

Flocculants and Polymers (FLC)



Practice Description

Flocculants are used to promote clumping in sediment-laden water. Flocculants can be used in chemical stabilization of soils on steep slopes as is discussed in the *Chemical Stabilization Practice*. This section discusses the use of flocculants in conjunction with pumped construction site stormwater systems. Flocculant is dissolved into sediment retention basin inflows via a rainfall-activated system. The flocculant causes individual particles to be destabilized (i.e. neutralizing electrical charges that cause particles to repel each other), accelerating the coagulation and settlement of particles out of the water column. Flocculant types include polyacrylamides (PAM), gypsum, and alum. Anionic PAM is a negatively charged long-chained molecule that consists of acrylamide and acrylate units. It is available as a crystalline powder, an emulsion, or a solid block or log (McLaughlin, 2007). Anionic PAM used for turbidity reduction should contain less than 0.5 percent free acrylamide due to the suspected carcinogenic effect of acrylamide. Gypsum, a natural mineral composed of calcium sulfate and water, is often used in water and wastewater treatment processes. Alum is an aluminum sulfate material that can also be used for water clarification.

Planning Considerations

When utilizing flocculants to aid in sediment removal, the following criteria are required by the MDEQ: 1) only anionic polyacrylamide (PAM) polymer; 2) polymer shall contain less than 0.05% free acrylamide; 3) polymer shall be non-toxic to fish and other aquatic organisms, and; 4) polymer shall be selected for site-specific soil conditions (i.e. jar test). For polymer system treatment of turbidity, the following criteria are required at a minimum: 1) polymer shall be introduced through turbulent mixing into the stormwater upstream of sedimentation BMPs; 2) sedimentation basin shall be constructed in

accordance with the criteria specified in ACT 5, T-5 (2)(A) of the Large Construction General Permit (see *Appendix B*); and 3) polymer shall be applied in accordance with manufacturer's instructions, and there shall be no discharge of undissolved polymer, clumps of polymer, and/or unsettled flocculant material.

Design Criteria and Construction

PAM Screening Method

Because of the varied type of soils across the state, there is no one type of PAM that is applicable to all. At this time, the only way to determine the most effective type (or types, if the site is large) of PAM is to do a jar test. Most PAM retailers will perform this test.

1. Obtain a clear container (approximately 16 oz).
2. Fill with tap water.
3. Add a small amount of PAM (a "pinch").
4. Add a teaspoon of soil from the site.
5. Shake for 10-20 seconds or until the water begins to clear, then allow to settle.
6. Repeat for several PAM products, and then select the product that clears the water the most quickly.

Pumped Injection

Pumped injection is an effective treatment route because the concentrations of PAM used can be controlled and the reaction between PAM particles and suspended solids is faster than a solid PAM dosing technique. This setup includes a turbid water source, a PAM dosing pump, and a silting basin to treat turbidity.

A pumped injection system consists of a PAM solution pump and a PAM reservoir. An electric pump is often used to inject the PAM solution, preferably a peristaltic pump with variable speeds. The PAM pump hose can be connected into the intake hose to ensure proper dosing and mixing. A sample configuration is provided as Figure FLC-1.

Dosage Rate

The recommended dosage rate of PAM is 1–5 milligrams per liter or parts per million. Rates can be adjusted based on the results of a jar test.

Baffles

A porous baffle of coir netting is recommended to catch the floating flocs created by the flocculation reaction. The preferred weight for sediment basins is 900 grams per square meter. The flocculation of turbid water may cause sediment baffles to become clogged faster than systems without flocculant use and may require more frequent replacements.

