Large-Scale Sediment Retention Device Testing (ASTM D 7351)

Modified to Represent Exposure to Street Sweep Sediment Load

of

FLEXSTORM PC Inlet Filter

November 2009

Submitted to:
Inlet & Pipe Protection, Inc.
24137 W. 111th St., Unit A
Naperville, IL 60564

Attn: Mr. Jamie Ringenbach

Submitted by:
TRI/Environmental, Inc.
9063 Bee Caves Road
Austin, TX 78733

C. Joel Sprague
Project Manager

November 30, 2009

Mr. Jamie Ringenbach
Inlet & Pipe Protection, Inc.
24137 W. 111th St., Unit A
Naperville, IL 60564
E-mail: jr@inletfilters.net

Subject: Sediment Retention Device Testing of FLEXSTORM PC Sediment Bags Exposed to Street Sweep Sediment Load (Log #2278-01-46)

Dear Mr. Ringenbach:

This letter report presents the results for large-scale sediment retention device tests performed on the FLEXSTORM PC sediment bag, a 2-ply geotextile with a nonwoven inner liner and woven outer layer. Included are data developed for simulated sediment-laden runoff from a 100-ft long, 3:1 slope exposed to a 4 inch storm event. All testing work was performed in general accordance with the ASTM D 7351, *Standard Test Method For Determination Of Sediment Retention Device Effectiveness In Sheet Flow Application*, though the protocol was modified to represent a flow to an inlet consisting of runoff from a swept road surface. Generated results were used to develop the following effectiveness percentages for the tested materials:

Product Tested	Sediment Load	Particle Size of Sediment Load	% TSS Removal	Gross Soil Retention Efficiency
FLEXSTORM PC Sediment Bag	2.5% = 100 lbs Sed / 4000 lbs water	.001 mm – 10.0 mm (median 200 micron)	99.68%	95.61%

TRI is pleased to present this final report. The data presented herein appears to be consistent with commonly reported values. Please feel free to call if we can answer any questions or provide any additional information.

Sincerely,

C. Joel Sprague, P.E.
Senior Engineer
Geosynthetics Services Division

Cc: Sam Allen, Jarrett Nelson - TRI

SEDIMENT RETENTION DEVICE (SRD) TESTING REPORT

FLEXSTORM PC Inlet Filter

TESTING EQUIPMENT AND PROCEDURES

Overview of Test and Apparatus

TRI/Environmental, Inc.'s (TRI's) large-scale sediment retention device (SRD) testing facility is located at the Denver Downs Research Farm in Anderson, SC. Testing oversight is provided by C. Joel Sprague, P.E. The large-scale testing is performed in accordance with ASTM D 7351 *modified to present the flow to an area inlet and to stop the test upon the SRD ceasing to capture additional sediment or at 30 minutes*. Effluent Grab Samples are taken at intervals for TSS laboratory analysis. As a check for removal efficiencies and confirmation of upstream sediment concentration, the amount (via water and soil weight) of sediment-laden flow is measured upstream of the SRD. The measurement of sediment collected in the SRD compared to the calculated amount of sediment in the upstream flow over time is used to quantify the gross effectiveness of the SRD in retaining those sediments and confirm TSS removal rate %.

This test method is full-scale and therefore, appropriate as an indication of product performance, for general comparison of product capabilities, and for assessment of product installation techniques. For this testing, a simulated area inlet comprised of a lined wooden "box" section and 24" diameter inlet opening was used to position the SRD in a representative condition. This facilitates multiple test repetitions during a single day of testing. The test apparatus is shown in Figure 2.

Sediment Retention Device (SRD)

The following table describes the tested SRD.

