any issues can reduce solubility , compatibility and cause stability issues.

Classification of Essential Plant Nutrients



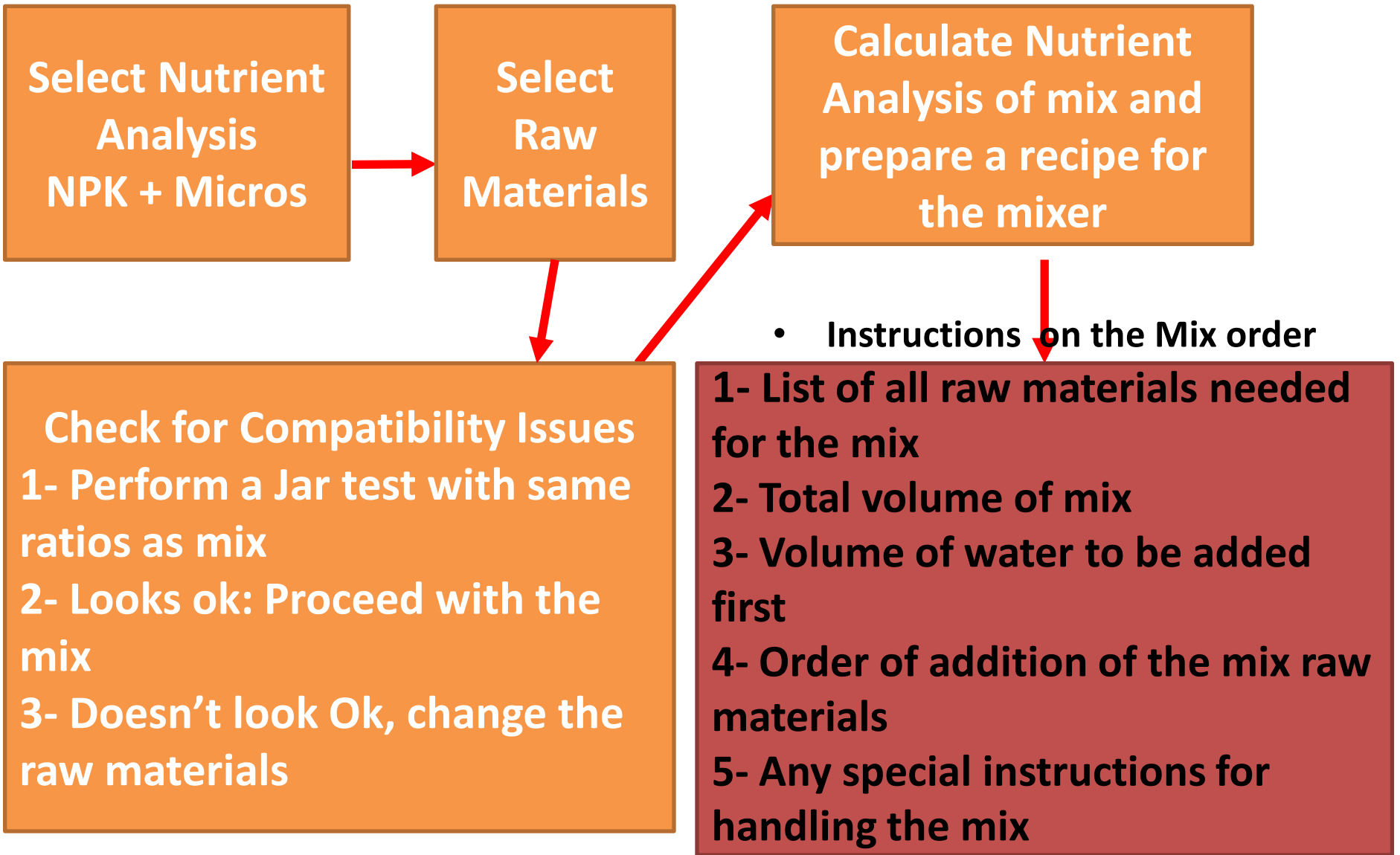
Advantages of Liquid Fertilizers

- Ease of handling and use
- Require less labor to handle
- 65%(est.) of California Agriculture is under micro irrigation. Utilizes the growers equipment.
- Allows for custom blending to specifications (Soil & Tissue test)
- Allows for applying nutrients at critical plant growth stages
- Adheres to the 4R principals

Types of Base Liquid fertilizers

- *Straight Fertilizers*
  - *UAN Fertilizers*
- *Complex Fertilizers*
  - *10-34-0*
  - *11-37-0*
- *Mixed Fertilizers*
  - *NPK + Micronutrients: Can be classified into*
  - *Suspension fertilizers: partially dissolved in water, but some of the nutrients, are suspended in the water using suspension agents such as Bentonites, clays, or other gells.*
  - *Solution fertilizers: Dissolved completely in water*

