FEECO International, Inc.
PAM's Potential Impact on Fertilizers

The Fertilizer Industry Round Table
Winston-Salem, NC October 2003

FEECO INTERNATIONAL
GREEN BAY WI USA

PAMS Potential Impact on the Fertilizer Industry

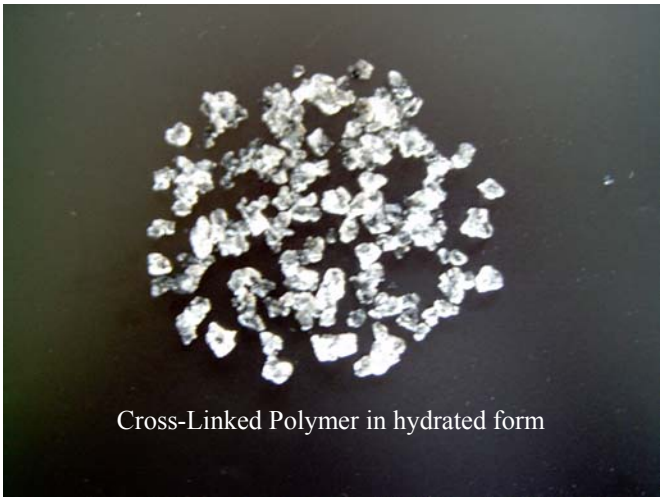
PAM-12 Fertilizer Granules
October 26-29, 2003

Brent Cummings

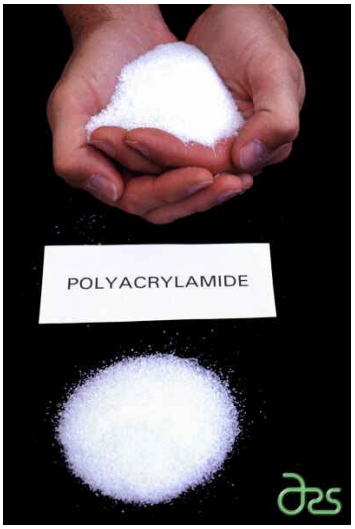
History of the use of PAM with Soils

Irrigation
Soil Erosion
Reforestation
Immobilization of Surface Contaminants
Soil Conditioner
Potting Soils

Water Soluble PAM (WSPAM)
is not a Cross-linked Polymer



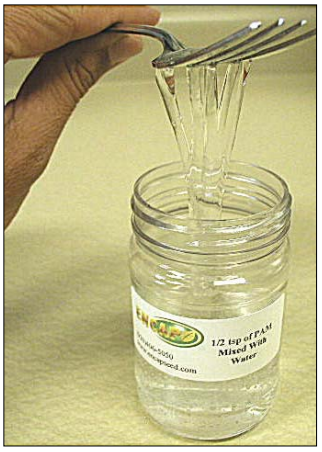
Cross-Linked Polymer in hydrated form



WSPAM is…

- In its characteristic form, a white granule nearly powder substance. In the past this has made it extremely difficult to spread.
- A highly researched, anionic, linear polymer which has been used in agriculture for many years.
- Used widely in Hydro-seeding operations for soil stabilization.

