Taming Turbidity

Using passive dosing with polyacrylamide to treat turbid storm water

By Jihoon Kang & Richard McLaughlin

Sediment and turbidity in runoff from construction sites is one of the challenges faced in most construction projects. Channels typically are installed to route runoff into sediment settling basins. However, muddy water often is discharged from the basin even though all sediment control measures are in compliance. Part of the reason can be attributed to the nature of the muddy water. Turbidity, which is the measure of how much cloudiness the water has, increases when fine silt- and clay-sized particles become suspended in the runoff. These particles take a long time to settle by gravity, which is how most sediment control measures work.

Chemical Solution

Erosion and sediment control practices are required on construction sites, but they present a cost with no benefit to developers aside from avoiding fines. A challenge has been to improve the quality of discharged runoff without significant additional expenses. In some areas, developers must bring in pumps and filters to deal with turbidity at a considerable cost. However, there is a simple and relatively inexpensive way to treat turbid storm water without expensive equipment: passive dosing with polyacrylamide (PAM).

PAM is a chemical that is commonly used in water and wastewater treatment plants to flocculate suspended solids to get them to settle quickly. There are many types of PAM, but those with a negative charge are recommended to minimize potential toxic effects. Small doses of PAM are needed to clarify turbid water and there is a wide safety margin for aquatic toxicity. A passive dosing system relies on dissolution of solid flocculants (granules or solid blocks) into water flowing downhill. There are many places to introduce PAM into water passively, such as on check dams or channel liners, or in drop inlets and slope drains.

Fiber check dam and granular polyacrylamide applied at a construction site.

Research projects at North Carolina State University and elsewhere have demonstrated significant turbidity reductions with passive dosing systems combined with typical sediment control measures.

PAM & Check Dams

One approach to reducing turbidity is to treat runoff with PAM applied to fiber check dams (FCDs). Granular PAM works well and is relatively inexpensive, but solid blocks also can be used. The granular PAM is applied to the FCDs at the center weir point and on the erosion control blanket above and below the FCD. Apply 2 to 4 oz at each FCD, with half on the FCD and half applied above and below on the blanket. The PAM will be activated (partially dissolved) and will bind to the fibers during the next rainfall event. Sprinkling the granular PAM to make thin patch instead of a thick one is recommended, otherwise the applied PAM can break off in pieces before it dissolves and be buried in sediment further downslope. Once exposed to rainfall and runoff, the granular activated PAM forms a gelatinous pad that will slowly

release PAM into the water flowing over the FCD. Reapply PAM at the same rate when it no longer can be observed on the FCD and blanket.

PAM-treated runoff should be directed into a sediment basin or similar device prior to discharge to effectively trap the flocculated sediment. With optimized sediment basins that have porous baffles and a surface outlet, the sediment retention and turbidity reduction can be more than 90%. If there is no such device at the end of the ditch, no PAM should be applied to the last few FCDs so that the FCDs themselves will trap the resulting flocs. There are many types and formulations of PAM, so make sure your supplier or manufacturer provides one that works for your soil. This can be quickly determined with a jar test, in which the soil or turbid water is mixed with a small amount of PAM to see how quickly and completely it flocculates the suspended sediment. It also is important to control erosion within the ditch in which the passive dosing system is deployed, because heavy sediment loads can overwhelm or bury the PAM. Finally, be sure to check state and local regulations on the use of flocculants to treat storm water because they vary widely.

Because flocculated sediment settles much faster than untreated sediment, in theory, sediment basins could be smaller and still achieve required sediment capture efficiencies. In fact, studies have demonstrated that this can be done. However, sediment basin size often is dictated by calculated runoff volume for a specific type of storm (e.g., a 10-year event) and regulators are not likely to stray from that design. Furthermore, poorly implemented or maintained passive treatment systems may not effectively flocculate the sediment, so smaller basins present some risk of reduced treatment of runoff.

Conclusions

Passive dosing systems using PAM or other flocculants can greatly reduce the turbidity of water discharged from construction sites. The cost to implement them is minimal, and only minor changes in typical erosion and sediment control plans are needed. These systems can greatly reduce the suspended sediment and turbidity in construction site discharges, minimizing the impacts on nearby streams. This also may reduce the risk of violations or complaints and lawsuits from downstream neighbors. With proper installation and maintenance, passive treatment can clear up many construction site storm water worries. SWS

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