Home
Applications
Endorsements
Test Data
Our Team
News
Contact Us
UltraTech

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Oil Sorption Properties of X-TEX vs. Polypropylene for Storm water Catch Basin Inserts

Introduction- Both industry and municipalities are increasingly utilizing storm water basin inserts as a best management practice (BMP) control for storm water runoff pollution control. The inserts are closest to "point of origin" and in many cases the only line of defense for protecting our waterways from secondary pollution sources. The storm water inserts used today are devices that are installed into catch basins to help reduce pollutants that are washed off automobile parking lots, roadways, etc. These inserts must be strong enough to withstand the physical abuse of the environment and the introduction of up to several pounds of sediment (1). The oil adsorption capabilities and physical properties of the inserts must not significantly degrade for many months after installation to insure limited maintenance and assure cost effectiveness.

Most catch basin inserts in use today are constructed of "virgin" polypropylene material, which has an oil and grease removal efficiency of 78 to 87 percent (2,3). No "recycled" adsorptive material was found that had the same or better adsorbent abilities and physical properties as polypropylene based materials…..until now. Now a new textile has been successfully developed from a blended bulk fiber media derived from "recycled polymeric waste". This textile "blanket" has superior oil adsorption and absorption, physical attributes that withstand the rigors of the environment and is cost effective. The textile blanket and blended fiber material are registered under the trade name Xextex (patent pending). **X-TEX** gives engineers, designers and manufactures an innovative recycled material for their storm water inserts. **X-TEX** is currently being used successfully in storm water filtering systems for the removal of free oil and grease, and many types of emulsified oils as found on construction sites and in truck washing facilities.

The following tests compares the oil and grease adsorption properties and capacity of polypropylene 225EX material and the **X-TEX** Blanket material. Both materials are similar in weight per volume basis. An equal size and weight of each material was used.

Method- A test apparatus was designed to evaluate the insert performance and absorbance/adsorbance of **X-TEX** and polypropylene. A 9 by 12 inch drain frame was assembled using heavy plastic strips. Each test material was cut into a 14 by 18 inch rectangle that allowed for a 4-inch deep pocket to be formed for the introduction of the effluent oil stream. The insert material was clamped between the plastic frame and PVC pipe was used to deliver a constant water flow of 10 liters per minute. The end section of the pipe was perforated to allow even distribution of water over the entire length of the test area pocket.

A mixture of 50 percent used motor oil and 50 percent diesel was injected into the PVC delivery pipe using a metering pump. The oil was metered into the influent stream at one gram per minute, and the flow rate was held constant at 10 liters per minute, yielding a 100 mg/l influent waste stream. Although this concentration is much higher than actual environmental field conditions, the amount of oil effluent was sufficient to measure a break-through point of each material.

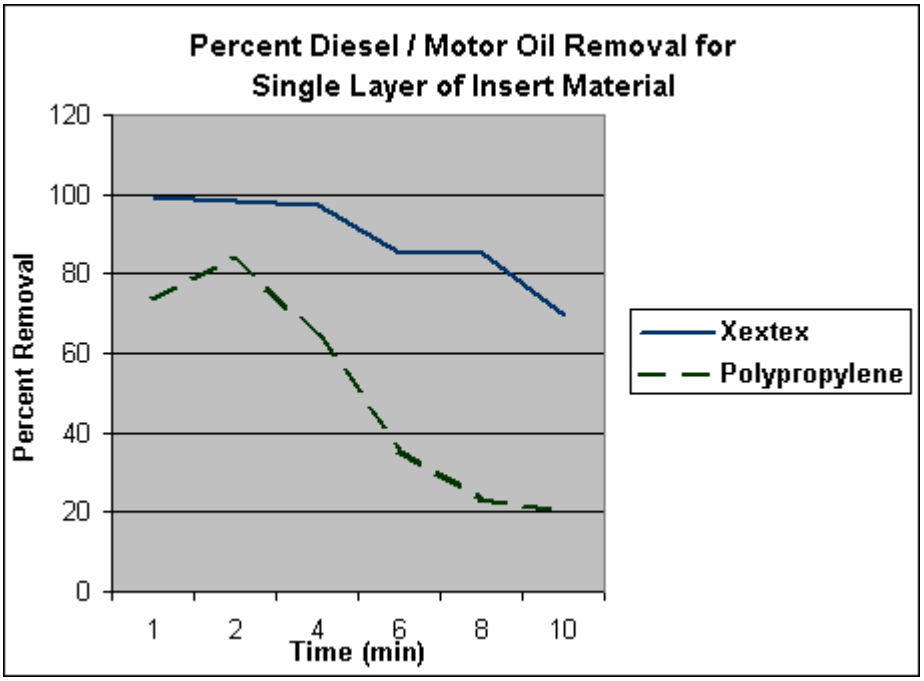
The two materials were tested at both a single and a double thickness at high concentrations to determine if additional removal efficiencies could be improved by using more material. Each material tested was exposed to a total of a 10-minute flow of oil/water effluent. Samples were collected at 1,2,4,6,8 and 10 minute intervals of filtering. A total of 10 grams of oil was discharged with 100 liters of water for each test. The oil/water effluent passed through both materials for all tests without collecting or pooling. Samples were analyzed using EPA 418.1 method for total petroleum hydrocarbons.

Results- The results from this bench test demonstrate that the **X-TEX** Blanket out performs the polypropylene material substantially for the single layer and double layers of material.
For the single layer the polypropylene break-through of the effluent occurred just after two minutes of testing with a drop from 84% to 64% removal rate. The **X-TEX** material maintained a high percent of removal until break-through between the 9th and 10th minutes of the test when the removal rate dropped from 85 % to 69 %. There was no break through for the two layered **X-TEX** material or the polypropylene textile under the test conditions. Table 1 summarizes these results, and Graph 1 shows these test results in percentages.

