

Defining Enhanced Efficiency Fertilizer Sources

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Water Soluble Nitrogen Sources

- Also referred to as “Readily Available N” sources
- Rapid growth and color responses expected
- Leaching potential (especially on sandy soils) and foliar burn potential significantly higher

Standard WSN Sources

Fertilizer	Analysis	Salt Index (>2.5 = high; 2.5 to 1=mod; <1 = low)	Water Solubility g/L (lb/gal)
Ammonium nitrate	34-0-0	3.2	1810 (15)
Urea	45-0-0	1.7	780 (6.5)
Ammonium Sulfate	21-0-0	3.3	710 (5.9)
Potassium nitrate	13-0-44	5.3	130 (1.1)

Water Soluble Nitrogen Sources

- Application levels SHOULD vary depending on:
 - The specific situation.... the grass and its use, the soil, the climate, impending weather conditions, surrounding environment.
 - While it is more labor intensive, N-use efficiency is improved by applying smaller levels of WSN on a more frequent basis... often referred to as ‘Spoon Feeding’
 - ‘Foliar Feeding’: nutrients delivered as a spray solution at a spray volume of at least 40 gallons per acre; N applied typically at 0.05 to 0.25 lb N/1000 sq ft.



American Association of Plant Food Control Officials Definitions

- “Enhanced Efficiency” describes fertilizer products with characteristics that allow increased plant nutrient availability and reduce the potential of nutrient losses to the environment when compared to an appropriate reference product. (AAPFCO, 2009).
- Enhanced Efficiency is an ‘umbrella term’ that covers categories of both ‘slow release’ and ‘stabilized’ N sources.

American Association of Plant Food Control Officials Definitions–AAPFCO, 2011

- The term “stabilized” be adopted to describe products that have been amended with an additive that reduces the rate of transformation of fertilizer compounds, resulting in extended time of availability in the soil. Examples of stabilizing amendments are nitrification inhibitors, nitrogen stabilizers, or urease inhibitors.
- Stabilized N is not classified as WIN or SAN at this time. It is the opinion of VT scientists that stabilized N be handled as water soluble N in terms of nutrient application levels and planning.

American Association of Plant Food Control Officials Definitions –AAPFCO, 2011

- “Slow or controlled release fertilizer” means a fertilizer containing a plant nutrient in a form which delays its availability for plant uptake and use after application, or which extends its availability to the plant significantly longer than a reference product. A slow or controlled release fertilizer must contain a minimum of 15 percent slowly available forms of nitrogen. Examples of slow release products are **coated or occluded materials** that regulate soluble nutrient release, **water insoluble**, or **slowly available water soluble**.

Determining Slowly Available Forms of Nitrogen Sources

- There will be a designation on the label's guaranteed analysis indicating a specific percentage of SAN, Water Insoluble Nitrogen (WIN), Controlled Release Nitrogen (CRN) or Slow Release Nitrogen (SRN)
- For standardization the goal is to follow guidelines defined by AAPFCO– Assoc. of American Plant Food Control Officials)
- Slowly Available N is due to either:
 - Inherent synthesis/composition of the product (e.g. ureaformaldehyde, natural organics, or isobutyraldehyde diurea)
 - Coating (sulfur, polymer, or a combination of the two)

Stabilized Fertilizers

- Nitrification inhibitors
 - DCD, DMPP, Nitrapyrin
 - Products like: UFLEXX, UMAXX

- Urease inhibitors
 - NBPT
 - Products like: UFLEXX, UMAXX, LSN

Controlled Release Fertilizers

- Reduced Solubility
 - Urea formaldehyde or “urea forms”
 - Methylene urea
 - Isobutylidene diurea (IBDU)
 - Occluded urea
- Coatings
 - Sulfur
 - Polymers
 - Resins

Low Water Solubility N Fertilizers

- Urea-formaldehydes or urea-forms
 - White, odorless solids containing about 38% N that are made by reacting urea with formaldehyde in the presence of a catalyst.
- Methylene urea
 - React methylene molecules with urea
- Isobutylidene Diurea (IBDU)
 - Approximately 30% N
 - React isobutyraldehyde with urea

Low-Solubility Compounds (UF, MU)

