

The Monthly Dirt

A Monthly Newsletter on the California Construction General Permit
By WGR Southwest, Inc.

Putting a Bind on Dust

May - June 2018

Regulations can be a burden until you find yourself on the receiving end of the regulated problem. Now, imagine it's a nice summer day. Then out of nowhere something is blocking the sun. What is it? No, it's not the Goodyear blimp hovering over your backyard croquet game. It's a gigantic dust storm that's about to hit the house. The construction site next door forgot to use water trucks to wet down and suppress the dust. That's not only going to make for unhappy croquet players, but the regulators won't be too pleased either. But this could have easily been avoided by reading this article. So, in this edition of the *Monthly Dirt* let's look at the options the contractor next door could have utilized to *put a bind on dust*.

The Problem. Using water trucks can be labor intensive and result in significant costs to the project. Many contractors have found that water trucks are not always the best way to control dust. Wetted roads can produce mud which can be tracked onto paved roads and spread by passing vehicles – just aggravating the dust situation. And, what about after hours? Many times, strong breezes pick up in the afternoon and early evening hours when no one is at the site to keep the dirt roads wet. In addition to these problems, there is also the on-going drought conditions in California that have caused many municipalities to restrict the use of water for dust control.

Dust Control without the Use of Water. So, what can be done about controlling dust in such situations? There are actually a variety of products commercially available that will get the job done without the need to be constantly wetting soils. These products are generally referred to as **dust suppressants** or **soil binders** and they are chemicals or all-natural products that reduce the amount of dust by stabilizing dirt surfaces. They help bind soil particles making them more resistant to the erosive forces of passing vehicles. The suppressants cause the dirt particles to stick together, so it'll stay on the ground; and won't lift into the air and be carried off by the wind. One of the most common products used is called a **hygroscopic suppressant**. The most common types of hygroscopic suppressants are calcium chloride and magnesium chloride. These are salts similar to sodium chloride, which is something we consume everyday - basic table salt. These salts work to suppress dust by drawing moisture from the air to keep the road surface constantly damp. It is like having microscopic water trucks constantly wetting the road down. **Adhesives** are another category of suppressants. An adhesive is typically made of all-natural plant-derived glues that include lignin and lignosulfonate. An adhesive provides cohesion by binding the soil particles

together. Another dust suppressant commonly used are petroleum or plant-based **oil emulsions**. The most environmentally friendly products are natural biodegradable oils such as soy bean oil. Other commercially available oil emulsion products consist of petroleum asphaltic slurries and waxes. **It should be noted that the old common practice of applying diesel or waste oil to a road surface is illegal** and could result in unwanted State and Federal regulatory action and expensive soil contamination investigations and cleanup activities. One last category of suppressants that we want to mention are **polymers** which is a chemical agent that can bind soil particles through electrochemical forces. Anionic polyacrylamide (PAM) is typically used as a powerful soil binder not only on roadways, but also on areas of soil disturbance on construction sites and on farms.

Does it work? All of the previously mentioned suppressants have been proven to be effective. Each of them will have different results depending on the location, soil type, humidity, and number of trips made on the dirt roadway. A test conducted by Northern Arizona University explained how an adhesive called Envi-Rox 2000 applied by Lyman Dust Control worked on a section of highly traveled dirt roads. The product effectively bound loose surface silt particles and penetrated 0.2 inches into the soil. Surface samples of the treated roadway were sieved and tested two weeks after the application for silt fraction (%<200 mesh) and compared to samples collected before the application. The treated soils had a reduction of silt content ranging from 38 to 47%.¹

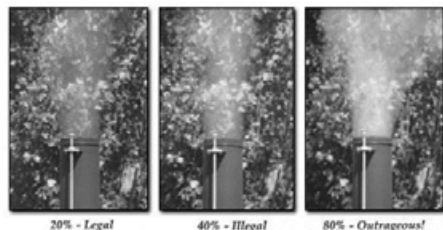
Pros and Cons: But, as with any erosion control method there are pros and cons to the various options. The pros of using hygroscopic suppressants is that they are relatively cheap, easy to apply, and will typically be long lasting. Negative aspects of using these salt-based products include the potential to dissolve in storm water causing runoff to have