Diesel / Motor Oil Removal from Water – Polypropylene Textile vs. X-TEX Blanket

Table 1	Amount of Diesel/Oil Added		Amount of Diesel/Oil Removed (ppm)		Amount of Diesel/Oil Removed (percent)	
Time (min)	Total (grams)	Oil/Water (ppm)	PPL Insert	X-TEX	PPL Insert	X-TEX
1	0.88	88	65	87	74	99
2	1.76	88	74	87	84	99
4	3.52	88	56	86	64	97
6	5.28	88	31	75	36	85
8	7.04	88	20	75	23	85
10	8.8	88	17	61	20	70

Graph 1- Percent of removal for single layer test



Conclusions- The test data illustrates that the polypropylene textile material initially retains about 80% of the oil/diesel blend while the X-TEX Blanket retains virtually 100% of the oil from the influent waste stream. With a 10-gram total oil influent load, the polypropylene textile removed 6.0 grams of oil and allowed 4.0 grams of oil into the effluent stream, resulting in a 60% oil removal rate for the entire test. The X-TEX blanket removed 9.0 grams and allowed 1.0 gram of oil to pass through removing 90% of the total oil.

Oil breakthrough / saturation for the polypropylene textile occurred after 2 grams of oil/diesel had been retained. For the X-TEX blanket the breakthrough / saturation point was after 8 grams of oil retention, indicating an oil retention capacity four times greater.

The actual adsorption area was restricted to a 4 x 8 cm. area representing the effluent flow at the low point of the insert pouch. This effluent point will shift as sediment excludes exit sites in real-world inserts, and the oil adsorption capacity will extend to the entire insert surface area, greatly increasing the inserts total capacity. The oil/diesel influent concentrations used in these tests were intentionally high and were meant to determine an insert materials capacity, not simulate real world conditions.

Test Conducted by: Brent Hepner, Vice President and Director of Product Development, The Xextex Corporation USA, Assisted by Tom Coyner Technical Director for Product Design, The Xextex Corporation USA.

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Home Applications Endorsements Test Data Our Team News Contact Us UltraTech

Adsorption/Absorption Capacity: Motor Oil and Vegetable Oil

Introduction- Tests were performed on **X-TEX** sorbent media to determine its capacity to sorb oils.

Method- The tests were performed using guidelines described in ASTM method F726-81, "Sorbent Performance of Adsorbents". This test method measures the maximum adsorption of oils and floating immiscible liquids. The materials tested were representative samples of **X-TEX** bulk material. The oils used were 30W motor oil and a liquid vegetable oil. Three replicates were performed for each type of oil.

Results

Table 1 – Vegetable Oil

Replicates	Xextex (gm)	Oil (gm)	Oil/Xextex
Xextex Bulk 1	3.71	59.65	16.1x
Bulk 2	3.45	59.25	17.2x
Bulk 3	4.03	71.53	17.7x

Table 2 – Motor Oil – 30W

Replicates	Xextex (gm)	Oil (gm)	Oil/Xextex
Xextex Bulk 1	3.44	70.17	20.4x
Bulk 2	3.3	72.33	21.9x
Bulk 3	3.46	69.1	20.0x

Conclusions- The bulk material adsorbed 17 times its weight in vegetable oil and 21 times its weight in motor oil.

♻ Xextex products are recycled.

Home
Applications
Endorsements
Test Data
Our Team
News
Contact Us
UltraTech

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Xextex Oil Retention Study

Introduction- One proposed use for **X-TEX** media is as a filter/sorbent in stormwater catch basin inserts. Previous studies have shown this product's excellent ability to filter and adsorb petroleum hydrocarbons from water on contact. It is also important that any material used have the ability to retain adsorbed hydrocarbons thru intermittent dry weather periods. Potential users requested a study to determine **X-TEX's** ability to retain adsorbed hydrocarbons.

An oil retention study was conducted using **X-TEX** filter/sorbent media and a sorbent media (granulated reactive polymer) currently preferred for this use. The study was designed to measure and compare oil loss from each of the media after alternating periods of water flushing and drying.

Method- 20 grams of each media was weighed and placed into a filter apparatus. 10 grams of used motor oil was poured into each media. A high oil to media ratio was purposely used to increase the chances for measurable oil loss. After five minutes each filter was flushed with one liter of water. This flushing was repeated at measured intervals from one hour to three days. The flush waters from each interval were analyzed in accordance with EPA Method 413.1 to determine the weight of any oil rinsed from the filters. The results of these analyses are presented in Table 1.

10 grams Motor Oil Initial Loading

Table 1	Flushed Oil (weight in grams)		Flushed Oil (percent)	
Time	X-TEX	Reactive Polymer	X-TEX	Reactive Polymer
5 min.	0.014	0.609	0.2	6.1
1 hr.	0.003	0.048	< 0.1	0.5
2 hr.	0.007	0.007	< 0.1	0.1
6 hr.	0.001	0.005	< 0.1	0.1
1 day	0.003	0.003	< 0.1	< 0.1
2 days	< 0.001	0.002	< 0.1	< 0.1
3 days	< 0.001	0.001	< 0.1	< 0.1
TOTAL	0.029	0.675	0.3	6.8

Conclusions- Given the extreme test conditions, both products retained oil well after the first hour. The "reactive polymer" released a substantial amount in the first hour, which may be the time required to complete the media/oil reaction. Oil adsorption to the **X-TEX** media was almost immediate. After one day the percent of oil flushed from either media was less than measurable.

Total oil flushed: **X-TEX** – 0.03 gm; "reactive polymer" – 0.7 gm