Diagram for Mixing Fertilizers



Formulation Steps

- Confirm Solubility
  - Solubility is defined as the maximal amount of the fertilizer, that can be completely dissolved
  - To be available to plants, at least some of a nutrient must be slightly soluble in the soil solution.
- Confirm Compatibility
  - Put a sample together to make sure of compatibility.
- Make sure of your Order of Addition
- Be aware of the “Ion Effect”
  - Solubility is dependent other inputs. The solubility becomes reduced when materials have the same element or ion.
  - An example would be Potassium Nitrate and Potassium Sulfate. They are both compatible, however their solubility becomes reduced because each contain potassium.
- Make sure of the quality of product your using.
  - 10-34-0 is a good example.
    - Watch for polyphosphate content or impurities

Water Quality

- Important for formulating the Fertilizer Mix
  - pH
  - EC
- Important for injecting through the irrigation System
  - pH
  - EC
  - Hardness

Salt Out Temp

- Salt out Temp: The Temp at which the fertilizer will fall out of solution and precipitate.
- Reduced Solubility due to high ionic strength
- Important why:
  - Storage of liquid Fertilizers through Winter
  - Mixed fertilizers will have a different Salt out Temp than the separate fertilizers before mixing

Product	Salt-out Temp. (°F)
28-0-0	-1
32-0-0	28
10-34-0	-10
12-0-0-26S	<20
10-0-0-10Zn	32
7-21-7	20
4-10-10	18
8-21-4-3S-.5Zn	<5
9-18-4-6S-.5Zn	<5
9-20-2-7S-.5Zn	<5
18-13-0-7S	<5
10-30-0-3S	<5

Order of Addition

- Check your product labels and SDS's about known incompatibility or insolubility issues
- Should always save a little water to mix with at the end. Use about 50 to 80% up front .
- Should always add your liquid materials before drys. It gives a little more breathing room and sometimes provides a little heat if there is a chemical reaction.
- Always put acid into water – not water into acid!
- Acid products first-then alkaline products- then neutral products last. This reduces the risk of forming precipitates.
- Add your dry material slowly. Too fast just produces clumps and adds to mixing time.
- Don't mix 2 or more liquid concentrates directly together

Other Factors

- Target your desired salt out temperature.
  - Colder materials take longer to mix.
  - Heat source can speed up mixing time.
  - Potash can can cool your solution and add to mix time.
- On-site storage temperature.
- Confirm any potential tank contamination issues at the delivery site.
- Know your materials!
  - Specific gravity
  - Acid , Base, or Neutral
  - Individual salt out temperatures
  - Individual solubility boundaries
- Most of the issues encountered when producing solution blends are related to the quality of source materials

Compatibility

- When mixing fertilizers to prepare a custom blend. The mix is Incompatible if it forms a precipitate.

$$Ca(NO_3)_2 + (NH_4)_2SO_4 \longrightarrow CaSO_4\downarrow$$

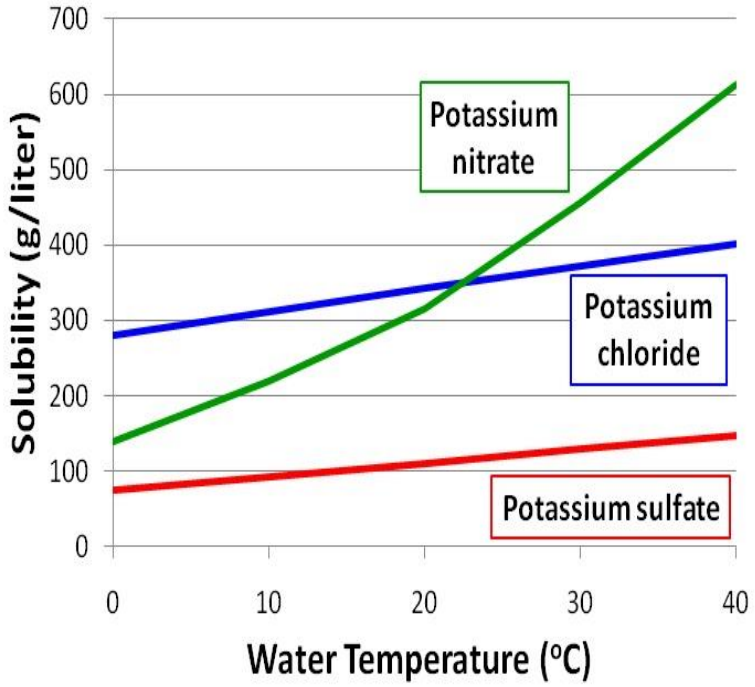
Calcium Nitrate Ammonium Sulfate Precipitate of Calcium Sulfate (gypsum)