¹ Northern Arizona University CENE 330 Terry E. Baxter, Ph.D., P.E., 2004, <http://lymandustcontrol.com/study/arizona-dust-control-study/>

a high specific conductivity. This saline water can harm vegetation (or crops) and have a negative impact on the ecosystem of the receiving water. Magnesium chloride is also highly corrosive. Extended exposure to metal surfaces of vehicles and equipment can cause accelerated corrosion to occur. Another negative aspect of hygroscopic suppressants is that they are not as effective in dry arid locations since they depend upon humidity to absorb water and bind the soil. A significant advantage of adhesives is that, because they tend to be all-natural and biodegradable, they are less toxic to the environment than the other choices of suppressants. The cons of using adhesives include being more expensive than salt-based binders and the life expectancy of the natural adhesives is not as long as many of the other suppressants. The pros of using petroleum and plant-based emulsions is their durability. They are best for semi-permanent or long-term dust control. However, they are also typically the most expensive option in controlling dust. Polymers are very effective in controlling erosion and dust and are long-lasting and easy to apply. But, the downside of polymers is that they can be very toxic to receiving waters if they are improperly used and applied. Although the use of anionic PAM can be very effective and shows great potential for controlling erosion, the State Water Board is concerned by the impact on the environment from this "passive treatment" chemical and is in the process of considering language for the renewal of the Construction General Permit to regulate the use of it.

Application. When putting on a suppressant it is important to carefully consider the previously stated pros and cons and to select a product that will satisfactorily accomplish the dust abatement but also present the least impact to the environment. For this reason, these products are typically something you do not just pick up at the local building supply store and apply yourself. Professional assistance should be sought from the manufacturer, a licensed applicator, and a QSD and/or Civil Professional Engineer who has experience in specifying the types of products and the application dosage.

Conclusion. California regional air districts limit dust clouds crossing a project's perimeter at 20% opacity. What does 20% opacity look like?



An air district inspector once explained that it is when you can barely see the cloud of dust. That's not a lot of dust! Over 20% can result in fines from the air district and trouble with the Water Board. Taking care of dust on a site can be a pain but in the long run it will save the site trouble from regulators and neighbors angry about ruining their croquet game. Suppressants are a great option to use to control dusty roadways, save precious water supplies, and financial impact to your project's budget. **MD**

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Magnesium Chloride



Magnesium chloride is a highly soluble halide salt with a solubility in water of 52.9 grams per 100 ml of water. It is harvested from sea water and, in North America, it primarily comes from the Great Salt Lake in Utah. Magnesium values in natural seawater are between 1250 mg/L and 1350 mg/L, approximately 3.7% of the total seawater mineral content. In its crystalline form, it has an octahedral structure. As mentioned in the previous article, magnesium chloride is often used during hot summer months as a hygroscopic dust suppressant on dirt roadways and surfaces. But, it is also used on roadways during cold winter months as a de-icing agent. Other uses of "mag" chloride include dietary supplements, pharmaceuticals, as a coagulant for the processing of tofu and soy milk, and it is used in gardening and horticulture to correct magnesium deficiency in plants. Chloride (Cl⁻) and magnesium (Mg²⁺) are both essential nutrients important for normal plant growth. Too much of either nutrient may harm a plant, although foliar (leaf) chloride concentrations are more strongly related with foliar damage than magnesium. High concentrations of MgCl₂ ions in the soil may be toxic or change water relationships such that the plant cannot easily accumulate water and nutrients. Once inside the plant, chloride moves through the water-conducting system and accumulates at the margins of leaves or needles, where dieback occurs first. Leaves are weakened or killed, which can lead to the death of the tree.²

² https://en.wikipedia.org/wiki/Magnesium_chloride

Please contact us if you have any questions ...

