Environmental Solutions

X-TEX™ ***is a highly efficient, lipophilic lightweight fiber matrix that adsorbs an average of twenty times its weight of hydrocarbons or vegetable oils yet allows large volumes of water to pass through.*** This report examines **X-TEX's** superior performance in filtering and absorbing numerous chemicals and compounds.

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X-TEX is a new and unique lipophilic media with a multitude of potential environmental applications. X-TEX is produced from *recycled* synthetic fibers. Utilizing state-of-the-art technology, these fibers are blended and processed into a lightweight fiber mass with enormous surface area and interstitial spaces creating a high performance sorbent and filter media*. Our fiber blend is also utilized in our X-TEX Rolled Fabric, designed for use as a durable long lasting geo-textile and filter media

- Because of X-TEX's selective affinity for *lipophilic ("oil attracting")* it is very efficient in removing hydrocarbons from water.
- X-TEX excels as a spill removal media capable of sorbing liquid hydrocarbons, including petroleum, animal and vegetable oils onto its vast fiber mass surfaces and into process-created interstitial spaces.
- When used as a filter medium, water passes freely, while adsorption of target hydrocarbons begins on contact. X-TEX is extremely efficient due to the enormous lipophilic surface area of the altered fibers.
- X-TEX works well as a fibrous supporting matrix for other water conditioning materials such as selective zeolites, activated carbon, zero-valent iron filings, etc. X-TEX can be 'conditioned' to remove specific chemical compounds.
- X-TEX is cost effective in comparison to many conventional filtering media, adsorbing/absorbing an average of 20 times its own weight of liquid hydrocarbons.
- Approximately 85-90 % of sorbed oils can be reclaimed from X-TEX and the media reused.
- In bench-scale testing, X-TEX has shown promising results in filtering out emulsified oils and hydrocarbons out of a water stream. This characteristic creates opportunities for the use of X-TEX in oil/water separation applications and other hydrocarbon filter projects.
- X-TEX forms into cohesive mats or "wads" which can easily conform to various applications or filter devices.
- X-TEX is environmentally benign and user-friendly. It does not leach harmful substances into the environment and when incinerated produces minimal residue or ash.
- Choose either the exceptional X-TEX Bulk Fibers or our high performance X-TEX Rolled Fabric for the same stellar performance and results!

Please call for more information on specific applications, field and laboratory test results.

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X-TEX Rolled Fabric

Finally….one solution for a multitude of environmental problems. Wet or dry, a durable sorbent filter media and geo-textile in one product. X-TEX high performance Rolled Fabric will help reverse the effects of pollution. Produced from our cutting edge X-TEX recycled fiber blend* X-TEX Rolled Fabric has environmental problems *covered and solved!*

1. Adsorption: Sorbs on contact allowing water to pass through while retaining hydrocarbon pollutants and many additional compounds.

2. Savings: Produced from our recycled fiber blend so sorbed oils can be reclaimed and the Fabric can be reused. Idea: Existing booms can be retrofitted with the Fabric, saving expensive replacement costs. One product does it all, thus reducing inventories.

3. The Ultimate in Ground Cover and Run-Off Protection: Flexible, conforming easily to uneven surfaces such as shorelines, streambeds, rough terrain, rock formations, over and around machinery and piping. Exceptionally ideal for storm drain insert and geo-textile applications.

4. Versatile: Equally efficient wet or dry, use only what you need. Use as a filter media or as a ground cover. The Rolled Fabric can be made into pads for quick and easy clean ups.

5. Control: Extremely useful in erosion control where hydrocarbon pollutants are present and endangering the environment. Simple to use, easy to handle and completely safe for the environment.

X-TEX Rolled Fabric does it all more thoroughly and for far less cost than typical polypropylene products and unlike polypropylene allows water to flow through it while retaining hydrocarbon pollutants.

*Patent Pending

Details On Use Of X-TEX
As A Filter Media

X-TEX is a highly efficient and lipophilic lightweight fiber matrix that adsorbs an average of twenty times its weight of hydrocarbons or vegetable oils. In aqueous media, compounds are preferentially adsorbed on contact for efficient, rapid removal. The material is lightweight, resilient, durable and formable to various filter shapes. It remains cohesive while in liquids. Tests indicate that the majority (85 to 90% for motor oil) of adsorbed liquid hydrocarbons can be mechanically reclaimed and the X-TEX media recycled with little loss of sorbent efficiency. Hydrocarbons adhere to X-TEX and are not displaced by water. The following are descriptions of bench tests and actual field tests conducted with X-TEX*. The tests include:

- **Adsorption/Absorption Capacity of Motor Oil and Vegetable Oil**
- **Adsorption of Motor Oil/Diesel Fuel Mixture from Water**
- **Truck Wash Wastewater Filtration**
- **Removal of Emulsified Oil Using X-TEX**
- **PAH Removal**
- **Oil Retention Study**
- **X-TEX and the Competition**
- **X-TEX Sorbent's Potential Environmental Impact**
- **Residual Ash and BTU Values**
- **Oil Sorption Properties of X-TEX vs Polypropylene for Stormwater Catch Basin Inserts**

*Tests to validate the performance of X-TEX sorbent material were performed by Sound Analytical Services, Inc. Tacoma, WA using USEPA and ASTM standard laboratory methods when applicable.

