Large-Scale Sediment Retention Device Testing of FLEXSTORM PC / PC+ Inlet Filters for Total Petroleum Hydrocarbons (TPH) Removal at Various Flow Rates

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

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

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/PC+ Inlet Filters for Total Petroleum Hydrocarbons (TPH) Removal at Various Flow Rates (Log #2278-01-46)

Dear Mr. Ringenbach:

This letter report presents large-scale sediment retention device tests performed on the FLEXSTORM PC and PC+ sediment bags. The PC version is a 2-ply geotextile with a nonwoven inner liner and woven outer layer; a MyCelx skimmer pouch is used in the PC+ version. Oil retention effectiveness and removal rate based on total petroleum hydrocarbons (TPH) testing of effluent grab samples and captured oil measurements are reported. The data were developed for oil-laden runoff having a concentration of 243 mg/L. Generated results were used to develop the following effectiveness percentages for the tested materials:

Product Tested	Hydrocarbon Load	Ave Flow Rate GPM	TPH Removal	Oil Retention Efficiency
FLEXSTORM PC+	243 mg/L using 750 mL (1.45 lb) used motor oil + lube oil and Clean Water	19	99.04%	97.22%
FLEXSTORM PC		20	97.67%	91.61%
FLEXSTORM PC+		92	96.88%	99.11%

TRI is pleased to present this final report. 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

LARGE-SCALE SEDIMENT RETENTION DEVICE (SRD) TOTAL PETROLEUM HYDROCARBONS (TPH) TESTING REPORT

FLEXSTORM PC / PC+ Inlet Filters

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 to present oil-laden flow to an area inlet at varying flow rates. Effluent Grab Samples are taken at intervals for total petroleum hydrocarbons (TPH) laboratory analysis. Additionally, the oil collected in the SRD was measured. The results were compared to the calculated amount of oil in the associated upstream flow to quantify the effectiveness of the SRD in retaining the oils and to confirm TPH 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.

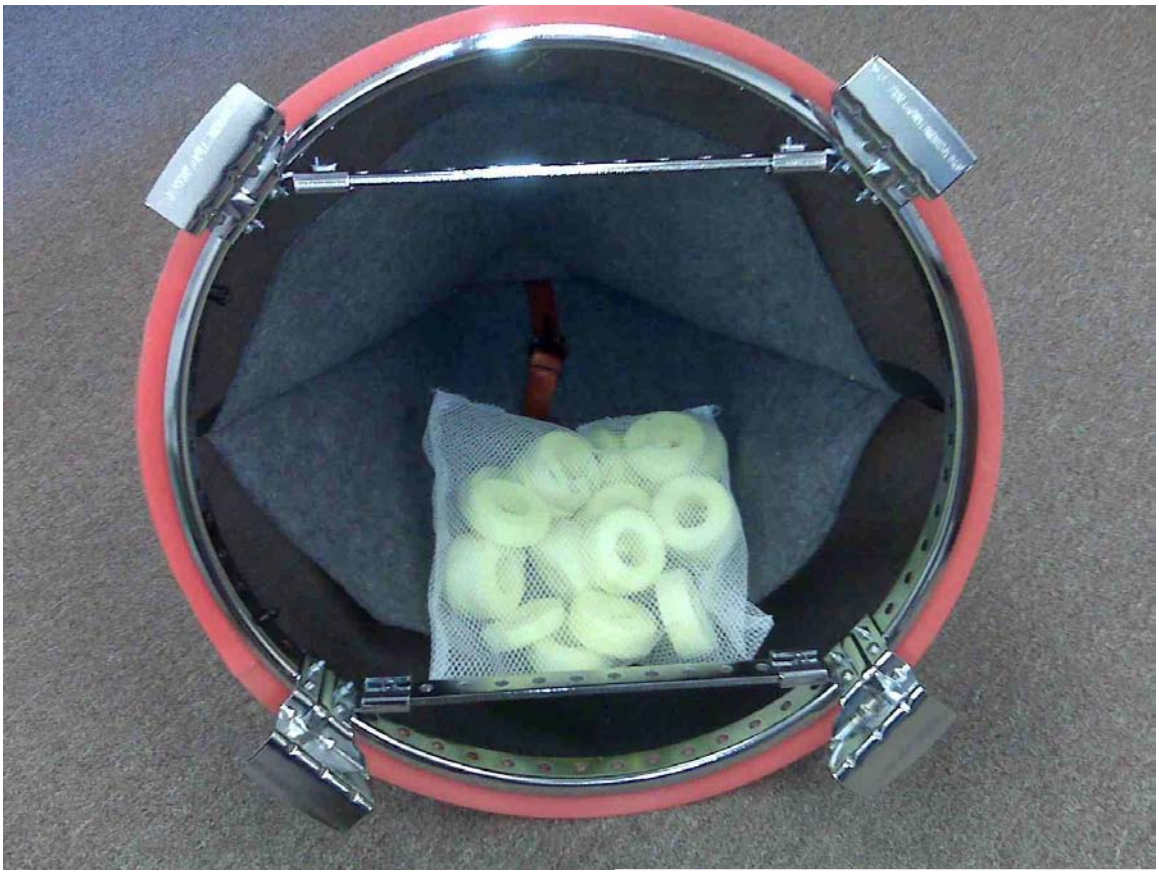
Sediment Retention Device (SRD)