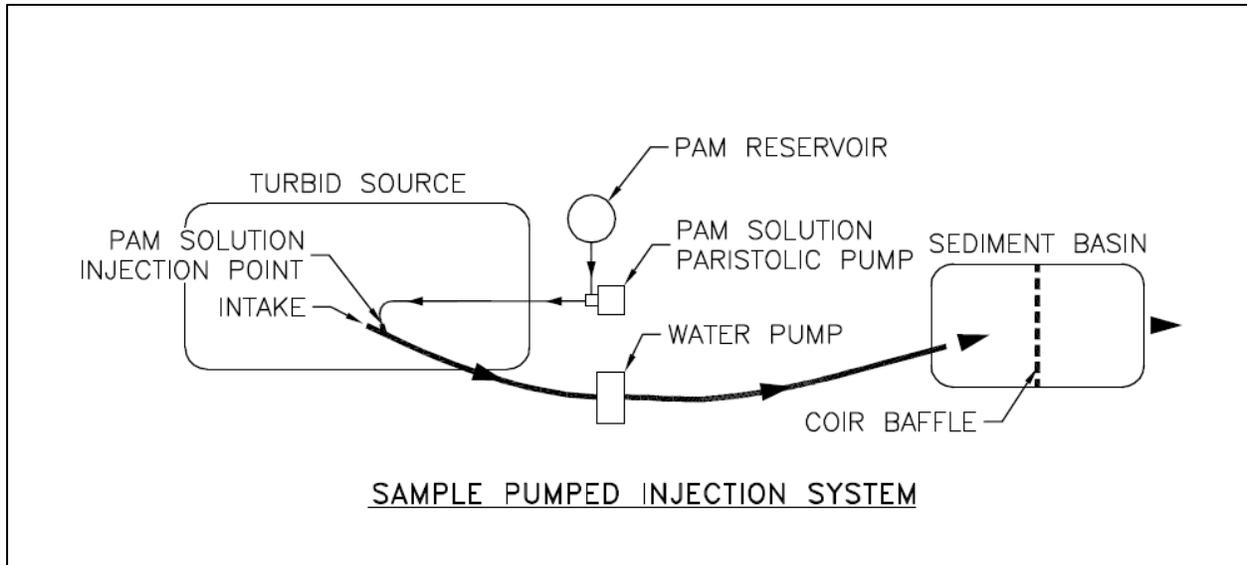


Figure FLC-1 Sample Pumped Injection System

PAM-Treated Channel

This practice uses solid PAM crystalline powder with a jute or coir-lined channel. The turbid water is pumped into the channel and mixes with the solid PAM as it travels toward a sediment basin. This method is also effective when used with fiber check dams (wattles).

The PAM power should only be applied when no water is in the channel. Some wetting of the erosion-control fabric may be required to stabilize the PAM powder. If PAM powder is added directly to the water flow, it will simply settle out and will not be effectively mixed.



Figure FLC- 1 PAM-Treated Channel - Runoff Flows over Inlet Protection Fabric into Sediment Basin (Source: North Carolina State University)

Treatment Approach

Flocculant use should be installed as a treatment-train approach. Turbid water should be contained on-site, treated with flocculant, and then stored in a sediment basin until solid particles have settled out.

Coagulants

Coagulants such as gypsum and alum can be used to reduce turbidity as well, with approval of MDEQ. These materials can be spread by hand into the water after each storm. The suggested dosage rate is 20–30 pounds per 1,000 cubic feet of water, spread over the surface.

Monitoring

Monitoring is currently voluntary, the results of which will not be required to be documented and/or reported. There are currently no active numeric effluent limitations for construction stormwater discharges. Numeric effluent limitations are expected to be established by the EPA for the next permitting cycle. While these monitoring activities are currently optional, they are still helpful in determining the effectiveness of turbidity reduction procedures. The following monitoring procedures were taken from the Mississippi Large Construction General Permit recommendations found in Act 9: Optional Monitoring (see *Appendix B* for full permit document):