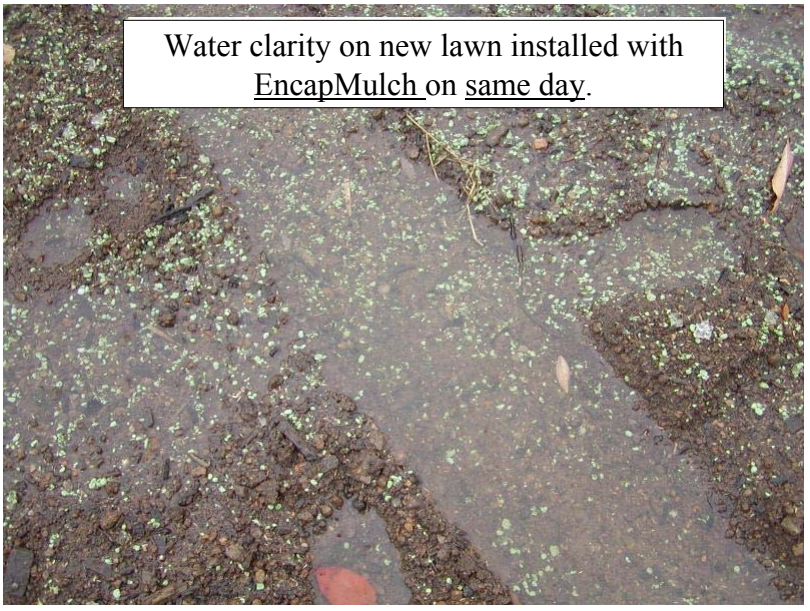
WSPAM acts as a strengthening agent, electrochemically binding soil particles together.

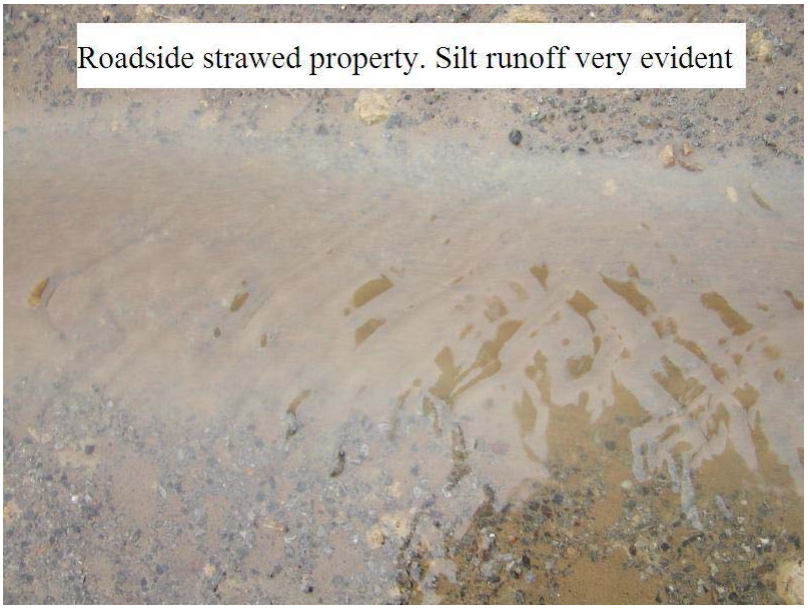


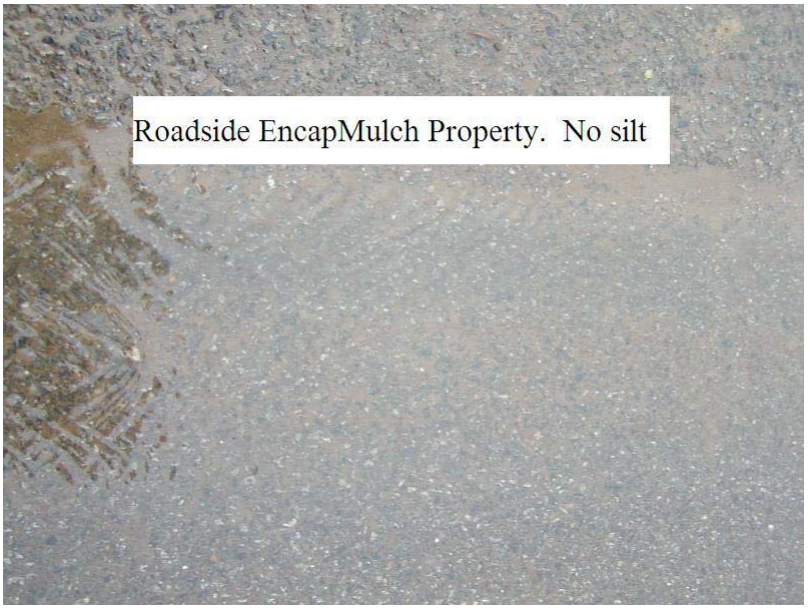
WSPAM benefits as a soil amendment…

- Increases water penetration
- Reduces surface soil crusting
- Reduces erosion
- Reduces eroding soil transport of Nitrogen, Phosphorus, Seed and non-point source pollutants


Water clarity on new lawn installed with straw as mulch


Water clarity on new lawn installed with EncapMulch on same day.


