

Polyacrylamide (PAM)

Definition

Polyacrylamides (PAMs), are polymer-based materials used to facilitate erosion control and decrease soil sealing by binding soil particles, especially clays, to hold them on site. In addition, these types of materials may also be used as a water treatment additive to remove suspended particles from runoff.

Description and Purpose

PAM increases the soil's available pore volume, thus increasing infiltration and reducing the quantity of stormwater runoff that can cause erosion. Suspended sediments from PAM treated soils exhibit increased flocculation over untreated soils. The increased flocculation aids in their deposition, thus reducing stormwater runoff turbidity and improving water quality. PAMs may be used as a water treatment additive to remove suspended particles from runoff. PAMs may also be used to provide an appropriate medium for the growth of vegetation for further stabilization.

Pollutant(s) controlled:

- Suspended Solids

Treatment Mechanisms:

- Chemical (flocculation & coagulation)

Companion and Alternative BMPs

- Dust Control
- Hydroseeding
- Sediment Basin

Advantages and Disadvantages

Advantages:

- Improves stability of problem soils to prevent soil detachment (i.e. prevents erosion) in the first place
- Provides quick stabilization where vegetation has yet to be established
- Promotes flocculation (reduces settling time) of smallest particles
- Increases soil pore volume and permeability, thus decreasing impervious cover
- Less obtrusive than some conventional measures - doesn't interfere with construction machinery/activity
- Convenient and easy to apply and store along with other soil amendments (fertilizer, mulch, etc.) with conventional seeding, mulching, or irrigation equipment
- Material is specifically designed for the soil, waters, and other on site characteristics
- May prevent costly repair and reshaping of rilling or failing slopes

- Re-application may not be necessary for several months if treated areas are mulched
- Reduces seed, pesticide, and fertilizer (phosphorus and nitrogen) losses that hinder vegetation establishment on site, increase costs, and promote nutrient and chemical loading offsite
- Reduces windborne dust conditions

Disadvantages:

- Materials are soil type-specific so a contractor cannot use leftover material at another site or bulk order for multiple sites.
- Using it requires site-specific testing that may take several days to complete.
- Overuse may clog soils, thereby decreasing infiltration.
- It is not effective when applied to pure sand or gravel with no fine silts or clays, nor when applied over snow cover.
- PAM shall not be directly applied to water or allowed to enter a water body.
- Do not use PAM on a slope that flows into a water body without passing through a sediment trap or sediment basin.
- PAM will work when applied to saturated soil but is not as effective as applications to dry or damp soil.
- Some PAMs are more toxic and carcinogenic than others. Only the most environmentally safe PAM products should be used.
- The specific PAM copolymer formulation must be anionic. **Cationic PAM shall not be used in any application because of known aquatic toxicity problems.**
- A review of scientific literature and field demonstrations have identified several forms of PAMs that are potentially toxic to the aquatic environment and not suitable for use in Michigan. These toxic forms include:
 - Non-food grade PAMs. These PAMs contain residual monomer acrylamides in concentrations that may be toxic in the environment. Only food grade (National Sanitary Foundation/American National Standards Institute) or products containing less than 0.05 percent residual monomer by volume should be used.
 - Any cationic PAM or a form other than an anionic polymer. Only anionic forms of PAMs demonstrate non-toxic qualities.
 - Emulsion-based PAMs or any polymer that is pre-mixed in a substance other than pure water. Some of these emulsions have a surfactant base for easy application. While the polymer may not be toxic, some emulsions demonstrated significant toxicity during field trials

Location

PAM can be applied to the following areas:

- Rough graded soils that will be inactive for a period of time.
- Final graded soils before application of final stabilization (e.g., paving, planting, mulching).
- Temporary haul roads prior to placement of crushed rock surfacing.
- Compacted soil road base.
- Construction staging, materials storage, and layout areas.
- Soil stockpiles.
- Areas that will be mulched.