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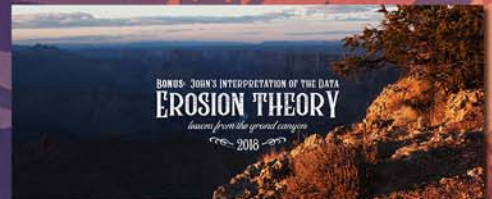
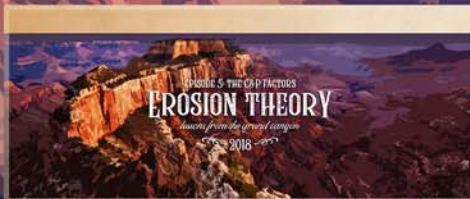
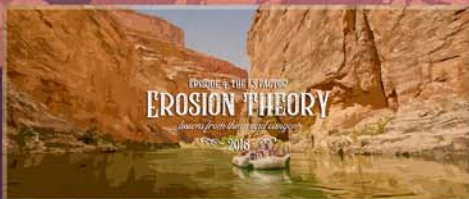
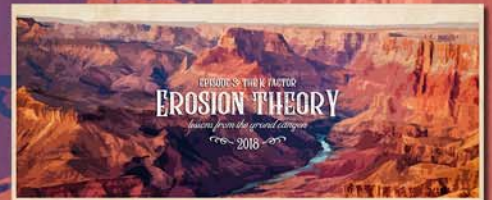
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Minimum Measure

Construction Site Stormwater Runoff Control

Subcategory

Sediment Control

Stormwater Turbidity and Its Aquatic Life Toxicity

Turbidity is a measure of the amount of suspended material in a liquid. In stormwater or a natural waterbody (e.g., river, lake, or estuary), turbidity depends on the amount of suspended sediment, dissolved organic matter, and plankton in the water. Turbid stormwater entering a natural waterbody can significantly degrade the habitat of fish and other aquatic life. Reductions in light levels may reduce submerged aquatic vegetation that provides the cover necessary for survival of the prey species. Or reduced visibility may make it difficult for predators to find evasive prey. Gravel on the bottom of a riverbed, which is necessary for salmon to spawn successfully, may be covered with sediments. Often it's not just a few species but the whole food chain that's affected. One of the references on page 7 (Meager, 2013) is an article for non-scientists on how turbidity affects the growth, reproduction, and survival of fish. Another reference (Meager, 2006) lists over 185 technical publications, which thoroughly document the toxic effects of stormwater turbidity on aquatic life.

The instrument used to measure the turbidity of a liquid is called a nephelometer. It works by passing a light beam (source beam) through a sample of the liquid and then measuring the light scattered by the suspended particles with a light detector set to the side (often 90°) from the source beam. The particle density is a function of the light scattered toward the detector by the suspended particles in the liquid. The units of turbidity measured by a calibrated nephelometer are called Nephelometric Turbidity Units (NTU). Contractors can use a hand-held nephelometer to measure the turbidity of their construction site's stormwater runoff.

Polymer Flocculation for Reducing Stormwater Turbidity and Its Aquatic Life Toxicity

Flocculation is the process where a chemical agent (flocculant) is used to reduce the turbidity of a liquid by binding suspended particles in the liquid together to form larger particles (flocs) that are heavy enough to settle to the bottom of the liquid. When the liquid is stormwater runoff, this particle binding and settling process reduces soil erosion and the runoff's turbidity, as well as the aquatic life toxicity associated with turbidity. Some polymers are good flocculants. Polymers are chemical compounds that have very large molecules composed of one or more structural units that are joined together in a repeating pattern to form long chain-like macromolecules. The two red wavy ribbons in Figure 1 represent polymer molecules

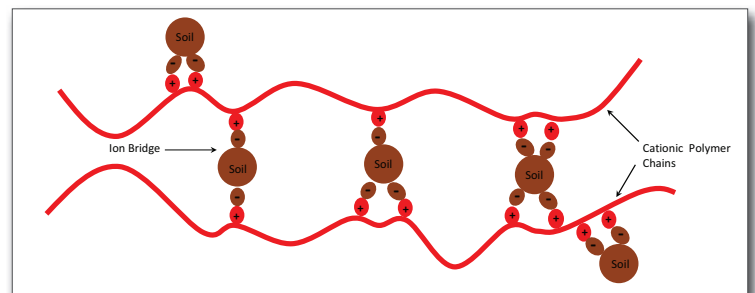


Figure 1. Cationic polymer flocculation

dissolved in water, and the brown circles represent suspended soil particles. Cationic polymer molecules have positive charges, and many soil particles (particularly clays) have negative charges. The negatively charged soil particles are attracted to the positively charged polymer molecules, and this causes the soil particles to bind with the polymer chains as shown in Figure 1. Many of the soil particles form ionic bridges between the polymer chains, and some bind to the outside of the polymer chains. This binding process continues until many thousands of polymer chains and soil particles combine to form a floc having sufficient mass to settle to the bottom, thereby reducing the water's turbidity.