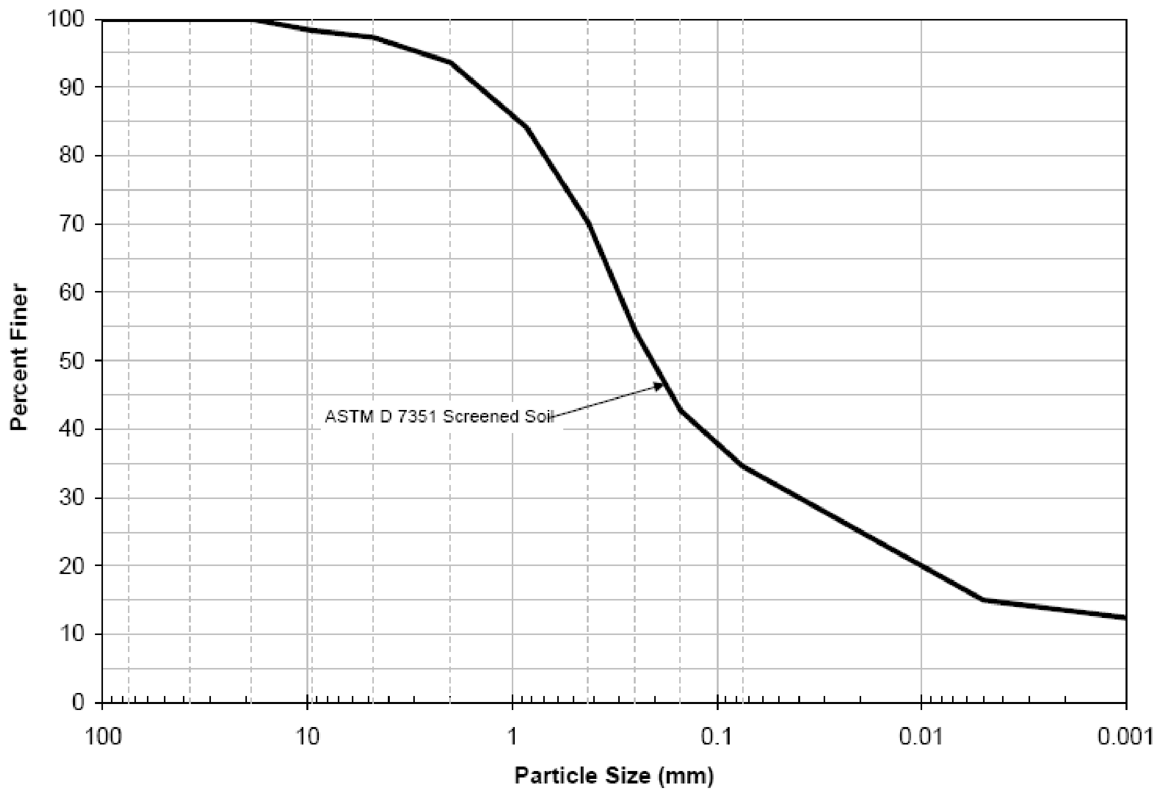
Table 1. Tested FLEXSTORM PC Sediment Bag

Fabric Component Description	Inner Liner NonWoven	Outer Layer Woven Polypropylene
AOS, Sieve	170	35
Water Flow Rate, gpm/ft^2	81	336
Tested Bag Capacity, ft^3	~ 2.1	

Test Soil

The test soil used for sediments had the characteristics shown in Figure 1. The particle size distribution is somewhat finer than that typically found from street sweep material. The sediment particle sizes ranged from less than 0.001 to 10.0 mm in size with a median particle size os 200 microns. (See Appendix A for Typical Street Sweep Particle Size Distribution.) The use of a finer gradation likely produced conservative retention results since it would be more difficult to retain the finer particles.

Figure 1. TRI-Loam Characteristics



Test Preparation

SRD Installation – The Sediment Retention Device (SRD) installation used a simulated area inlet comprised of a wooden “box” section and inlet opening to position the Inlet Filter Bags in a representative condition.

Mixing Sediment-Laden Runoff - Sediment-laden runoff was created by combining water and soil in the mixing tank and agitating during the test. The standard protocol uses 4000 lbs of water and 240 lbs of soil - a 6% sediment concentration - representative of on-site construction runoff. ASTM D 7351 details the derivation of these “default” quantities. In this testing, 4000 lb of water and 100 lb of soil were combined to create the sediment-laden runoff. The 2.5% sediment concentration mix is thought to be reasonably representative of runoff from a paved street near a construction site or a commercial development. 100 lbs of sediment was also chosen as the amount of soil that could be adequately retained given the volume capacity of the test bag. Soil would fill the bag to approximately 60% of max volume and and cause overflow to be filtered through the initial by-pass zone of the FLEXSTORM PC sediment bag.

