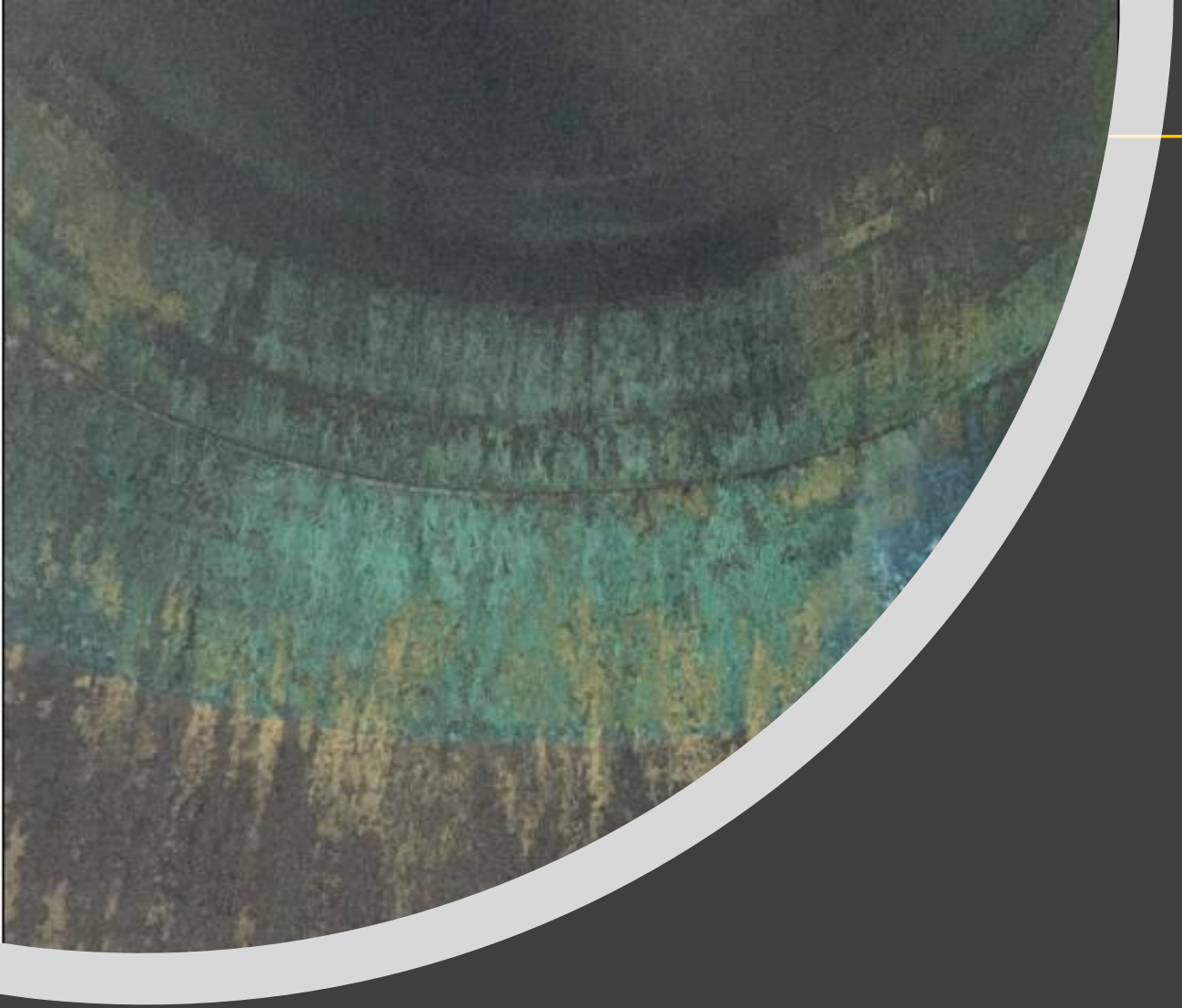


Product Stability and Compatibility

"Quality is not what happens when what you do matches your intentions. It is what happens when what you do matches your customers' expectations." Guaspari