Although cationic polymers are effective flocculants and do reduce turbidity, their positive charges make them toxic to aquatic organisms when dissolved in water. Consequently they should not be used as flocculants in stormwater that runs off

Stormwater Best Management Practice: *Polymer Flocculation*

the land into natural waterbodies. However, anionic polymers, which carry a negative charge, are not toxic. If they're added to stormwater along with some positive ions, the soil particles will bind onto these anionic polymer molecules and form the ionic bridges shown in Figure 2. Adding positive calcium ions (Ca^{++}) to the anionic polymer enables anionic polymer flocculation, which can reduce the turbidity without harming the aquatic life.

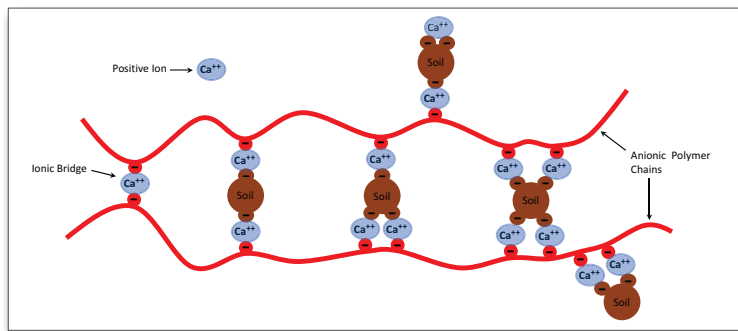


Figure 2. *Anionic polymer flocculation*

Floc collection becomes important if the stormwater runoff velocity is too high to allow the flocs to settle to the bottom. In these cases an attachment surface, such as the soft matting (jute, hemp, burlap, or coconut coir) shown in Figure 3, needs to be installed across the flow to collect the flocs. Polymer flocculation is based on three fundamental processes: chemical binding, settling, and floc collection.



Figure 3. *Matting used for floc collection*

Polymer Flocculation BMPs

Polymer flocculation provides the basis for a number of best management practices (BMPs) for reducing stormwater turbidity and its toxicity. Flocculants can be applied directly to: the soil surface, water flowing in a channel, a natural waterbody, or a settling pond. Examples of these four basic types of BMP applications are described below. One of them alone may be sufficient for a relatively simple project, or several of these BMPs may be used together to design a polymer flocculation system for a larger project.

Soil Surface Applications—3 examples

Soil stabilization. The objective is to bind soil particles together so they become more resistant to the erosive forces

of wind or water and to promote revegetation following a soil disturbing activity such as construction. Soft matting can be applied over the ground (Figure 4) to provide an attachment surface for floc collection as runoff flows down the slope. If hydroseeding is used, the addition of a polymer flocculant in liquid form to the hydroseeding mix will bind the seed, fertilizer, and other additives to the soil until the new vegetation is established. The hydroseeding mix is then sprayed on the slope (Figure 5), and vegetation is established to stabilize the slope (Figure 6). When hydroseeding is not used, the powdered polymer can be applied by hand over the matting. When it rains, the powdered polymer dissolves and the soil particles become chemically bound to the long polymer molecules. The resulting flocs are sticky and adhere to the fibers of the soft matting to create a highly erosion resistant surface that supports vegetation. If straw or mulch is used instead of soft matting to cover the ground, the flocs will also adhere to either of them and provide good erosion resistance and revegetation support.

Dispersion fields. The objective is to reduce the velocity, erosive force, and turbidity of rapidly flowing water by allowing it to spread out over a relatively level area. Checks or wattles can be placed perpendicular to the flow to reduce its velocity. Soft matting installed over the dispersion field and covered with a polymer powder will reduce the water's turbidity by binding the suspended particles together so they form particulate-polymer agglomerations that settle and adhere to the jute matting.

When wells are drilled during home construction to provide drinking water or geothermal water for heating and air



Figure 4. *Slope covered with floc collection matting*



Figure 5. *Hydroseeding the slope*



Figure 6. *Stabilization four weeks later*

conditioning systems, the water discharged from the drilling operations can be laden with rock chips and sediment and is often toxic. A drilling rig and its settling pit that allows larger particles from the rig's discharge to settle out is shown in



Figure 7. *Drilling rig and settling pit*

Figure 7. The water then flows through a flocculation ditch and a small dispersion field, which is lined with jute matting covered with polymer flocculant powder to clarify the water before it's discharged. The turbidity of water coming from the drilling rig was over 5,000 NTU. But after the settling pit and polymer flocculation in the mixing ditch and dispersion field, the discharged water's turbidity was reduced to 2 NTU.

