Polymer Enhanced BMPs for the Construction Industry

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Even with good BMPs compliance issues can occur!

Perimeter silt fence alone cannot prevent fine sediment loss
Ponds and basins can be overwhelmed with sediment.
Slope failures can occur even with hydroseeding. This slope failed due to use of an untested/incorrect hydroseeding mulch containing polymer additives.

Slope Protection

Erosion blankets alone may not prevent erosion.
Inlet Protection

BMPs may fail or be overwhelmed during high flow events
Turbid discharges in clay or organic soils may not settle out in a timely manner. This can result in an unauthorized pollutant discharge.
Inadequate or ineffective BMPs can result in sediment loss, damage to aquatic systems, costly repairs, and enforcement. It is more cost effective to prevent problems then to repair/correct them.
Anionic Polyacrylamide (PAM)

- PAM is a polymer of acrylamide (AMD) monomers
- Erosion PAMs are 12 to 24 Mg/mole & >150,000 chained monomers/molecule.
- Erosion PAMs have <0.05% unreacted AMD
Uses of Polyacrylamide

Removal of suspended solids from industrial waste water before discharging, reuse, or disposal

Flocculent in the treatment of municipal water supply

POTABLE WATER

Adhesives and Paper in contact with food

Animal Feed Thickener

*Soil conditioning agent*

COSMETICS

Clarify fruit juices and sugar liquors

*Mineral Processing*

-Mining and Drilling applications-

Paper and Pulp Production
1940s PAMs were used as a soil conditioner to construct roads and airfields under adverse conditions during WW2.

1950s PAMs were used as a soil conditioner to reduce erosion and stabilize soil on farms.
USDA PAM Research:

- Reduced erosion
- Reduced fertilizer export
- Reduced pesticide export
- Improved water infiltration
- Reduced animal waste transport
- Little or no toxicity to aquatic life with anionic PAM
Stormwater BMPs

2017 CGP Final

EPA review of anionic polyacrylamide flocculation
Anionic - negative charge
Neutral - no charge
Cationic - positive charge
Fish gills are negatively charged
Anionic polymers are repelled from gills
Cationic polymers are attracted to gills
Cationic polymers are therefore toxic to aquatic life
Three Rules of Polymer Use:

1. Toxicity testing to ensure no aquatic life harm

2. Performance testing matching soil/water with PAM formulation

3. Residual acrylamide monomer < 0.05% (food grade)
Performance Based Results

Determine PAM-Blend

Written Test Results and Guidelines

Toxicity Test Results
Polymer Matched To Soil/Water

- No Polymer
- Non-Optimized Polymer
- Optimized Polymer
Anionic Polyacrylamide Types:

- Emulsions
- Powders
- Gel Block
How Polymer Enhancement Works

Soil Untreated VS Soil Treated
Polymer + Soil + Surface Area = Bonded Matrix
Open weave soft matting works best to capture agglomerated soil & particulate
Inlet protection can be enhanced by use of polymer enhanced soft armor applications.
Apply jute matting with the correct soil specific polymer to reduce soil movement at the BMP
Clear water discharges through inlet filter and sediment remains outside of stormwater pipes.
Apply the correct soil specific polymer to the matting
The greater the systems in series the greater the performance and cleaner the water quality.
Fine sediment and silts move through these BMPs and enter the water ponds or streams.
Apply jute matting to the rock check. The matting provides a surface area for attachment of soil-polymer matrix.

Next, apply the correct soil specific polymer to the matting.
Notice how the fine sediments become attached to the matting reducing the impact to the ponds and streams.
Silt fence alone cannot prevent fine sediment loss
Silt Fence can easily be used as a water quality device

Fine Sediment Retention between Silt Fence
(Install at all low areas during Grading Stages)

- Polymer layer
- Mulch layer
- Flow

Loosely Placed
Straw, Mulch, Wood Chips with Water Clarifying Polymer (50#/100 lineal feet)

Sediment Retention Barrier (SRB)
Clear discharge water from construction site
Silt Retention Barriers Retained 83% of Test Soil
Silt Retention Barriers Showed No Failure During Tests
Minimal Flow Reduction Between Silt Fence
Significant Turbidity Reduction Achieved