Presented by Jesse Voss

Quality Assurance - Specialty Liquids

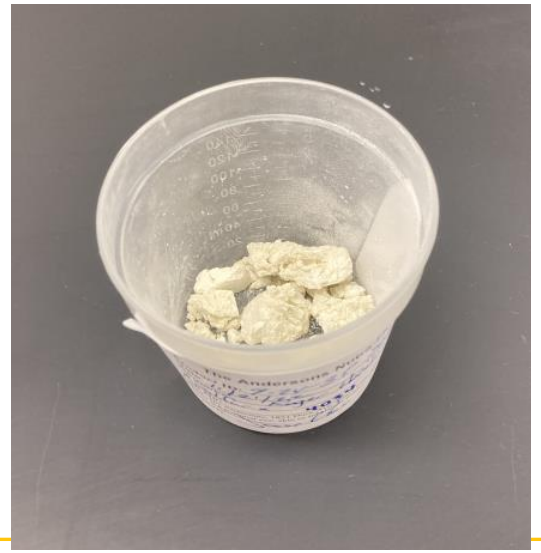
The Andersons

Product Stability and Compatibility

- Stability
  - Major issues affecting stability - Extremes
    - Hot Summer Storage
    - Freezing Cold Winter Storage
  - Formulate the problem out
  - Reduce inventory of vulnerable products during extreme periods
    - 10-34-0 in Summer
    - 6-24-6 D in Winter
  - Ship vulnerable products closer to time of use
  - Understand the effects of extreme storage conditions on received product
- Compatibility
  - If done right, compatibility can be formulated out
  - Jar test is always recommended

Compatibility

- Differentiation – Makes formulation tricky
  - Stringent process for product developement
- Reduced passes - Humic Acid compatibility with Capture LFR
- SRN (triazone) compatibility with Polyphosphate
- Non chelated micronutrient compatibility with Ortho and Pyrophosphate



Compatibility

	Compatible
	Limited Compatibility
	Incompatable
Color	Might change final color

Product last in the trailer

Product to be loaded	Gold Start Fertilizer 20% Polys	Premium Fertilizer 50% Polys	Conventional 10-34-0 70% Polys	Diamond Fertilizer 100% Ortho	X-0-X zero Phosphate grades	Aqua Ammonia	Urea Solution	Ammonium Nitrate Solution	Urea Ammonium Nitrate Solution	Ammonium Sulfate solution	Ammonium Thiosulfate Solution ATS	Potassium Thiosulfate Solution KTS	Potassium Carbonate Solution	Super 72 SRN 28-0-0	Water	Nulex 10%,15%& 20% Zn	Citrate, EDTA 10% Zn (10XL)	Chelate 6 Zn	Chelate 9 Zn	Chelate Mn 6	10% B MEA	4.5 % Fe EDTA	7.5% Cu EDTA	MS Corn Mix	MS Soy Mix	MS Wheat Mix
Gold Start Fertilizer 20% Polys																						Color	Color	Color	Color	Color
Premium Fertilizer 50% Polys																						Color	Color	Color	Color	Color
Conventional 10-34-0 70% Polys																						Color	Color	Color	Color	Color
Diamond Fertilizer 100% Ortho																						Color	Color	Color	Color	Color
X-0-X zero Phosphate grades																										
Aqua Ammonia																	Color					Color	Color	Color	Color	Color
Urea Solution																						Color	Color	Color	Color	Color
Ammonium Nitrate Solution																	Color					Color	Color	Color	Color	Color
Urea Ammonium Nitrate Solution																	Color					Color	Color	Color	Color	Color
Ammonium Sulfate solution																						Color	Color	Color	Color	Color
Ammonium Thiosulfate Solution ATS																						Color	Color	Color	Color	Color
Potassium Thiosulfate Solution KTS																						Color	Color	Color	Color	Color
Potassium Carbonate Solution																						Color	Color	Color	Color	Color
Super 72 SRN 28-0-0																						Color	Color	Color	Color	Color
Water																	Color									
Nulex 10%,15%& 20% Zn																	Color			Color		Color	Color	Color	Color	Color
Citrate, EDTA 10% Zn (10XL)																				Color		Color	Color	Color	Color	Color
Chelate 6 Zn																	Color			Color		Color	Color	Color	Color	Color
Chelate 9 Zn																	Color			Color		Color	Color	Color	Color	Color
Chelate Mn 6																						Color	Color	Color	Color	Color
10% B MEA																										
4.5 % Fe EDTA																							Color	Color	Color	Color
7.5% Cu EDTA																						Color				Color
MS Corn Mix																										Color
MS Soy Mix																										Color
MS Wheat Mix																										