TEST SETUP

As noted, the submitted SRD installation used a simulated area inlet comprised of a wooden “box” section and 24” dia inlet opening to position the FLEXSTORM PC in a representative field condition. Sediment laden flow was introduced through a pipe from the mixing tank as shown in Figure 2.

Inside View of Hopper Agitator

Hopper With Outlet Pipe Leading To Area Inlet

Area Inlet Simulated Showing Influent Discharge From Pipe

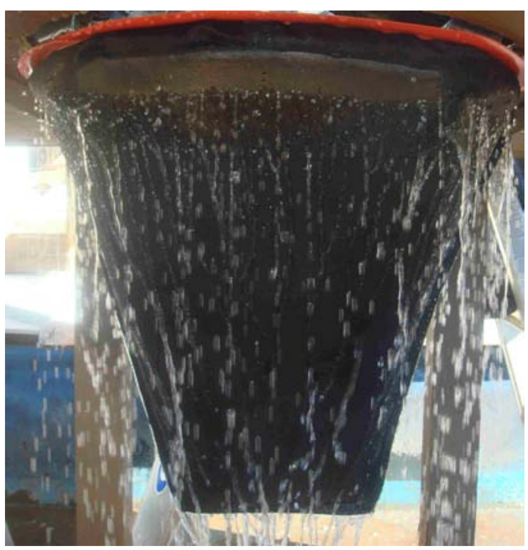
Figure 2. Test set-up, including mixing tank and wooden box with simulated area inlet.

Test Procedure

Releasing and Collecting Sediment-Laden Runoff - The sediment-laden water was discharged at an average flow rate of 16 gpm for 30 minutes. The test was stopped when the bag became nearly filled with sediment and could not pass additional runoff and the water in the tank was nearly emptied. Effluent Grab Samples were collected during the test for laboratory TSS testing, and weight of water and sediment discharged was recorded at intervals. Retention observations and associated times were also recorded during the test. Figure 3 shows typical pictures.

Effluent Grab Samples Taken Here

Grab Sample Containers



Testing Near Completion With Full Sediment Bag

Figure 3. Collection of Sediments and Test Sampling.

TEST RESULTS

Laboratory TSS analysis results of the Effluent Grab Samples are shown in Table 2 below along with the % Removal Rates. Total sediment and associated runoff measured during the testing are the supporting data used to confirm the performance of the product tested in addition to the measured TSS in the Effluent Grab Samples. The Net Sediment Captured vs the Calculated Sediment Discharged helps confirm the Soil Retention Effectiveness of the SRD and Removal Rate %.

Table 2. Measures of Effectiveness

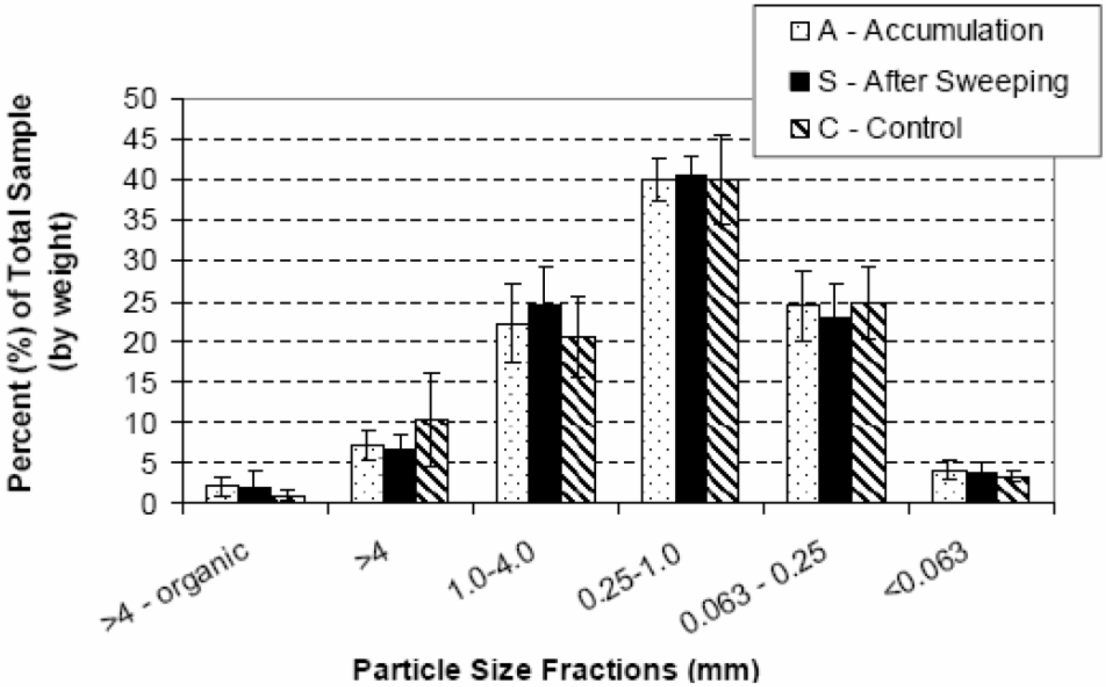
Run:	D			
Sediment Load:	100 lbs loam + 4000 lbs water (2.5% Sediment Load)			
Calculated Sediment Concentration (mg/L):	25,000			
Ave Flow Rate (lb/min):	137			
Ave Flow Rate (gal/min):	16			
Product Tested:	FlexStorm PC w/ Initial By-pass			
	No.	Time, min	mg/L	% Removal
Samples (downstream):	D1E	1	85	99.66%
	D2E	10	70	99.72%
	D3E	13	85	99.66%
		30		
	Note: D3E sample taken after Initial By-pass was activated			
***Average TSS Removal Rate:**	**99.68%**			
Calculated Water In (lbs):	4100			
Calculated Soil In (lbs):	100.0			
Soil Captured + Bag (lbs):	96.55			
Estimated Bag Wt. (lbs):	0.94			
Net Sediment Captured (lbs):	95.61			
Gross Soil Retention Effectiveness:	**95.61%**			