Download report at:
Erosion Control

Anionic polymers are used to prevent erosion on slopes and control sediment runoff. Soil specific polymer additions (in granular or liquid form) can assist temporary or permanent grassing by binding the seed, fertilizer, mulch, and soil together until the grass germinates.
Slope Stabilization

Anionic polymers are used with organic matting (jute) to provide soft armoring. This system holds soil, seed, and fertilizer in place during vegetation germination. Results are quickly seen in lush, thick stands of vegetation that hold the soil in place and protect slopes.
Vegetation Establishment

These photos are taken from a site where there was poor vegetation establishment with the normal hydroseeding application. Slope was re-hydroseeded using the soil-specific polymer to aid the establishment of the vegetation.
University of Central Florida
Stormwater Academy Testing

Polymer Treated

Untreated
Polymer blocks can be used to mitigate turbidity from construction activities. They can be directly placed in storm drain systems or in a designed treatment system (active or passive) to clarify water.
Water Clarification Projects

Turbid canal before PAM treatment
Canal 24 hours after PAM treatment
Split-Pipe Treatment System

Treatment System Assembly & Polymer Block Deployment
PAM Floc Captured & Attached To Jute Matting
Discharge From Jute Mat = 19 NTUs
98% Turbidity Reduction
Discharge From Wetland = 6.5 NTUs
99% Turbidity Reduction
Treatment Goal Achieved!
Pipe Mixing PAM Treatment Systems

Advanced Treatment Systems

Ultimate I-4 Project

Walt Disney World Project
Pipe-Mixing Treatment System

500-5,000 GPM Flow Rates
Particle Attachment to Curtain Surface

Particle Curtain System
Particle Curtain System
Demucking

Powders can be used for mud thickening to remove unmanageable muck. Highly saturated soils can be messy and difficult to remove without spilling or dripping.

PAM polymer sets up and thickens soupy muck to consistency of wet sand.

Material can now be removed in full bucket loads with little or no dripping. Process is repeated for each three foot muck layer.

Powder applied to muck soil using a leaf blower unit. Material is mixed by excavator for several minutes.
PAM turns a problem soil into a resource as a topsoil amendment.
Canal and ditch maintenance can be performed without creating turbidity. Polymer blocks are suspended from the equipment and mix with suspended sediments. Turbidity >1,000 NTUs can be reduced to <10 NTUs.
The polymer enhanced BMP for this project maintained clear water discharges within compliance limits.
Dust Control

PAM material is designed to agglomerate very fine particulate and retain that agglomerate for 1-4 days while still allowing water to penetrate the soil. This has been shown to reduce airborne dust from haul roads, waste dumps, tailing piles, and open areas on construction sites.
Polymer liquid concentrate material can be added to water tankers to control dust particulate. This results in improved air quality and reduces the frequency of water applications on the treated road surface.
Edmonton, Alberta, Canada

Industrial runoff
Pollutants of Concern:

• Turbidity

• TSS

• Metals
Treatment Train Design:

• Capture metal bound particulate
• Fit within stream channel footprint
• No pumps or tanks for chemical dosing
• System must survive winter with minimal maintenance in spring
• Materials must be non-toxic to aquatic life
Passive treatment system selected:

- Soft armoring along stream channel
- Granular PAM applied to create particle capture system
- Duplex polymer block treatment of water column
- Sand bags anchored polymer blocks at 3 meter (10 ft.) intervals
Soft armoring applied in stream channel and along embankment
Polymer blocks installed in duplex at 3 m intervals
Particulate containing metals captured on jute. Clear water discharge downstream.
Summary:

• Metals significantly reduced
• Passive treatment system fit in footprint
• PAM materials performed well in cold weather and survived ice/snow
• Future system design could harvest metal particulate from discharge
Conclusion: Anionic PAM Blends

- Versatile
- Applied directly to soil, static or flowing waters, and ponds
- Performance testing assures results with least amount of polymer
- Good BMP design achieves compliance standards
- Toxicity testing protects aquatic life and environment
- Reduce TSS, turbidity, and metals in extreme and remote areas
All anionic polymer products should meet or exceed the requirements of the EPA Construction Generic Permit for chemical treatment of stormwater from construction activities using anionic polyacrylamide (Effective February 16, 2017).
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