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Compatibility

The Andersons Ag Specialty Compatability Chart

PRODUCTS	TRIPLE CROWN	EEZY MAN	BORON 10%	APP CORN MIX	MICRO CARB ZMB	PHOS FIX	SWEET N' EEZY	EZG CA 3%	EZG CU 7.5%	EZG FE 4.5%	EZG MG 2.5%	EZG MN 6%	EZG ZN 9%	EZG ZINC MAN	EZG BEAN BLEND	EZG CORN MIX	EZG WHEAT BLEND	EEZY CAL 10%	EEZY CAL-B	EEZY CAL-K	LIQUID CALCIUM NITRATE	SEASON PASS	100% ORTHO	POLY BLENDS	OVERPASS SF	OVERPASS CF	FOLIAR K	BEAN MAKER	MICRO NOURISH	ULTRA MATE SG	UAN	GLYPHO SATE
EZG ZINCMAN																																
EZG BEAN BLEND																																
EZG CORN MIX																																
EZG WHEAT BLEND																																
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LIQUID CALCIUM NITRATE																																
SEASON PASS																																
100% ORTHO																																
POLY BLENDS																																
OVERPASS SF																																
OVERPASS CF																																
FOLIAR K																																
BEANMAKER																																
MICRONOURISH																																
ULTRAMATE SG																																
UAN																																
GLYPHOSATE																																

Color Chart

- Compatible
- Splash N' Go
- Do Not Mix

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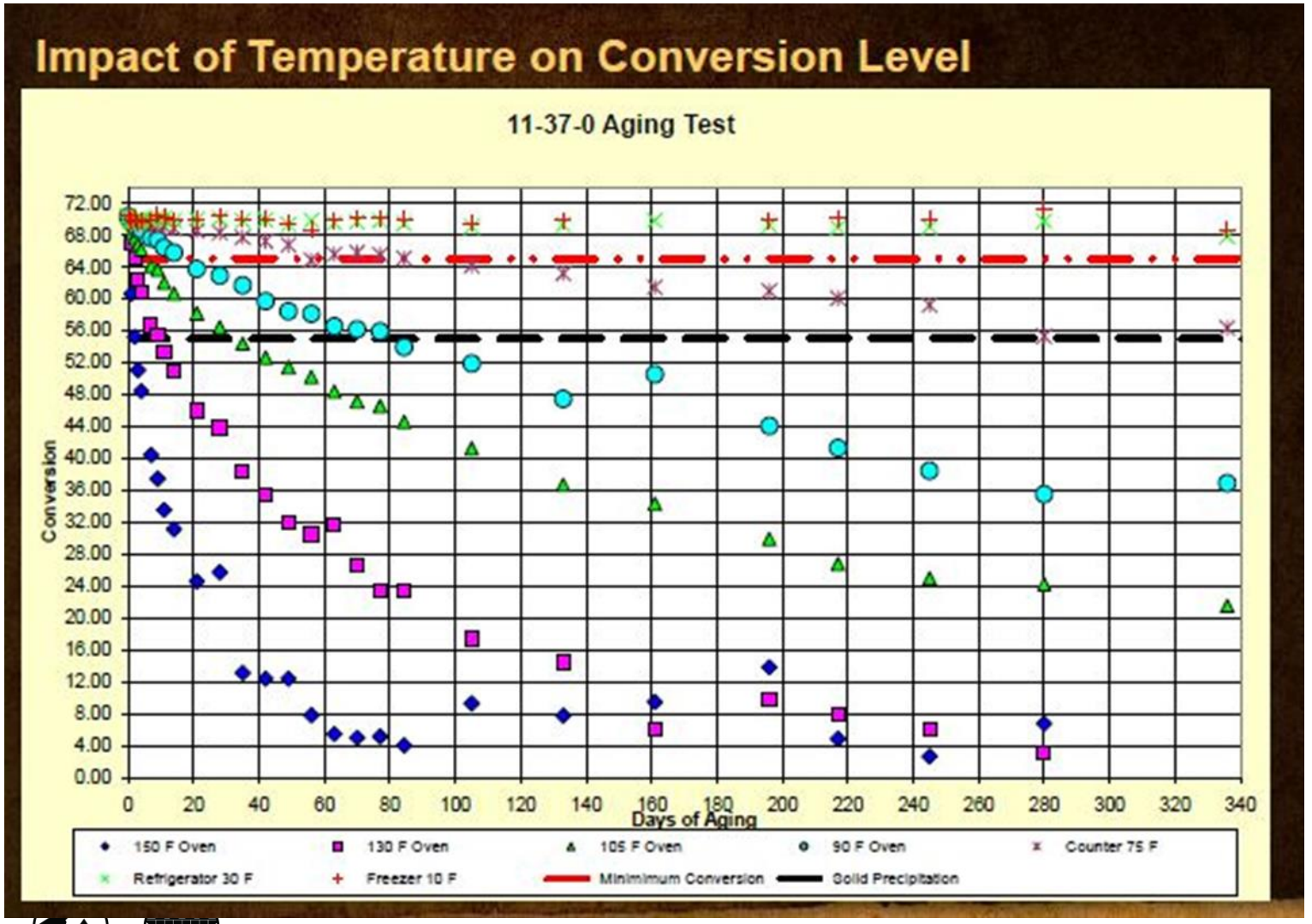
Extreme Heat

