Observations of Fertilizer Absorption of Atmospheric Water

Risk to Water Absorption and Caking

Lyle Cowell, PAg, CCA
Nutrien Ag Solutions
Factors

Environmental
• RH at storage and during transfer
• Condensation at rapid temperature change

Fertilizer Physical Quality
• Fertilizer type
• Fertilizer Blends
• Fertilizer Quality (prilled? dust? oil?)
• Specialty fertilizer (ESN?? AMS vs elemental S?)
Relative humidity = water retained by air at given temperature. Warm air can retain more water. Warming air will absorb water, cooling air will deposit water.

‘Critical Relative Humidity’ = RH above which a fertilizer will begin to absorb moisture. Each fertilizer or blend will have a unique CRH

Try to keep RH well below 50% at all times.
Condensation is an added problem.

If air is rapidly cooled, moisture will condense.

If very warm fertilizer rapidly contacts cold air, condensation may occur.

If warm air rapidly contacts cold fertilizer, condensation may occur.
Where does warm air hit cold fertilizer?

Cold fertilizer

‘Warm’ moist air in spring

Condensation in tank, then deposition in rollers, augers, lines and manifolds
Physical Factors

Prills do not reduce ability to absorb water but they do reduce risk to form crystalline bridges = ‘Caking’
Crystal bridges between fertilizer particles can cause ‘caking’
So.....how to measure fertilizer absorption of atmospheric air? A $50 lab.

Trials: Blends that represent 80N-25P₂O₅-15K₂O-15S in plastic cups in a closed plastic tub with 1” of water to provide 75% humidity at 20C.
Products used in two trials:

Blend Trials

Urea prills (46-0-0)
MAP granules (11-52-0)
Potash granules (0-0-62)
Ammonium sulphate prills (20-0-0-24)

Product trials

ESN (44-0-0)
Tiger Combo (12-0-0-50)
MES15 (13-33-0-15)
Ammonium sulphate (21-0-0-24) from multiple sources

Fertilizer Blends based on 80N-25P$_2$O$_5$-15K$_2$O-15S
Conditions: 70%RH at 21 C. Initial Weight 200 grams.
Trial 1: Individual fertilizers and Blends

55 days

No caking in 11-52-0, slight caking in 0-0-62
3-4x Fertilizer Blends: severe water absorption with loss of prill structure – caked only when dried under low humidity
Absorption of Water by Fertilizer Blends

Linear absorption of water

Fertilizer Blend based on 80N-25P₂O₅-15K₂O-15S
Conditions: 70%RH at 21 C. Initial Weight 200 grams.
Absorption of Atmospheric Water by Primary Fertilizers

% weight gain of water after 55 days at 70% RH, 21C

Urea is the Baddy
Absorption of Atmospheric Water by Urea Blends

Urea is the Baddy, AMS is its Buddy

% weight gain of water after 55 days at 70% RH, 21C
Absorption of Atmospheric Water by Multinutrient Blends

More products = More Risk

% weight of water vs 200 gram initial weight after 55 days at 70% RH, 21C
NPKS Blend had severe water absorption
Trial 2: Fertilizer Product Comparison

(up to) 100 days

Primary goal to compare AMS products and specialty products such as ESN, ME15 and Tiger Combo
Absorption of Water by Fertilizer Products

Fertilizer Blend based on 80N-25P<sub>2</sub>O<sub>5</sub>-15K<sub>2</sub>O-15S
Conditions: 70%RH at 21 C. Initial Weight 200 grams.
Absorption of Atmospheric Water by Individual Fertilizers

% weight gain of water after 60 days at 70% RH, 21C

Urea was still the Baddy
Yes, that is free water....

Urea

At 100 days

MAP
ESN Absorbs Atmospheric Water Slower than Urea

% weight gain of water after 60 days at 70% RH, 21C
AMS Fertilizers Absorb Atmospheric Water at Same Rate

% weight gain of water after 55 days at 70% RH, 21C
% weight gain of water after 55 days at 70% RH, 21C
Tiger Combo is 60% AMS and 40% ‘Tiger 90’ (12-0-0-50)
Overall

- Avoid high humidity (CRH....try to keep RH under50%)
- Avoid condensation – rapid changes in temperature
- Physical quality is important but not as important as CRH
- Urea and blends with urea have a higher risk
- Communicate with farmers when there is risk and approach solutions with thought to risk factors in mind