General Characteristics

- PAM can be used in several forms:
 - Powder
 - Powder added to water (wet, as a stock solution)
 - Emulsion
 - Gel blocks or bricks
- When used correctly and in concert with existing erosion control best management practices (BMPs), land applied PAMs should not enter surface waters of the state.
- PAMs are manufactured in various forms to be used on specific soil types, and are generally applied at a rate of up to 10 pounds/acre.
- Using the wrong form of a PAM on a soil will result in some degree of performance failure, and increase the potential for this material to enter surface waters.
- The use of PAMs as a soil erosion control should be listed with all other BMPs as part of your soil erosion control plan.
- Pam shall be used in conjunction with other BMPs and not in place of other BMPs, including both erosion controls and sediment controls.
- Stormwater runoff from PAM treated soils should pass through a sediment control BMP prior to discharging to surface waters.
- PAM can be applied to wet soil, but dry soil is preferred due to less sediment loss.
- Keep the granular PAM supply out of the sun. Granular PAM loses its effectiveness in three months after exposure to sunlight and air.
- Proper application and re-application plans are necessary to ensure total effectiveness of PAM usage.
- PAM, combined with water, is very slippery and can be a safety hazard. Care must be taken to prevent spills of PAM powder onto paved surfaces. During an application of PAM, prevent over spray from reaching pavement, as pavement will become slippery. If PAM powder gets on skin or clothing, wipe it off with a rough towel rather than washing with water this only makes cleanup messier and longer.
- PAM tackifiers are available and being used in place of guar and alpha plantago. Typically, PAM tackifiers should be used at a rate of no more than 0.5-1 lb per 1,000 gallons of water in hydro mulch machine. Some tackifier product instructions say to use at a rate of 3-5 lbs per acre, which can be too much. In addition, pump problems can occur at higher rates due to increased viscosity.
- **Prior to the application of polyacrylamides [PAMs] directly within "Surface Waters of the State", MDEQ must approve their use.** To obtain approval, specific project information must be submitted to and reviewed by *MDEQ*. All requests involving the use of PAMs in direct contact with surface water, including facilities covered by National Pollutant Discharge Elimination System permits through Permit by Rule, or soil erosion and sedimentation control permits or plans, must be submitted to:
 - Ms. Diana Klemans of the Surface Water Assessment Section, Water Resources Division, P.O. Box 30458, Lansing, Michigan 48909-7958.
 - Requests should include the following:
 - applicant's name and address
 - the specific application location

- area and frequency of treatment
- name and amount of Pam(s) being used
- the name and location of receiving surface waters
- Please specify if the characteristics of the PAM(s) meet the guidelines specified above and if on-site soil or sediment characteristics have been identified and matched to the appropriate polymer

Materials

- Polyacrylamide
- Mulch

Design Specifications

- PAM may be applied in dissolved form with water, or it may be applied in dry, granular, or powdered form. The preferred application method is the dissolved form.
- PAM is to be applied at a maximum rate of ½ pound PAM per 1000 gallons water per 1 acre of bare soil. Table 1 and Figure 1 can be used to determine the PAM and water application rate for a disturbed soil area. Higher concentrations of PAM **do not** provide any additional effectiveness.

Construction Guidelines

1. Pre-measure the area where PAM is to be applied and calculate the amount of product and water necessary to provide coverage at the specified application rate (1/2 pound PAM/1000 gallons/acre).
2. PAM has infinite solubility in water, but dissolves very slowly. Dissolve pre-measured dry granular PAM with a known quantity of clean water in a bucket several hours or overnight. Mechanical mixing will help dissolve the PAM. Always add PAM to water – not water to PAM.
3. Pre-fill the water truck about 1/8 full with water. The water does not have to be potable, but it must have relatively low turbidity – in the range of 20 NTU or less.
4. Add the dissolved PAM and water mixture to the truck.
5. Fill the water truck to specified volume for the amount of PAM to be applied.
6. Spray the PAM/water mixture onto dry soil until the soil surface is uniformly and completely wetted
7. PAM may also be applied as a powder at the rate of 5 lbs per acre. This must be applied on a day that is dry. For areas less than 5-10 acres, a hand held “organ grinder” fertilizer spreader set to the smallest setting will work. Tractor mounted spreaders will work for larger areas.

Monitoring

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.

Maintenance

- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- PAM must be reapplied on actively worked areas after a 48-hour period if PAM is to remain effective.
- Reapplication is not required unless PAM treated soil is disturbed or unless turbidity levels show the need for an additional application.
- If PAM treated soil is left undisturbed a reapplication may be necessary after two months.
- More PAM applications may be required for steep slopes, silty and clayey soils (USDA Classification Type "C" and "D" soils), long grades, and high precipitation areas.
- When PAM is applied first to bare soil and then covered with straw, a reapplication may not be necessary for several months.
- Rinse all PAM mixing and application equipment thoroughly with water to avoid formation of PAM residues
- Downstream deposition from the use of PAM may require periodic sediment removal to maintain normal functions

References

California Stormwater BMP Handbook, Construction, 2003 Polyacrylamide

Disturbed Area (acre)	PAM (lbs)	Water (gallons)
0.50	0.25	500
1.00	0.50	1,000
1.50	0.75	1,500
2.00	1.00	2,000
2.50	1.25	2,500
3.00	1.50	3,000
3.50	1.75	3,500
4.00	2.00	4,000
4.50	2.25	4,500
5.00	2.50	5,000