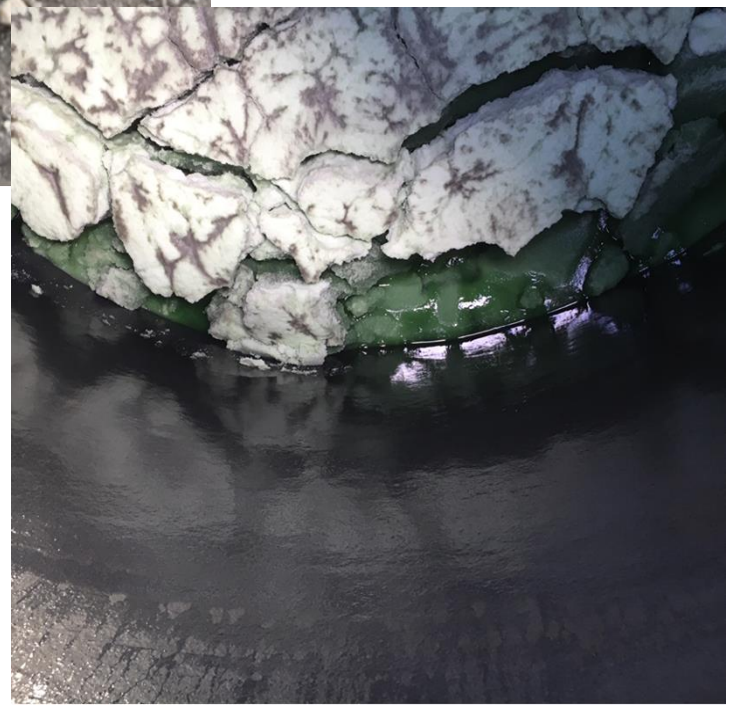


Johnny Walkers

Extreme Cold

- Seeing increased gallons shipped in the fall to be stored over winter
  - Market driven
- 80/20 and 100% Ortho products are most vulnerable
- Extreme Cold weather
  - Storage – Steel Tank
  - Shipment – Stainless Trailer