- Urea-formaldehyde reaction products

- Discovered in 1930s

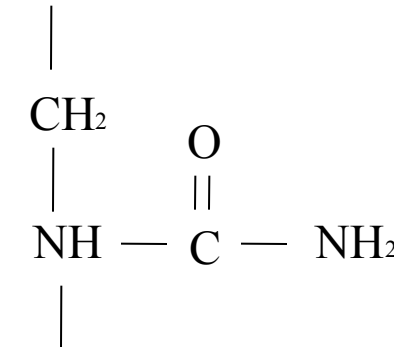
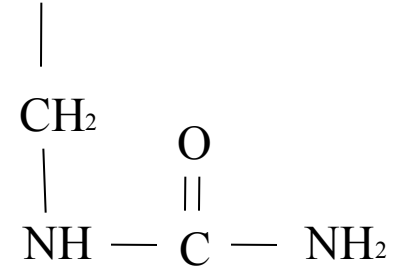
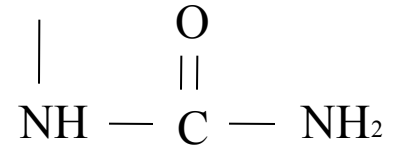
- First fertilizer use in 1940s

- Mixture of urea and UF polymers of various chain lengths

- Solid and liquid products

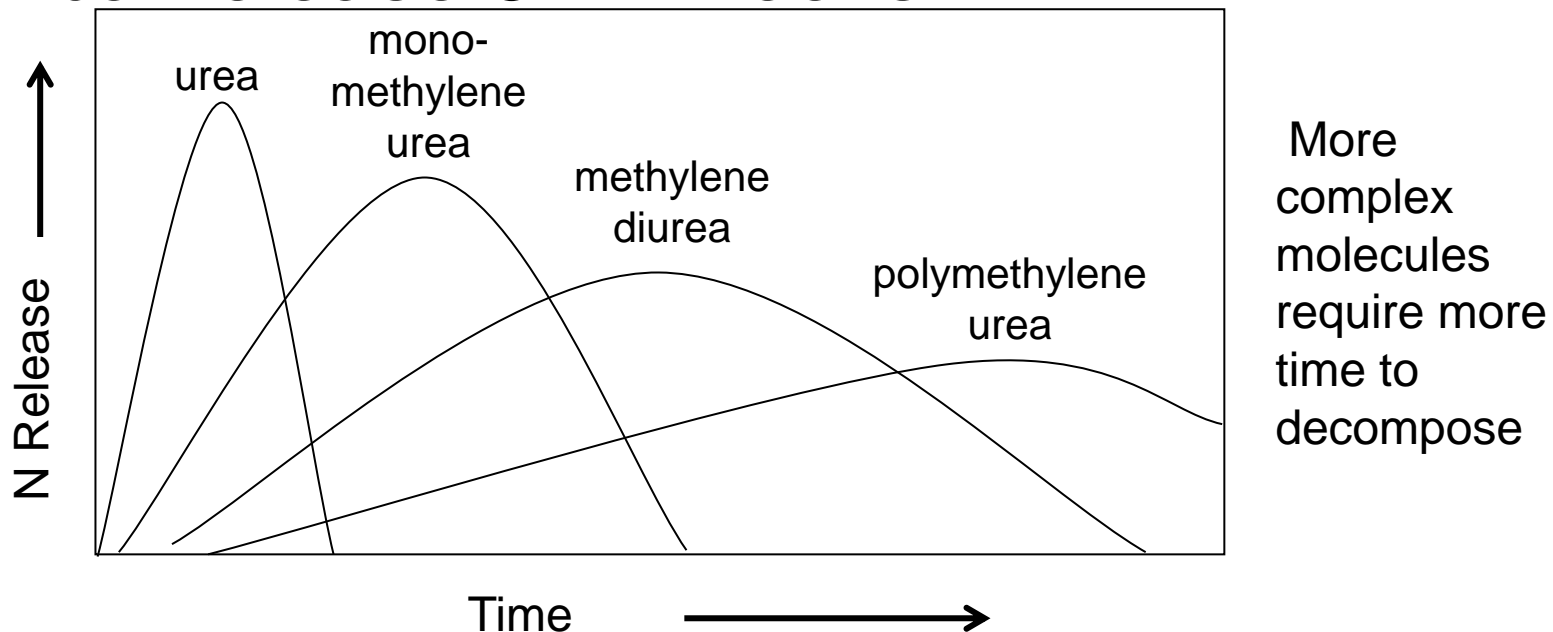
- Solubility dependent on chain length

- Products: Nutralene, Nitroform, Nitamin, CoRoN



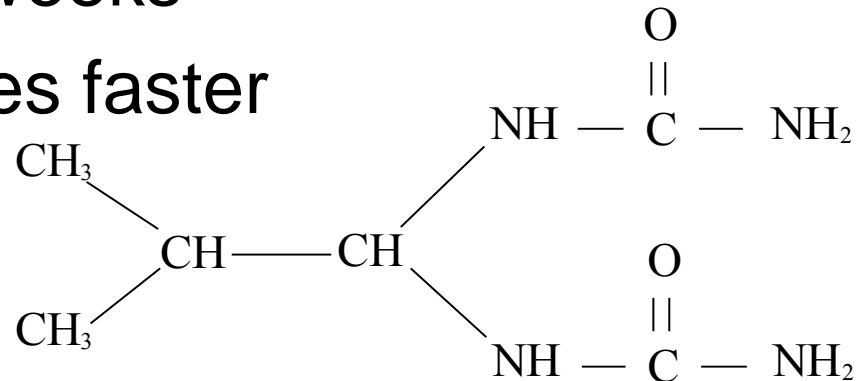
Low-Solubility Compounds (UF, MU)

- N release by microbial mineralization (soil temperature, moisture, pH, etc)
- Longer chains = slower release
- Typical release 8-12 weeks



Low-Solubility Compounds (IBDU)

- Isobutyridene diurea – IBDU (Solid)
- Uniform chemical composition – no free urea
- Release by slow dissolution and hydrolysis
 - IBDU reacts with water to release urea
 - Typical release 8-12 weeks
 - Finer material dissolves faster