The following table describes the tested SRD.

Table 1. Tested FLEXSTORM PC / 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	

NOTE: The PC+ Sediment Bag includes a skimmer pouch filled with 20-25 MyCelx impregnated snippets. A photo of the FLEXSTORM PC+ is shown in Figure 1.



FLEXSTORM PC+ INLET FILTER

Figure 1. FLEXSTORM PC+

Test Oil

The test oil used was a combination of 50% used motor oil and 50% lube oil

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 Oil-Laden Runoff - Oil-laden runoff was created by combining water and oil in the mixing tank and agitating during the test. 6000 lbs of water and 1.45 lbs of oil mix (750 mL) were combined to create the oil-laden runoff at a oil concentration of 243 mg/L. This concentration was determined to be consistent with "pavement runoff" conditions.

Controlling Flow - Flow was controlled by opening a valve to release water through an outlet pipe leading to the area inlet. Weight change in water leaving the hopper over time was used to confirm average flow rates. Three tests were performed at low, medium, and high flow rates, respectively. A new bag was used at the start of each test.

TEST SETUP

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

HOPPER WITH OUTLET PIPE LEADING TO AREA INLET

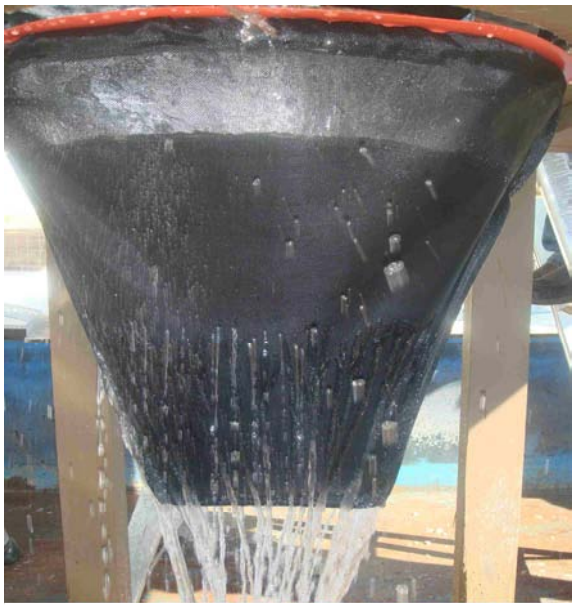
INSIDE VIEW OF HOPPER AGITATOR

AREA INLET SIMULATED SHOWING INFLUENT DISCHARGE FROM PIPE

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

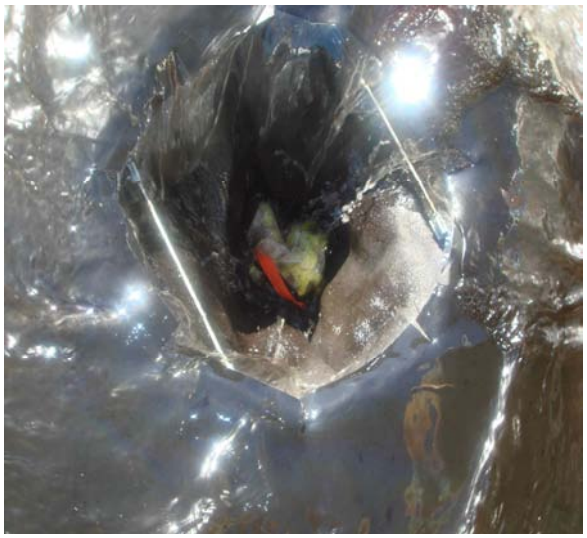
Test Procedure

Releasing and Collecting Oil-Laden Runoff - The oil-laden water was discharged at average flow rates of 19, 20, and 92 gallons per minute, respectively, in the three tests. Effluent grab samples were collected throughout the tests and the weight of water/oil discharged was recorded. Retention observations and associated times were recorded during the test.