Salt out Material

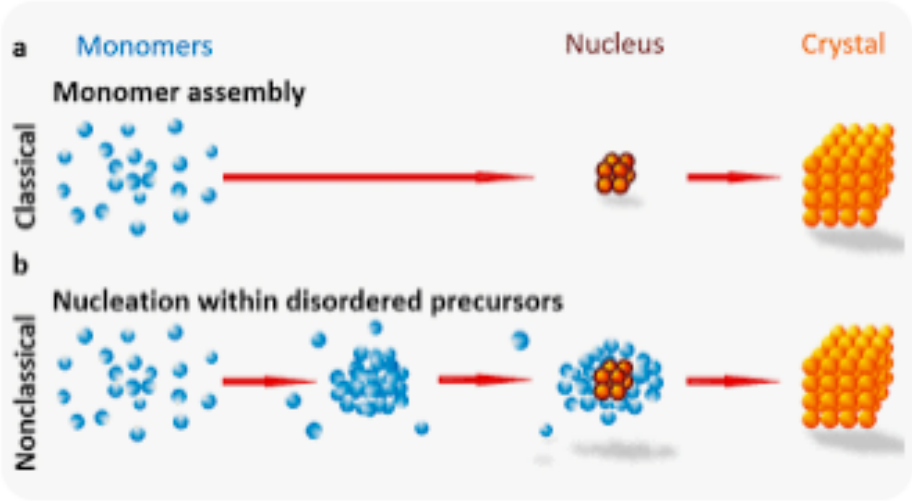


Product Analysis

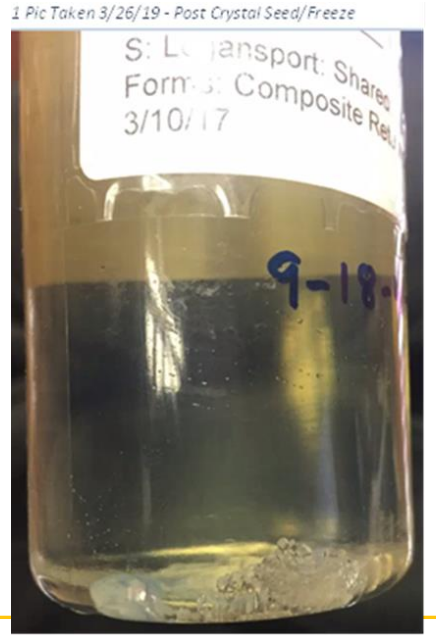
- As-is analysis
  - N = 13.68%
  - P205 = 42.64%
  - K20 = 1.85%
    - Boron = 0.006%
    - Copper = 0.0142%
    - Iron = 0.211%
    - Manganese = 0.0354%
    - Zinc = 0.225%
- DAP Analysis
  - 18-46-0 (dry)

Nucleation

- Product can seem to be stable in cold extremes in very clean containers
- Presence of crystals in a tank can cause nucleation
- Reduces the stability of the overall product
- Clean tanks are extremely important for product stability



ACS Publications - American Chemical Society

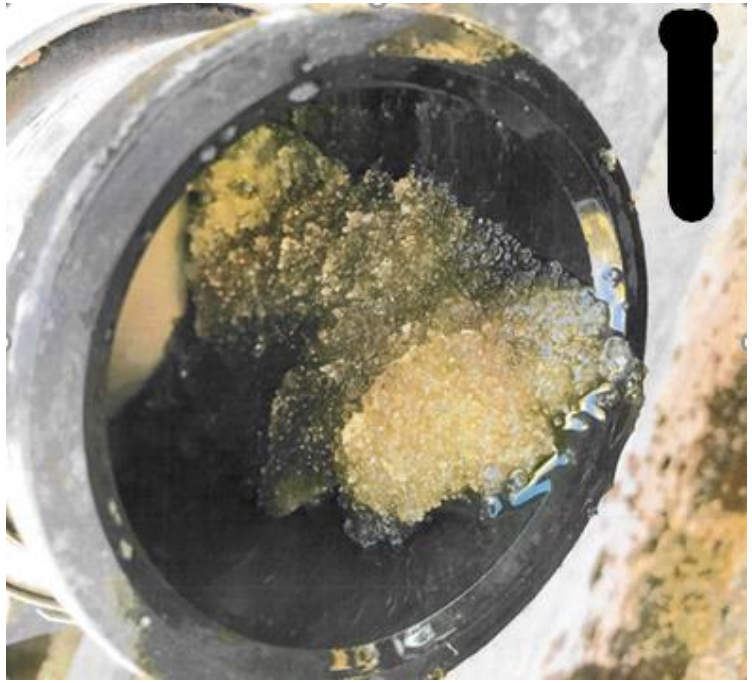


Phase Separation

- Water freezes and rises to the top
- Salt solution concentrates
- Sometimes crystals can then form in the concentrated salt solution and fall to the bottom