A much larger dispersion field was needed to clarify the spoils from a dredging operation before they were discharged back



Figure 8. *Large mixing ditch*



Figure 9. *Dispersion field with jute matting and flocculant powder*



Figure 10. *Clarified dredge spoils returning back to the lake*

into a Tennessee Valley Authority lake. The dredge spoils were initially pumped into a settling pond to allow the heavier particles to settle. Then after passing through the mixing ditch in Figure 8, they entered an 8,100 square foot dispersion field (Figure 9) lined with jute matting, which was covered with a powdered polymer flocculant. After passing over a dispersion field and through a sediment retention barrier, the clarified water was returned to Kentucky Lake (Figure 10). The dredge spoils pumped into the settling pond were 15% solids. After settling, the water discharged from the settling pond had a turbidity ranging from 500 to 600 NTUs. And after flocculation in the treatment ditch followed by additional

flocculation and particle collection in the dispersion field and a sediment retention barrier, the turbidity was only 21 NTUs.

Dust control. The objective of dust control is to reduce airborne dust from haul roads, tailings piles, waste dumps, and open areas on construction sites. The polymer is mixed and dissolved in water and then sprayed directly on the road or other ground surface (Figure 11). A comparison of construction site road dust before and after polymer flocculation is shown in Figures 12 and 13. Using a flocculant to bind the dust particles will also reduce the amount of water needed to spray dusty construction areas.



Figure 11. *Water truck applying dissolved polymer flocculant*



Figure 12. *Road dust before applying polymer flocculant*



Figure 13. *Road dust after applying polymer flocculant*

Channel Applications—4 examples

Treatment ditches.

When a construction site sediment basin like the one in Figure 14 needs to be dewatered, an above-ground treatment ditch built of hay bales covered with plastic can be used to reduce the water's turbidity before it's discharged to the environment. Soluble polymer blocks are tethered along the higher portion of the ditch, and particle collection matting covers the bottom of the ditch along its lower portion (Figure 15). When water is released from the settling



Figure 14. *Sediment basin to be dewatered*



Figure 15. *Lower portion of the treatment ditch*

Stormwater Best Management Practice: Polymer Flocculation

basin and flows through the upper part of the treatment ditch over and around the blocks, the polymer blocks begin to dissolve, turbulence causes mixing, and the sediment particles suspended in the water bind with polymer molecules to form flocs. When these flocs reach the lower and wider portion of the ditch, the water velocity is reduced and the flocs settle to the bottom and adhere to the soft matting. After this flocculation and particle collection, the clarified water is discharged. A larger above ground treatment ditch with a 3,500 gallons per minute flow was previously shown in Figure 8.

Treatment ditches can also be dug into the ground. A treatment ditch in Figure 16 has checks placed perpendicular to the flow to increase polymer mixing. This flocculation ditch reduced the turbidity of water from a phosphate mining operation from 1,500 NTU to 25 NTU, which meets Florida's turbidity standard.

The treatment ditch used to clarify stormwater runoff from a highway construction site (Figure 17) has deeply corrugated sides that create turbulence which facilitates flocculation by mixing the polymer flocculant with the turbid stormwater. The ditch is made of high density polyethylene (HDPE) sections that can be disassembled and reused on other projects or recycled. These sections eliminate the need for the hay bales and plastic linings, they reduce the amount of construction material taken to municipal landfills for disposal, they will stack tightly for transporting to another job site or storage, and they can also be used to line in-ground treatment ditches (Figure 18). They're a green product made of about 75% recycled material.



Figure 16. Flocculation ditch with checks to increase the polymer mixing



Figure 17. HDPE treatment ditch liner



Figure 18. In-ground treatment ditch

Closed pipes. The construction site for a large number of homes near Disney World was drained because it was originally marsh land. The contractor pumped the water over a quarter of a mile through closed pipes to a natural lake. To prevent the lake from becoming turbid, soluble polymer blocks were inserted through holes that were cut along the top of the pipes and anchored in place (Figure 19). Polymer flocculation within the pipes bound suspended sediment particles in the water together, so they had sufficient mass to settle before discharged into the lake, rather than increase the lake's turbidity. Water leaving this construction site had a turbidity of about 8,000 NTU, but after flocculation the water discharged to the lake measured about 10 NTU.