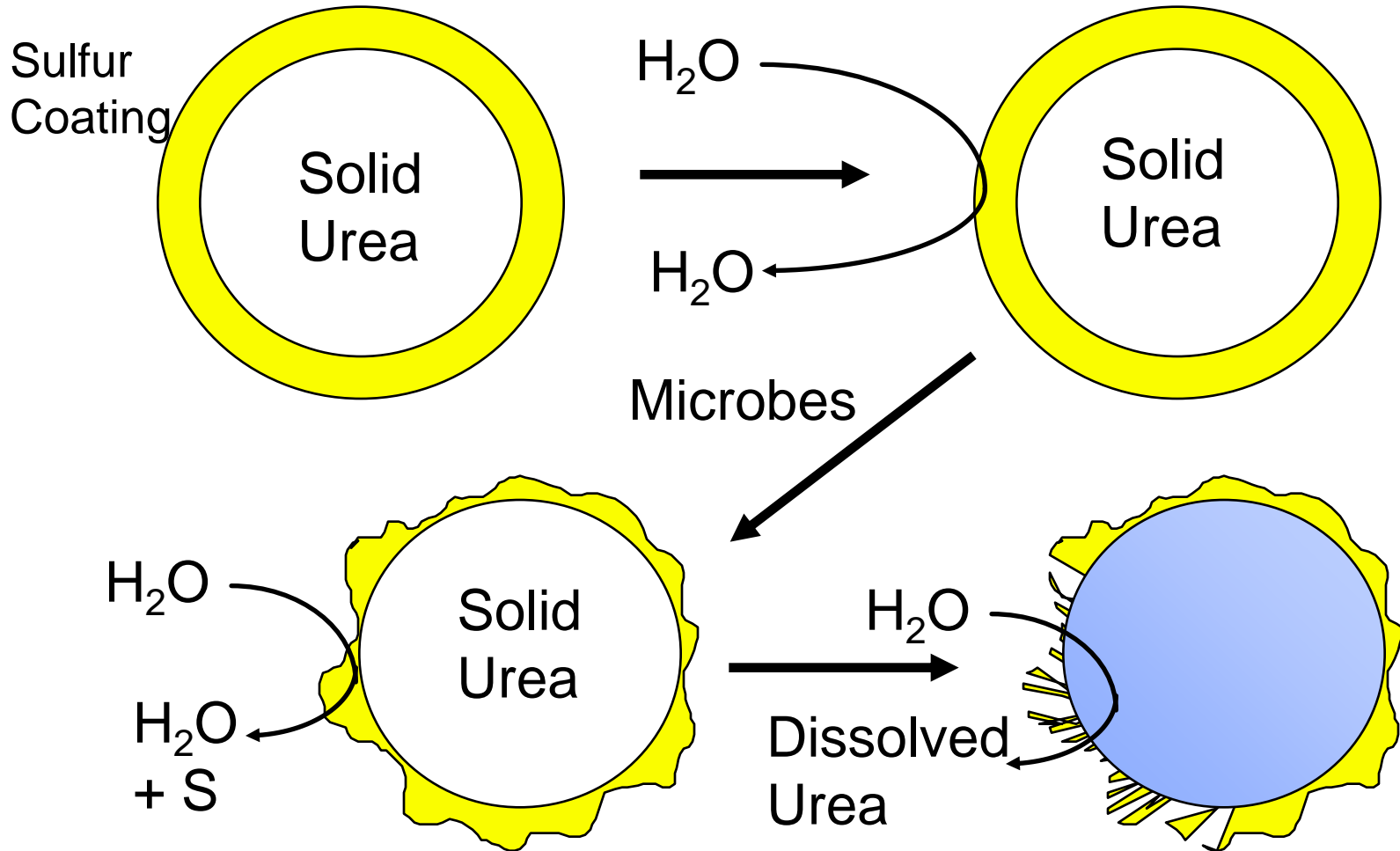
N Fertilizers of Low Solubility

- Availability of N in these materials is
 1. related to their water solubility
 2. Related to the rate of microbiological decomposition of organic molecules
 3. Rate of chemical hydrolysis (getting the N molecules into solution) which is dependent on solubility, particle size and soil temperature.

Coated Water-Soluble Fertilizers – Sulfur-Coated Urea

- N availability dependent on destruction of sulfur coating and diffusion
 - Physical breakage
 - Dispersion
 - Biological oxidation
- Release rate determined by