Roadside strawed property. Silt runoff very evident


Roadside EncapMulch Property. No silt

Agriculture Specific uses of PAM

Irrigation
Soil Erosion
Tacktifier
Nutrient Retention
Soil Conditioning

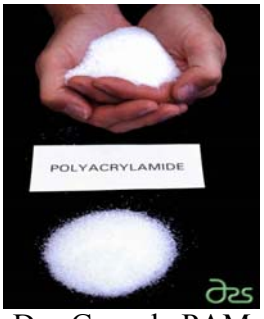
Application of PAM on Crops

Historic Methods of Application

- Irrigation - Trench Irrigation
  Spray Irrigation
- Dry Application
- Hydro-seeding
- Aerial Application

Forms of WSPAM

Methods of applying PAM



Dry Granule PAM

Dry PAM Carrier

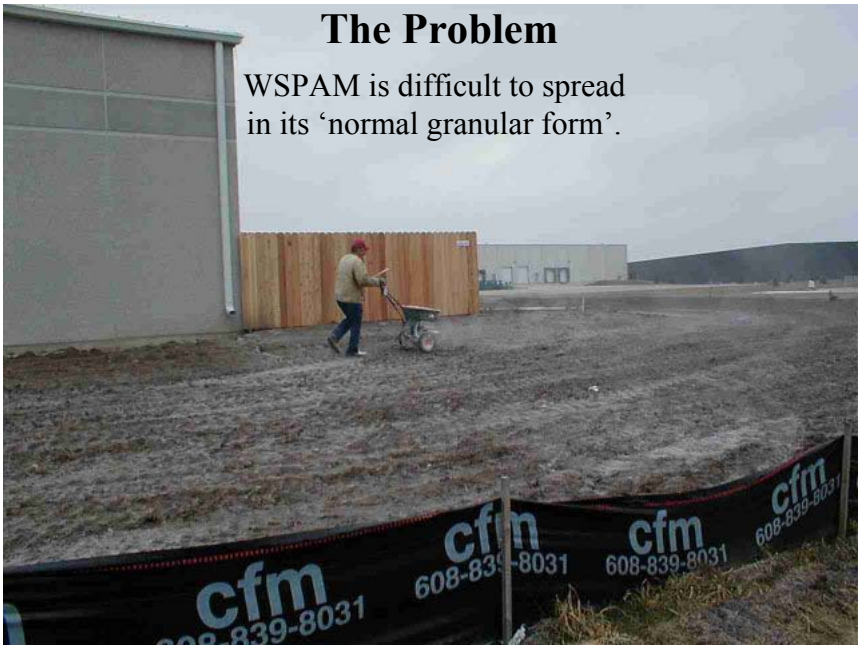
1. Spread using Dry Granule
- Using dry spreader capable of spreading low rates from 1 to 10 Lbs. per acre.
  - Very difficult to spread in this form

2. Added to Hydro Seeder. (With or without seed)
- Without Hydro-Mulch using liquid, or dry granule
- With Hydro-Mulch when Hydro Mulch specified –Need for large often expensive equipment and a considerable quantity of water.