Figure 19. Polymer blocks inserted into pipes

Split pipes. A sediment pond at a construction site was dewatered using split pipe sections joined together. The pipe's upper sections contained soluble polymer blocks (Figure 20) and its lower sections were lined with soft matting to collect the flocs (Figure 21).



Figure 20. Split pipe with polymer blocks



Figure 21. Split pipe with soft matting

Irrigation furrows. Applying polyacrylamide (PAM) to irrigation furrows improves the irrigation process by providing more water to the crops. As water flows down the furrow it infiltrates through pores in the sides and bottom of the furrow and into the surrounding soil. PAM binds the fine soil particles into aggregates (flocs), which are too large to clog these pores, and this increases the infiltration. Maintaining larger pores provides more water to the crops because infiltration rate increases exponentially with the diameter of the furrow's pores. The water

is then delivered to the crops by a soil water pressure gradient, which is greatest by the wetted furrow and then decreases toward the crop roots as water is taken up by the roots due to the plants' transpiration.

Polymer flocculation also reduces irrigation-induced erosion and sediment transport. The binding of polymers to furrow soils increases the soil aggregate cohesion, prevents aggregates on the bottom of a furrow from breaking up, and helps preserve the furrow's roughness. In addition, PAM flocculates fine soil particles that may become suspended in the furrow stream. The resulting large flocs are less likely to seal soil pores and reduce infiltration. The polymer's combined effects on furrow roughness and infiltration reduce the furrow's erosion and sediment transport.

Figure 22 shows a furrow treated with PAM having little erosion and clear water. Figure 23 shows an untreated furrow having erosion and cloudy water. Imhoff cones in Figure 24 compare the turbidity in these two furrows. The cone on the left holds water from the furrow treated with PAM; the cone on the right holds water from the untreated furrow.



Figure 22. *Furrow treated with PAM*



Figure 23. *Untreated furrow with erosion*



Figure 24. *Comparison of water from furrows with and without PAM*

Natural Waterbody (in situ) Applications—4 examples

Salmon spawning habitat. The Anna River in Michigan's Upper Peninsula is good Coho Salmon spawning habitat. An old rusty culvert under a road that crosses over the river was scheduled

to be replaced during a fall salmon run. Before this construction project began, water soluble, polymer flocculant blocks were placed in the river 20 to 30 feet downstream of the culvert (Figure 25) to protect the spawning ground from turbidity. Jute matting was placed downstream of the polymer blocks (Figure 26) to collect the flocculated soil particles. Before the old culvert could be removed, a channel had to be dug to divert the flow around the construction site. The diversion channel was lined with plastic and crushed limestone, which was covered with polymer powder to prevent white plumes of lime sediment from drifting downstream. This flocculation successfully clarified the water in the diversion channel and in the river below the construction site. Little salmon smolts (Figure 27) as well as spawning adults could be seen swimming in these waters. To protect the habitat, it was important to have this flocculation system in place before the construction project began.



Figure 25. *Six of the polymer blocks placed downstream*

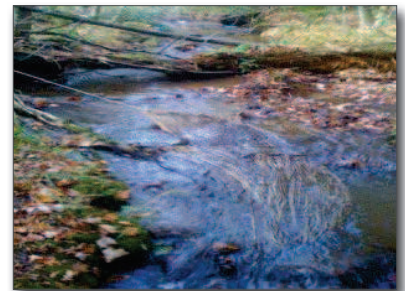


Figure 26. *One of the in situ jute particle collection mats*



Figure 27. *Salmon smolt swimming in the diversion ditch*



Figure 28. *Three in-stream baskets*

In-stream baskets.

The baskets in Figure 28 introduce soluble polymer blocks to turbid water downstream of construction work. This allows the dissolved polymer to mix with the turbid water and facilitates the binding reaction between polymer molecules and suspended particles, which reduces turbidity.