EFFLUENT GRAB SAMPLES
TAKEN HERE

GRAB SAMPLE CONTAINERS



OIL LADEN RUNOFF ENTERING PC+ SEDIMENT BAG
THROUGH 24" DIAMETER OPENING

TEST RESULTS

Laboratory TPH analysis results of the effluent grab samples are shown in Table 2 below along with the percent removal rates. Total oil 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 TPH in the effluent grab samples. The oil captured captured was compared to the calculated oil discharged to quantify the oil retention effectiveness and the removal rate of the SRD.

Table 2. Measures of Effectiveness

Run:	E				F				G			
Oil Load:	750 mL (1.45 lb) used motor oil + 6000 lbs water											
Calculated Oil Concentration (mg/L):	243											
Flow Rate (lb/min):	160				168				767			
Flow Rate (gal/min):	19				20				92			
Product Tested:	FlexStorm PC+				FlexStorm PC				FlexStorm PC+			
	No.	Time, min	mg/L	% Removal	No.	Time, min	mg/L	% Removal	No.	Time, min	mg/L	% Removal
Samples (downstream):	E1E	1	1.4	99.42%	F1E	1	5.6	97.70%	G1E	1	8.5	96.50%
	E2E	2	1.9	99.22%	F2E	2	5.5	97.74%	G2E	2	8.1	96.67%
	E3E	3	3.2	98.68%	F3E	3	5.3	97.82%	G3E	3	7	97.12%
	E4E	4	2.8	98.85%	F4E	4	6.2	97.45%	G4E	4	7.9	96.75%
		5				5			G5E	5	6.4	97.37%
										5.5		
***Ave TPH Removal Rate (%):**	**99.04%**				**97.67%**				**96.88%**			
Calculated Water In (lbs):	800.0				840.0				4218.5			
Calculated Oil In (lbs):	0.19				0.20				1.03			
Oil Captured + Bag (lbs):	1.129				1.127				2.676			
Estimated Bag Wt. (lbs):	0.94				0.94				1.66			
Net Oil Captured (lbs):	0.189				0.187				1.016			
Oil Retention Effectiveness	97.22%				91.61%				99.11%			
Total Calculated Oil In (lbs):	1.424											
Total Oil Captured (lbs):	1.392											
Total Oil Retention Effectiveness (%):	97.78%											

*Oil and Grease TPH was measured in accordance with EPA 1664A

APPENDIX A – 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