FILTREXX®
Advanced Tubular Filters

TechLink Research Summary #3334

Performance of 5-inch Filtrexx® SiltSoxx™ for Sediment Control & Slope Interruption

Performance of sediment control barriers and slope interruption devices are of increasing concern to designers, regulators, and contractors. Historically, very little research has focused on developing best management practices (BMP) to fit a variety of site slope and rainfall conditions. For example, sites with nearly flat slopes or in areas with lower rainfall accumulation potential (or design storms below the national average) likely do not require sediment control barriers designed for runoff and sediment storage needed for sites with 3:1 (H:V) slopes and four inches of rainfall accumulation. Over-design of BMPs is just as commonplace as under-design of BMPs within the erosion and sediment control industry. Providing a correctly designed BMP for the site can offer substantial cost savings to the land owner. The objectives of this study were to determine the performance of: 1) a 5-inch diameter SiltSoxx on a 5% slope under a 2-inch design storm; and 2) a 5-inch diameter SiltSoxx on a 3:1 slope under a 2-inch design storm.


Figure 1: Testing of 5-inch SiltSoxx

MATERIALS AND METHOD

Experimental Set-Up

This project was conducted at the Texas A&M University Texas Transportation Institute Sediment and Erosion Control Laboratory at the Riverside Campus in Bryan, Texas. The tests were conducted on soil-filled tilting test beds that meet the ASTM D-6459 plot size requirements of 8′ x 40′ x 12″. A loamy sand (84% sand, 4% silt, 12% clay), with 0.35% organic matter, and pH of 8.6 was used in all test replicates. Two experimental treatments were evaluated, a 5-inch SiltSoxx on 5% slope exposed to two inches of rainfall for 60 minutes, and a 5-inch SiltSoxx on a 3:1 slope exposed to two inches of rainfall for 60 minutes. Both treatments were compared to a control (bare soil/no treatment) under the same experimental conditions. Each treatment and control was conducted in triplicate to obtain quantitative means and to quantitatively compare each treatment to its respective control.

Soil Test Bed

Galvanized 8′ x 40′ x 12″ test beds were prepared by lining the beds with a permeable filtration fabric which has a clear water permeability/flow through rate of 1″ per 13.17 seconds. The filtration fabric was securely attached to the bottom and sides of the galvanized test beds and soil was then added to fill the test bed. The beds were initially compacted in 3″ lifts as the bed was being prepared. After the test beds were filled with soil, the soil was then tilled using a rototiller to an approximate depth of 8-9 inches. Soil was tilled in order to achieve uniform moisture, texture and blending. The test soil was then tilled again multiple times until the soil was uniform in appearance and soil moisture was uniform across the entire test bed. Soil moisture was monitored by using a Kelway model #36 soil tester. The Kelway meter measures the moisture content of the soil by monitoring saturation percentage. Leveling of the soil surface, soil compacting and rainfall testing was not allowed until saturation readings of 70% or less were obtained from the Kelway tester.

When the soil saturation point reached 70% or less, tilling was discontinued and the soil was leveled using a leveling bar. The leveling bar was dragged repeatedly over the surface of the soil beds with a tractor or forklift until the surface of the soil was level with the top of the test bed and the soil surface was even and uniform. After leveling the beds, the soil was compacted using a 150 lb. cylinder compactor. The compactor was placed on the surface of the test bed and was rolled across the bed perpendicular to the long side of the test bed (perpendicular to the direction of flow). The cylinder compactor was rolled across the bed in an even manner at a steady rate over the entire length of the bed. Once compaction was complete the test beds were then ready for testing. The same process was followed for each testing event (replicate). Exact compaction rates and nuclear density readings are available upon request.

Once the soil filled test beds were prepared and compacted for each replicate of testing, they were brought into the rainfall test facility and lifted to the appropriate test slope angle using a hoist system. Bare soil runs were conducted first to establish base-line sediment loss numbers. After the bare soil runs the 5-inch SiltSoxx were installed according to manufacturer recommendations at the toe of the tilting test bed and these tests were then conducted.