3. Spread using PAM Carrier (New technology)
- Easy, effective way to spread small amounts of PAM over large areas without the need of expensive application equipment.
  - Spread with any broadcast or drop spreader
  - Can be used through a Hydro-Seeder

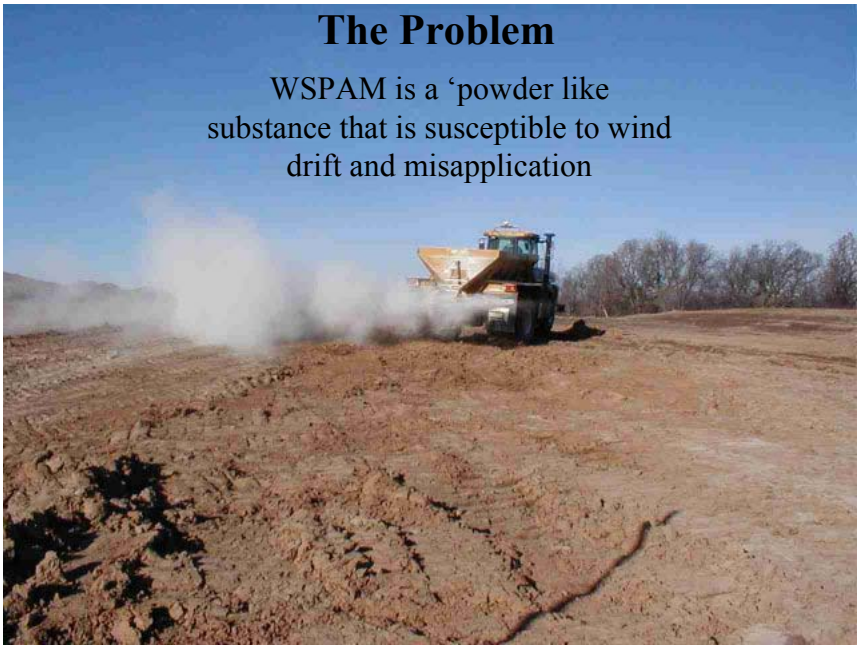
The Problem

WSPAM is difficult to spread in its 'normal granular form'.



The Problem

WSPAM is a 'powder like substance that is susceptible to wind drift and misapplication



The Solution

PAM-12 Soil Granules contain WSPAM for easy, accurate application of WSPAM.

Soil Typography

Benefits of PAM with:

- Sandy
- Clays
- Loams

Benefits of a Combined PAM / Fertilizer Application

- Single Pass of Application Equipment
- Conventional Fertilizer Equipment Used
- Reduced Watering Cycle
- Increased Germination and Seedling Survival Rates
- Increased Yields
- Custom Formulated Products

Process Development.

1. Lab Testing of Initial Polymers – Bench Scale
- Cross Linked vs. Linear
- Anionic vs. Cationic
- Germination Rates
- Charge Densities
- Concentration of PAM
- Granulation Substrate - Samples

Manufacturing Process Development.

1. Process Lab Testing of Granulation Equipment
- Cross Linked vs. Linear
- Concentration of PAM
- Correct Granulation Equipment

"The Old and

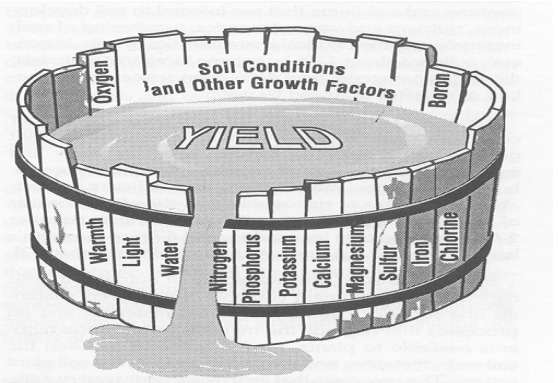


Figure 2.2. Liebig's "Law of the Minimum" Illustrated by Barrel Staves of Varying Lengths Representing Growth Factors.

and the New”


Miracle
Power of
PAM
ENCAP
SOIL ENVIRONMENT
FERTILIZER
PERMEABILITY
IONIC BONDS
EROSION
CRUSTING
MOISTURE
LEACHING
LEACHING
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