Don’t be afraid to “Bench Test”

Your Best Friends

Fertilizer Solubility

Fertilizer Material	Chemical Formula	Solubility (lb/100 gal)
Ammonia	NH_3	750
Ammonium nitrate	NH_4NO_3	983
Ammonium sulfate	$(NH_4)_2SO_4$	592
Borax	$Na_2B_4O_7 \cdot 10H_2O$	25
Calcium carbonate (limestone)	$CaCO_3$	0.050
Calcium metaphosphate	$Ca(PO_3)_2$	0.008
Calcium nitrate	$Ca(NO_3)_2 \cdot 4H_2O$	1,117
Calcium sulfate	$CaSO_4 \cdot 2H_2O$	2
Copper sulfate	$CuSO_4 \cdot 5H_2O$	267
Diammonium phosphate	$(NH_4)_2HPO_4$	209
Dicalcium phosphate	$CaHPO_4 \cdot 2H_2O$	0.168
Magnesia	MgO	0.005
Magnesium sulfate	$MgSO_4 \cdot 7H_2O$	709
Manganese sulfate	$MnSO_4 \cdot 4H_2O$	875
Monoammonium phosphate	$NH_4H_2PO_4$	358
Monocalcium phosphate	$CaH_4(PO_4)_2 \cdot H_2O$ *	15.4
Potassium chloride	KCl	233
Potassium nitrate	KNO_3	108
Potassium sulfate	K_2SO_4	67
Sodium nitrate	$NaNO_3$	608
Urea	$CO(NH_2)_2$	559
Zinc sulfate	$ZnSO_4 \cdot 6H_2O$	584



Fluid Fertilizer Foundation

Solutions for AGRICULTURE

FluidFertilizer.com

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 generally acceptable 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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3/1/09

	Anhydrous Ammonia	Aqua Ammonia	Urea Solution	Ammonium Nitrate Solution	UAN Solution	Ammonium Sulfate Solution	Ammonium Polyphosphate Solution	Ammonium Chloride Solution	Ammonium Thiosulfate	Potassium Thiosulfate	Calcium Thiosulfate	Magnesium Thiosulfate	Calcium-Ammonium Nitrate Solution	Calcium Nitrate Solution	Potassium Carbonate Solution	N-p Huric 28/27	N-pHuric 15/49	N-pHuric 10/55	Water	Nitric Acid	Phosphoric Acid (white)	Phosphoric Acid (gi	Sulfuric Acid	Urea	Ammonium Nitrate	Calcium Nitrate	Potassium Chloride	Potassium Nitrate	Magnesium Nitrate	Technical Grade MAP	Monopotassium Phosphate	PeKacid
Anhydrous Ammonia ; 82-0-0		△																	△													
Aqua Ammonia; 20-0-0	△																		△													
Urea Solution; 23-0-0	△																															
Ammonium Nitrate Solution; 20-0-0	△																															
Urea Ammonium Nitrate Solution; UAN 28/32-0-0	△																															
Ammonium Sulfate Solution; 8-0-0-9S	△	△																														
Ammonium Polyphosphate Solution; 10-34-0	△	△																														
Ammonium Chloride Solution; 6-0-0-16Cl	△																															
Ammonium Thiosulfate Solution; ATS, 12-0-0-26S	△																															
Potassium Thiosulfate Solution; 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; 8-0-0-11Ca								?																								
Potassium Carbonate Solution; 0-0-32								?																								
N-pHuric 28/27; 28-0-0-9S		△																														
N-pHuric 15/49; 15-0-0-16S		△																														
N-pHuric 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																								Dry								
Calcium Nitrate; 15.5-0-0-19Ca																								Dry	Dry							
Potassium Chloride; 0-0-62																								Dry	Dry	Dry						
Potassium Nitrate; 13-0-46								?																Dry	Dry	Dry	Dry					
Magnesium Nitrate; 10-0-0-9Mg								?																Dry	Dry	Dry	Dry	Dry				
Monoammonium Phosphate (Technical, 12-61-0)								?							?									Dry	Dry	Dry	Dry	Dry	Dry			
Monopotassium Phosphate (0-52-34)								?							?									Dry	Dry	Dry	Dry	Dry	Dry	Dry		
PeKacid (0-60-20)								?												△	△			Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	


This is what its all about!
THANK YOU