1. Monitor the turbidity of each storm water discharge from actively disturbed areas of the project site for each work day the discharge occurs. Actively disturbed areas are those portions of the project site that have undergone soil disturbing activities (i.e., clearing, grading, filling, excavating, etc.) and have not been stabilized.
 - a) Monitoring should be conducted for each point of storm water discharge from the project site. For the purpose of this permit, a discharge point means any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, or container from which storm water and/or pollutants are, or may be, discharged.
 - b) Diffuse storm water, such as non-channelized flow that infiltrates into a vegetated area, and does not then discharge to surface waters, would not generally require monitoring.
2. Due to the unique characteristics of linear projects, portions may have suspended construction activity and have undergone temporary or final stabilization [see Definitions] while other portions of the same project may have active construction activities. Therefore, in recognition of these unique regulatory circumstances, only those areas that have active construction activities will require numeric turbidity monitoring. Those areas that have been completed and stabilized will not require turbidity monitoring.
3. Sampling:
 - a) A minimum of three (3) samples per work day, per discharge, should be used to calculate a daily average turbidity value. Samples should be collected so as to be representative of the nature of the discharge over its duration. For example,

- (i) Collect first sample within the first hour of discharge or within the first hour of the work day.
 - (ii) Collect second sample in the middle of discharge or the middle of the work day.
 - (iii) Collect last sample at the end of discharge or at the end of the work day.
 - (iv) Continue sampling at the start of the next work day if there continues to be a discharge (until discharge ends or end of the work day). These data should be used to calculate a separate daily average.
- b) Monitoring samples should be collected at the nearest accessible point after final treatment, but prior to mixing with the receiving water body.
- (i) Due to the unique characteristics of linear projects, there may be multiple discharge points spaced over a wide geographic area. Therefore, MDEQ will allow representative discharge sampling. For example, representative sampling at certain discharge locations may be representative of the discharge characteristics of other locations within the same sub-watershed. For multiple outfalls that discharge substantially identical effluents, the owner or operator may sample one (or more) of the outfalls and report that data as representative of the other outfalls. At a minimum, at least one discharge point per sub-watershed must be monitored and the same or similar controls must be implemented on the different discharge points.
 - (ii) Representative sampling of non-linear projects may be allowed on a case-by-case basis.
- c) Monitoring may be accomplished via portable turbidity meters or fixed automated sampling/meter stations.
- (i) Monitoring should be based on grab samples for portable meters.
 - (ii) Automated samplers should be programmed to yield a minimum of three (3) representative readings per discharge, per day.
 - (iii) Daily turbidity averages should be the average of all monitoring results collected on the day of discharge for the respective discharge point(s). For example, if there were five (5) turbidity readings in a given day, then the average turbidity for that day would be the average of all five (5) readings.
- d) Grab samples should be collected according to the following methodology to ensure that each sample is representative of the flow conditions and other characteristics of the discharge.
- (i) Collect samples from the horizontal and vertical center of the storm water outfall channel(s) or other sources of concentrated flow.
 - (ii) Avoid stirring the bottom sediments in the storm water channel in which samples are taken by not walking through the areas of storm water flow or disturbing the sediment with the sampling device.
 - (iii) Hold sampling container so that the opening faces the upstream direction of the storm water channel in which samples are taken.
 - (iv) Avoid overfilling sample container.
- e) Monitoring should be conducted for any discharge that occurs during the normal working hours of the project site.

4. Turbidity Meters:
 - a) Turbidity meters should meet the following design criteria:
 - (i) Accuracy within +/- 5% of measurement,
 - (ii) Minimum upper range of 1000 NTU,
 - (iii) Able to be calibrated by operator, and
 - (iv) Operating temperature range be at least 32 to 122 degrees.
 - b) Turbidity meters should be operated, calibrated and maintained according to the meter manufacturer's instructions.

Construction Verification

Check finished grades and dimensions of the sediment basin. Check materials for compliance with specifications.

Common Problems

Consult with a registered design professional if any of the following occurs:

Pumped injection systems are not reducing turbidity in sediment basin. Check PAM reservoir and dosage rates.

A thick gel forms in PAM-treated channel. Application rates are too high – only a thin coating of PAM powder is need.

Maintenance

Regular inspections of PAM reservoir are required to maintain adequate supply.

Inspect power source and piping for potential failures.

Coir baffles may require regular replacement when using flocculants; inspect frequently for clogged baffles.

In PAM-treated channels, inspect channel lining often and replace when needed.

References

BMPs from Volume 1

Chapter 4

Chemical Stabilization (CHS)

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