*TSS Removal was measured in accordance with SM 2540D

APPENDIX A – TYPICAL STREET SWEEP PARTICLE SIZE DISTRIBUTION

(Results taken from a report prepared by the Center for Watershed Protection, Sept 2008)

Figure 12. Average percent by weight of each sample type by particle size fractions. Error bars represent 1 standard deviation of the mean. (from DiBlasi 2008)



APPENDIX B – LABORATORY QUALIFICATIONS

Testing Expertise

TRI/Environmental (TRI) is a leading, accredited geosynthetic, plastic pipe, and erosion and sediment control product testing laboratory. TRI's large-scale erosion and sediment control testing facility in the upstate of South Carolina at the Denver Downs Research Farm (DDRF) is focused on full-scale erosion and sediment control performance tests.

Technical Oversight

Joel Sprague, P.E., TRI's Senior Engineer provides technical oversight of all of TRI's erosion and sediment control testing and can be contacted at:

Mr. C. Joel Sprague, Senior Engineer
PO Box 9192, Greenville, SC 29604
Ph: 864/242-2220; Fax 864/242-3107; jsprague@tri-env.com

Mr. Sprague has been involved with the design of erosion and sediment control systems and the research, development, and application of erosion and sediment control products/materials for many years. He was the lead consultant in the development of bench-scale testing procedures for the Erosion Control Technology Council. Mr. Sprague has authored numerous technical papers on his research and is readily available to assist clients with their research and testing needs.

Operations Management

Sam Allen, TRI's Division Vice President provides operational management of all TRI laboratories and can be contacted at:

Mr. Sam Allen, Vice President & Program Manager
9063 Bee Caves Road
Austin, TX 78733
Ph: 512/263-2101; Fax: 512/263-2558; sallen@tri-env.com

Mr. Allen pioneered the laboratory index testing of rolled erosion control products (RECPs) and has been actively involved in the development and standardization of testing protocol and apparatus for more than 10 years. He set up and oversees TRI's erosion and sediment control testing laboratories. His oversight responsibilities include test coordination, reporting, and failure resolution associated with the National Transportation Product Evaluation Program (NTPEP) for RECPs.

Subcontract Laboratory Sample Testing

TRI/Environmental (TRI) subcontracts with leading, accredited analytical laboratories for some sample testing. Total Suspended Solids (TSS) testing and Oil and Grease (TPH/HEM) testing are performed by:

Shealy Environmental Services, Inc.
106 Vantage Point Drive
West Columbia, SC 29172
Ph: 803/791-9700; Fax: 803/791-9111