 - Thickness of coating
 - Environmental conditions
- Release slow and rates vary greatly

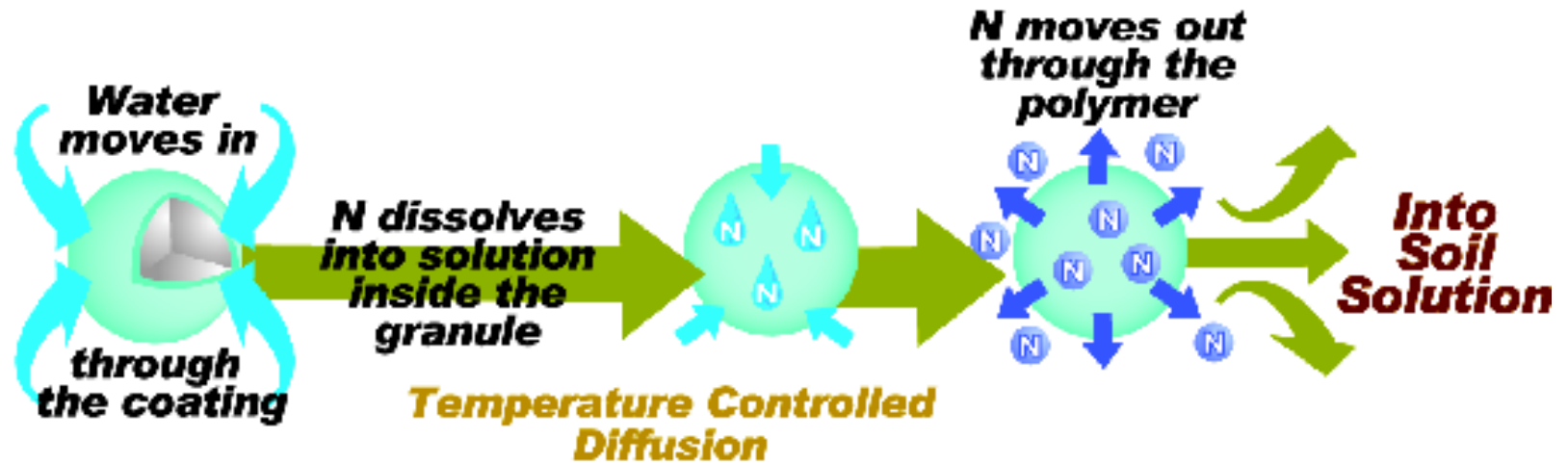
Breakdown of Sulfur Coating



Coated Water-Soluble Fertilizers – Polymer-Coated Fertilizers

- Polymer coatings applied to soluble fertilizer
- Release by diffusion through coating
- Release rate determined by
 - Polymer chemistry, thickness, coating process
 - Temperature
- Release can be highly controlled
- Can be designed to match plant uptake.
- Osmocote in 1967
- Products: Trikote, Polyon, Duration, ESN

How Does Polymer-Coated N Work?



Questions?