Research Summary

South Carolina Department of Transportation | Office of Materials and Research

Compliance with the United States Environmental Protection Agency (USEPA) Effluent Limitation Guidelines – Turbidity Control and Surface Outlets

Project Information
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This final report is available online at:
http://www.scdot.scltap.org/projects/completed/

This research evaluated turbidity and surface water withdrawal associated with SCDOT construction site stormwater discharge. Experimentation with and without the use of polymer flocculants (PAM) determined effluent values for TSS and turbidity from SCDOT BMPs and evaluated effectiveness of surface water withdrawal systems and baffle configurations deployed within sediment basins. Results indicate PAM applied directly to ditch checks can significantly improve the water quality of site discharge. Results also showed greater than 80% reduction in turbidity and TSS could be achieved with skimmers or through a combination of skimmer and baffle arrangements. With addition of PAM, turbidity and TSS reductions could be greater than 90%.

Linear BMP Monitoring Site with Installed Sampling Equipment.

Problem

U.S. Environmental Protection Agency originally published effluent limitations guidelines (ELGs) to control discharge of pollutants from construction sites. Though the decision has been put on hold, ELGs may ultimately require numeric turbidity limits for active construction in South Carolina. For SCDOT to be capable of complying with potential numeric turbidity standards, assessment of current best management practices and development of potential new BMPs would be necessary. To meet this potential standard, research was conducted to measure and evaluate turbidity in stormwater discharges from SCDOT construction sites and in controlled experimental field testing of current SCDOT specified sediment control BMPs. The research also studied other passive treatment BMPs such as polymers and chemical flocculants.

Research

This research evaluated turbidity and total suspended solids (TSS) in stormwater discharges from SCDOT construction sites employing various linear BMPs. Selected sites from the different regions of the state were used to quantify BMP performance with different South Carolina soil types. Evaluation of these on-site BMPs involved testing with and without the addition of flocculants. Both turbidity and TSS measurements were taken during storm events to quantify effects that different BMPs have on improving water quality.

Research then evaluated similar BMPs under controlled experiments to assess performance with and without polymer flocculants under different application techniques and time intervals. Research also evaluated the effectiveness of surface water withdrawal systems (skimmers) and baffle configurations deployed within sediment basins using a SCDOT scaled-model sediment basin. Experiments consisted of generating an inflow sediment load that was conveyed across the installed BMPs. Turbidity and TSS was measured to determine removal efficiencies of various BMP configurations.

Finally, a series of laboratory bioassays was conducted to evaluate acute and chronic toxicological effects resulting from exposure to commercially available PAM formulae.

Two key findings of this research were:

1. ***The use of PAM on construction sites can significantly reduce TSS and turbidity in stormwater discharges.***
2. ***Proper maintenance and regular inspections must be a priority to reduce both TSS and turbidity on active sites.***

Scaled Sediment Basin Experiment

Results

Research on SCDOT linear best management practices analyzed reducing turbidity and TSS using sediment tubes, rock ditch checks and rock ditch checks with washed #57 stone on the upstream face at three active roadway construction sites in the upstate, midlands, and coastal regions of South Carolina. In addition, data were collected from these BMP installations with and without a granular PAM application.

It was observed that both rock ditch checks and rock ditch checks with washed stone using PAM were most effective in reducing turbidity showing an average decrease of 58-63%. It was also observed from field sites where proper installation and/or maintenance of BMPs did not occur, increases in both TSS and turbidity was possible.

Results from the experimental linear BMP study showed that granular PAM applied directly to sediment tubes provided better reductions in turbidity and TSS than PAM delivered through other measures. Results also showed that reapplication of PAM will be required over the course of construction.

Results from the scaled basin study suggest that with skimmer alone or skimmer and baffle combination, greater than an 80% reduction in turbidity and TSS could be achieved. With addition of PAM, reductions could exceed 90%. Turbidity effluent levels ranged between 6-160 NTUs when PAM was used. A final basin study element compared single baffle and three-baffle configurations. For these tests, PAM was applied within the basin as a flocculant. While there was a difference between single and three baffles, both configurations resulted in reductions greater than 90%. For TSS, no difference between single baffle and three baffles was found. TSS reductions for both configurations were greater than 95%.

Results from the laboratory bioassays conducted to evaluate acute and chronic toxicological effects resulting from exposure to commercially available PAM formulae showed that toxicities reported were all above dosage recommendations made by the manufacturers.

Value & Benefit

Results of this research have provided better understanding of turbidity and TSS effluent levels being discharged from various linear BMPs. Findings have also led to a revised supplemental technical specification for porous baffles (SCDOT Designation: SC-M-815-16) and development of a new supplemental technical specification for polymer coagulants/flocculants for sediment control. To accompany the new polymer coagulant/flocculants spec, a qualified products policy (QPP) for polymer use has also been established. These two specifications and new QPP will allow for improved performance of sediment BMPs on active construction sites.

This research also confirms that proper BMP installation, maintenance and regular inspections must be a priority to effectively reducing TSS and turbidity. Infrequent maintenance often corresponded to higher turbidity and TSS levels and thus lower observed trapping efficiencies.

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