Product Handling

- Handling product at temps below the SOT (salt out temperature)
  - Does not allow crystals to go back into solution
  - Aggressive agitation and heat are required



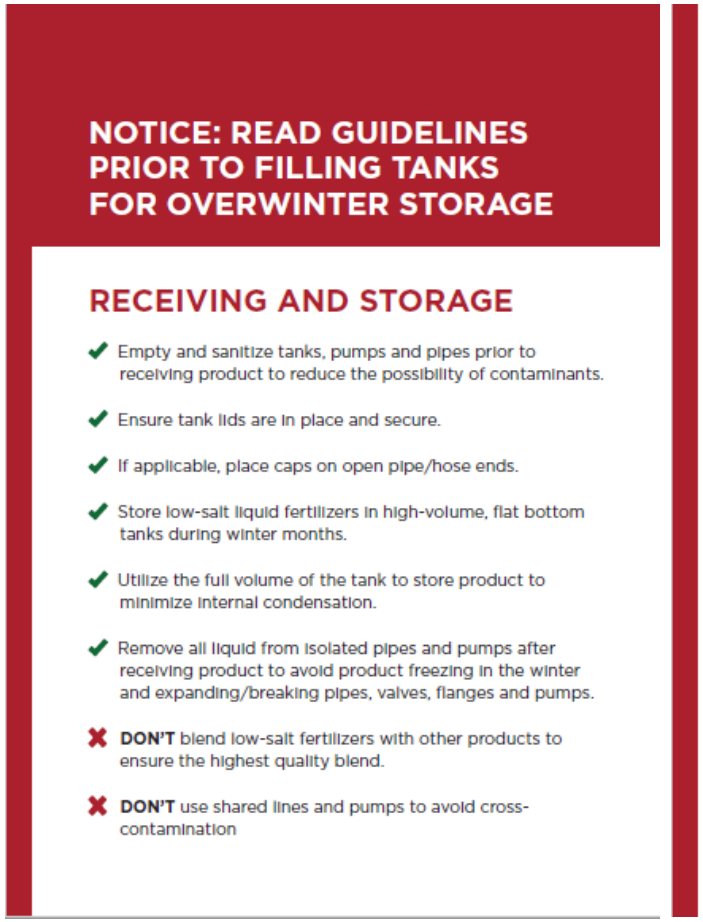
Production Correction

- Monopotassium Phosphate (MKP) formation at Low pH

New Challenges…Mold

- Increased carbon additives
  - Fulvic
  - Humic
- Product Carryover
  - Water condensation in tank tops leads to a thin water layer on top of product.
  - Prime environment for mold growth.

Product Handling and Storage Guidelines



NOTICE: READ GUIDELINES PRIOR TO FILLING TANKS FOR OVERWINTER STORAGE

RECEIVING AND STORAGE

- ✔ Empty and sanitize tanks, pumps and pipes prior to receiving product to reduce the possibility of contaminants.
- ✔ Ensure tank lids are in place and secure.
- ✔ If applicable, place caps on open pipe/hose ends.
- ✔ Store low-salt liquid fertilizers in high-volume, flat bottom tanks during winter months.
- ✔ Utilize the full volume of the tank to store product to minimize internal condensation.
- ✔ Remove all liquid from isolated pipes and pumps after receiving product to avoid product freezing in the winter and expanding/breaking pipes, valves, flanges and pumps.
- ✖ **DON'T** blend low-salt fertilizers with other products to ensure the highest quality blend.
- ✖ **DON'T** use shared lines and pumps to avoid cross-contamination

SPRING HANDLING: RECIRCULATION & FILTRATION

- ✔ Aggressive recirculation/agitation must be completed prior to removing product from tank.
- ✔ Recirculation/agitation can be initiated when product temperature is above the labeled salt-out temperature. 30 minutes is recommended for every 500 gallons of product. In all instances, longer is better.

  An ice plug may be present at the top of the tank at the time of recirculation where water has come out of solution and froze. Aggressive recirculation/agitation will aid in reconstituting the water and any salt-out material back into solution.
- ✔ Filter product prior to use.

- In-depth guidelines available
  - https://andersonsplantnutrient.com/agriculture/resources/tank-guidelines