Particle curtains. After suspended sediment particles are bound to the flocculant in flowing waters, if the velocity is too high to allow the flocs to settle to the bottom, then particle curtains of jute or other soft matting can be suspended from floats across the current, to collect the flocculated particles. However, particle curtains are not a stand-alone BMP. They must be placed just downstream of a polymer flocculation system. The particle curtain shown in Figure 29 is being lowered into a canal in central Florida. Three particle curtains in Figure 30 are placed across the inflow to a pond. Each curtain reduces the inflow's turbidity.



Figure 29. Particle curtain in a canal



Figure 30. Particle curtains clarifying the input to a pond

Waterfall mixing system.

A water garden landscape in Atlanta was quite turbid after its construction (Figure 31). Polymer logs were placed in the waterfall (Figure 32), which provided mixing of the dissolved polymer molecules and suspended sediment particles. After 24 hours the turbidity was significantly reduced, and after 48 hours coi (ornamental carp) could inhabit the pond (Figure 33).



Figure 31. Newly constructed water garden



Figure 32. Polymer flocculant logs placed in the waterfall



Figure 33. Coi pond two days later

Settling Pond Applications— 2 examples

Dewatering sediment

basins. When settling ponds or basins need to be dewatered, the water can be pumped through a sediment bag, which traps the coarse sediment



Figure 34. Sediment bag and its treatment ditch



Figure 35. Clarified discharge water near the end of the treatment ditch

particles. Jute matting covered with powdered polyacrylamide flocculant placed under the sediment bag and along its discharge ditch (Figure 34) will clarify the discharge water by flocculating the fine sediment particles that pass through the bag and binding them to the soft matting. The discharged water in Figure 35 is much less turbid than the water leaving the sediment bag.

Sediment removal. The highly saturated sediment remaining in a sediment basin after it has been dewatered is often difficult to remove. Mixing the granular form of PAM into this sediment will bind the particles together and stiffen it, making it easier to remove (Figure 36). This is done by spreading the granular PAM flocculant evenly over the sediment surface and then mixing it into the top three feet of sediment using the excavator equipment's bucket. Do not dump the flocculant in a pile. If the sediment is deeper than three feet, this mixing and removal can be repeated for each successive three-foot layer of sediment. The sediments removed may be recycled as topsoil (Figure 37).



Figure 36. Removing stiffened sediment from a sediment basin



Figure 37. Recycling sediment along a highway

Polymer Flocculation Systems Composed of Multiple BMPs Working Together—1 example

At an office construction site in Tennessee, a powdered polymer was applied directly to stabilize the soil surface in gullies (Figure 38) draining to a sediment pond at the lower portion of the site. Soluble polymer blocks were tethered inside a closed pipe (culvert) running under a construction road (Figure 39) that also drained to the pond. Before these BMPs were installed, the sediment pond was quite turbid (Figure 40). Two weeks after their installation and several significant rain events, the pond was clear, and only the sediment deltas remained (Figure 41). Designing polymer flocculation systems often involves using multiple BMPs and having them work well together.



Figure 38. Eroding gully on a construction site



Figure 39. Polymer block in a construction site culvert



Figure 40. Sediment pond before BMPs were installed



Figure 41. Same pond after BMPs were installed

Site-Specific Performance Testing

The effectiveness of polymer flocculation depends on the site-specific soil characteristics and the particular polymer used. There are hundreds of anionic polymers, and they're not all an effective flocculant for a particular soil. Sometimes a blend of polymers provides the most effective flocculation. A performance ratio of 95% (the amount of polymer attaching to soil particles) is considered a very effective flocculant. Increasing the flocculant application rate will not necessarily result in better performance. Site-specific soil sampling and analysis are recommended to determine the reaction time and most effective polymer blend.

References

- Applied Polymer Systems Inc. 2011. Polymer Enhanced Best Management Practice (PEBMP) Application Guide. Woodstock, GA. www.siltstop.com/pdf/PEBMPJune2013.pdf
- Meager, Justin 2006. Turbidity and Fish Behavior List of References. www.justin-meager.com/turbidity_references.htm
- Meager, Justin 2013. Turbidity and Fish Behavior. www.justin-meager.com/turbid.htm
- Toronto and Regional Conservation Authority 2013. Anionic Polyacrylamide Application Guide for Urban Construction in Ontario.
- USDA, Natural Resources Conservation Service 2002. Conservation Practice Standard: Anionic Polyacrylamide Application, Code 450. <http://efotg.sc.egov.usda.gov/references/public/NM/450STD-2011June.pdf>

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