Rainfall Simulator

For this experiment a rainfall simulator with 0.5 GPH drip emitters were used and the rainfall drip emitter rack was adjusted so it was exactly parallel to the tilting test beds at a distance of 14 feet above the surface of the test beds. The rainfall rack is adjusted via electronic winches and cables. This was done to provide uniform drop velocity and impact. Uniformity calibrations and drop size analysis were conducted according to ASTM D-6459 specifications and these results are available upon request.

Figures 2 & 3: Test plot with treatment installation at Texas A&M Texas Transportation Institute Sediment and Erosion Control Laboratory.

Runoff and Sediment Sampling and Analysis

Total volume of water and sediment runoff was collected in a bulk container and after each test replicate was complete the container was allowed to settle overnight. The following day, clear water was decanted from the sediment and the containers were then weighed. After weighing all of the sediment, three 1-pint bottles of sediment were randomly collected from the sediment container. These bottles were labeled and were subsequently used to determine percent moisture in the total volume of decanted sediment. These samples were dried to determine percent moisture content. Once soil moisture was determined in these samples, the bulk wet sediment weights were then adjusted according to moisture percentages measured to reflect dry soil loss for both the bare soil and SiltSoxx tests.

Dry soil sediment weights for each test were then compiled, compared and reported. Complete wet soil weights, sample drying reports, dry soil loss volume and sediment loss data are available upon request.

Treatment Installation

The 5-inch SiltSoxx were installed according to manufacturer recommendations at the toe of the test bed. They were installed by placing the BMP on top of the soil surface and then making a slight cut in the top of the sock and driving hardwood stakes through the sock to a depth of approximately 10 inches into the compacted soil on the test beds.

An 18" x 18" galvanized sheet-metal insert was installed by driving it into the soil at the ends of the sock to prevent end around flow and loss of runoff and sediment from the test bed. After inserts were installed, a small amount of Filtrexx® FilterMedia™ was placed at the ends of the socks where they met the galvanized sheet-metal to ensure flow through the device and no end around flow occurred at the abutting surface areas.

<u>RESULTS</u>

Results from measured design criteria and performance testing are reported below for each individual treatment and control. Performance test results are based on means for all three tested replicates.

Test	**Slope**	**Total Soil Loss (lbs)**	**Average Soil Loss (lbs)**	**Average Soil Loss (lbs/ft^2)**	**Removal Efficiency (%)**
Bare Soil	5%	30.5	10.2	0.32	N/A
SiltSoxx	5%	0.07	0.02	0.0001	99%
Bare Soil	3:1	1938.1	646	2.02	N/A
SiltSoxx	3:1	482.9	161	0.50	75%

Table 1: Design Characteristics and Performance of 5-inch diameter SiltSoxx.

SUMMARY & CONCLUSIONS

The main objective of this study was to evaluate the performance of 5-inch diameter SiltSoxx under 2 inches of rainfall on a 5% slope and 3:1 slope, under a standardized testing procedure. The 5-inch SiltSoxx on a 5% slope had a sediment removal efficiency over 99%, while the 5-inch SiltSoxx on a 3:1 slope was 75% effective. In practical terms, for regions where single event rainfall accumulations or design storms are 2 inches or less, a 5-inch SiltSoxx will be *at least* 75% effective. Performance of the 5-inch SiltSoxx will increase towards 99% effectiveness as project slopes trend towards 5% or less. According to the *US Soil Conservation Service's Technical Release 55: Urban Hydrology for Small Watersheds,* a majority of the western half of the United States has a 24-hour, 2-year return rainfall amount of two inches or less. Most states and regions utilize this document and the 24-hour, 2-year return event as the design storm for erosion and sediment control practices.

From an engineering and design perspective the 5-inch SiltSoxx is approximately 60% of the design height of the 8-inch SiltSoxx. Maximum drainage area and spacing requirements for the 5-inch SiltSoxx will be 60% of the published values for the 8-inch SiltSoxx.

Figures 4 & 5: Sediment accumulation at end of 60 minute rainfall event

Finally, 5-inch diameter SiltSoxx for Slope Interruption will provide optimum performance on similar slopes, as this BMP is designed specifically to slow sheet flow runoff on hillslopes to reduce soil erosion. Overtopping of the SiltSoxx in these applications is part of the design and intent of the BMP.

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