FILTREXX®
Advanced Tubular Filters

TechLink Research Summary #3332

Sediment Removal Performance of Filtrexx® SiltSoxx™ and Rock Bags in Inlet Protection Applications

Sedimentation rates from construction sites are typically 10 to 20 times greater than from agricultural operations, and 1000 to 2000 times greater than forestlands (US EPA 2005). In a short period of time, sedimentation from a construction activity can exceed decades of natural sedimentation that causes physical, chemical, and biological harm to our nation's water system (US EPA 2005).

Filtrexx® SiltSoxx™ are often used as storm inlet protection devices used to filter sediment from runoff prior to entry into the storm drain system. Sediment and soluble pollutants are filtered from runoff water as it passes through the organic structure. As water temporarily ponds behind the inlet protection, this allows deposition of suspended solids. Pre-cut and prefilled SiltSoxx™ for inlet protection also allow for quick and easy installation.

Filtrexx® SiltSoxx™ for Inlet Protection

Typical rock bag installation for inlet protection

While many other products are available for use as inlet protection devices, rock bags are another common management practice specified and installed around many construction sites across the United States in addition to SiltSoxx™. Although these practices are widely used, there has been very little evaluation (or test methodology developed to evaluate) of these management practices. Rock aggregate is commonly used because it does not impede the flow of storm water runoff, and is believed to remove some pollutants prior to entry into the storm drain.

Inlet protection devices should not restrict the primary goal of managing storm water in these areas – rapid removal of storm runoff from streets to reduce hazards to vehicular traffic. An inlet protection device that removes sediment and does not impede or divert runoff into the storm inlet shall be considered a superior product/practice. Additionally, these practices should be able to remove all types of sediment, including sand, silt, and clay.

Objectives

- Evaluate the total suspended solids (TSS) and turbidity reduction efficiency of clay loam and silt loam sediment-laden runoff using a SiltSoxx™
- Evaluate the TSS and turbidity reduction efficiency when filter sand is added to a SiltSoxx™
- Evaluate the TSS and turbidity reduction efficiency of coarse Filtrexx® FilterMedia™, fine FilterMedia™, rock, and a blend of fine FilterMedia™ and rock.

Materials and Methods

To test for filtration efficacy, compost filter medium were subjected to a laboratory scale storm runoff event, meant to simulate the conditions of storm water passing through an 8 in diameter SiltSoxx™. To achieve this, a tilt table was designed and produced (by Soil Control Lab of Watsonville, CA) to test the device. The tilt table used was 4 ft in length where water flows from one end of the table, through the filter medium, and out the other end of the table, where runoff water samples can be taken. In this study the slope was maintained at a ratio of 3:1. The runoff distributors were connected to a 57 L open-top water tank, equipped with a pump-enabled siphon tube. For the duration of this study, 2 gal/min/linear ft of runoff was pumped through the runoff distribution system.

Test Procedure

After the sample FilterMedia™ was assembled, City of Watsonville, CA tap water was run down the tilt table and through the FilterMedia™ for 10 min. Then the runoff distributors supplied a pollutant-laden storm water runoff containing a predetermined amount of sand, silt, and clay. After 10 min of running the pollutant-laden water through the FilterMedia™, the inflow and outflow runoff were sampled and tested for sediment constituents.

Analysis

The inflow and the outflow of the pollutant-laden runoff water were analyzed for the following sediment constituents using these test methods:

- Total solids (ASTM D3977-97C)
- Suspended solids (SM 2540 D)
- Total suspended solids (ASTM D3977-97C)
- Turbidity (SM 2130 B)

Full descriptions of US EPA test methodologies can be found in the Methods for Chemical Analysis of Water and Wastes (US EPA, 1983). Sediment removal efficiency was determined from runoff water for TSS and turbidity. Maximum flow through rate was also calculated for the FilterMedia™.

Sediment removal efficiency (%) of two sediment types for SiltSoxx™

	TSS Removal	Turbidity Reduction
Silt loam (1400 mg/l)	33	25
Clay loam (1400 mg/l)	64	26

Clay loam sediment removal efficiency (%) for SiltSoxx™ with sand filtration addition

	TSS Removal	Turbidity Reduction
No sand added to sock (control)	64	26
Sand mixed in sock at 6% (v/v)	71	53
Sand mixed in sock at 25% (v/v)	82	65

Sediment removal efficiency (%) and maximum flow through rate (gpm/lin. ft) of various inlet filters

	TS	TSS	Turbidity	Flow Rate
Coarse FilterMedia™	77	25	1	>50
Fine FilterMedia™	99	63	38	5
Fine FilterMedia™ + rock (1:1)	98	46	17	8
Rock	16	-14	-10	>50

Treatments

A clay loam soil from Athens, GA, and a silt loam soil from Watsonville, CA were used to create sediment-laden runoff at 1400 mg/l to evaluate the sediment removal efficiency of a typical clay and typical silt sediment. Sand was added to the compost FilterMedia™ to test for potential increase in sediment removal efficiency to tighten up pore space. The sand used was 50% #20 and 50% #30. Sediment-laden runoff was prepared using a Cecil clay loam soil from Athens, GA at 1400 mg/l. Two separate tests were performed. Test #1: sand was blended with compost at 6% on a v/v basis (1 cup/gal; 350 g/gal; 134 lbs/cubic yard); Test #2: sand was blended with compost at 25% on a v/v basis (2 pints/gal; 1400 g/gal; 535 lbs/cubic yard). A coarse FilterMedia™ (>1 in), a fine FilterMedia™ (< ¾ in), rock aggregate, and fine FilterMedia™ + rock (blended by volume 1:1) were tested as storm inlet protection FilterMedia™.

Conclusions

Based on the experimental design and conditions presented in this study, SiltSoxx™ exhibited higher removal efficiencies for clay loam relative to silt loam sediments. If filter sand is added to the FilterMedia™, removal efficiency of fine sediments increases. Furthermore, increasing the inclusion rates of filter sand will increase the removal efficiency of fine sediments from storm runoff. By reducing the particle size of the FilterMedia™, TSS and turbidity were greatly reduced. Blending rock with fine FilterMedia™ decreased sediment removal efficiency, but increased the hydraulic flow through rate; while rock media alone exhibited a very high flow through rate it contributed fine sediments to the runoff and removed a small fraction of large sediments. Based on this analysis the fine FilterMedia™ is the best option for sediment removal, the coarse FilterMedia™ is the best option for high flow situations, and rock does a poor job in removing sediments and is likely to contribute sediments if not prewashed.

References Cited

US EPA, 1983. Methods for chemical analysis of water and wastes, EPA-600/4 4-79-020. United States Environmental Protection Agency, Cincinnati, Ohio.

US EPA 2005. Storm Water Phase II Final Rule: Small Construction Program Overview. Office of Water 4203. Fact Sheet 3.0. EPA 833-F-00-013.

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