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 Fibers. 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	X-TEX (gm)	Oil (gm)	Oil / X-TEX	
X-TEX Bulk 1	3.71	59.65	16.1x	
Bulk 2	3.45	59.25	17.2x	
Bulk 3	4.03	71.53	17.7x	17x

Table 2 – Motor Oil – 30W

Replicates	X-TEX (gm)	Oil (gm)	Oil / X-TEX	
X-TEX Bulk 1	3.44	70.17	20.4x	
Bulk 2	3.3	72.33	21.9x	
Bulk 3	3.46	69.1	20.0x	20.8x

Conclusions

The X-TEX Bulk Fibers *adsorbed 17 times its weight in vegetable oil and 21 times its weight in motor oil.*

Adsorption of Motor Oil/Diesel Fuel Mixture from Water

Introduction

One proposed use for X-TEX media is as a sorbent for use in the removal of petroleum hydrocarbons from water after accidental spills or releases. To better determine the value of X-TEX as a media for this use a quantitative testing procedure was designed.

Method

X-TEX and a highly rated competing sorbent material (granulated reactive polymer) were tested to determine the uptake of a motor oil/diesel fuel mix from water. Precleaned sample containers were filled with 200 ml of water and 10 grams of motor oil/diesel fuel mix. A preweighed sample of sorbent was added to each container and allowed to sorb. The sorbent was then removed and the contents of each jar were analyzed to determine the weight of motor oil or diesel fuel remaining. The graph below illustrates the results.

Results

Absorbant Weight(g)	50/50 Oil/Diesel Added To Water	Residual Oil After Placing Material In Water	Percent Oil Adsorbed
0.25	10	1.7524	82.48
0.5	10	0.3623	96.38
1	10	0.2905	97.05
2	10	0.2264	97.74
4	10	0.2447	97.55
6	10	0.2308	97.69
8	10	0.2532	97.47
10	10	0.2976	97.03
20	10	0.2136	97.86

Rubber Particulate

Conclusions

Addition of 0.5 grams of X-TEX sorbent material removes more than 96% of the oil/fuel mix. The competing product requires 8.0 grams to achieve the same uptake of oil/fuel mix. With the addition of 0.25 grams the X-TEX material reaches saturation, but *removes more than 32 times its weight of the petroleum*. The saturation point for the competing product occurs at approximately 3.6 times its own weight in oil.

Other differences were observed in the experiment as well. The *X-TEX sorbent adsorbed the oil almost immediately on contact*, while the "reactive polymer" sorbent required several minutes to equilibrate before its maximum saturation was reached. When small amounts of the competing material were added, removal of the saturated material was difficult because the material did not clump or mat together. The X-TEX sorbent was cohesive and removed the fuel/oil mix with little difficulty.

Truck Wash Wastewater Filtration

Introduction

Initial laboratory studies show X-TEX sorbent to be very efficient in selectively adsorbing / absorbing petroleum and vegetable-derived hydrocarbons from water. This work was done using laboratory prepared and controlled test solutions. This test demonstrates X-TEX's sorbent effectiveness by testing real-world samples. Real-world samples measure not only the ability of the filter material to remove the pollutants of interest, but also to handle water that contains floating and dissolved hydrocarbons, emulsifiers and detergents, as well as debris that might affect filter performance.

Method

The environmental manager of a local lumber mill provided a five gallon sample of effluent from a logging truck wash station. The sample was thoroughly mixed and split into two sub-samples. One sub-sample was tested to determine suspected organic and inorganic pollutants. The other sub-sample was passed through a filter system using X-TEX filter media and the filtered water was analyzed for the same pollutants. The analyses were performed by a fully accredited environmental laboratory using current U.S. EPA methods recommended for determining these compounds.

Results

Truck Wash Effluent – Unfiltered / Filtered

Client ID	Method #	Parameter	Result Unfiltered	Result Filtered	Detection Limit	Units
Effluent 1/22/01	EPA 1664	Oil & Grease	>1000	6	5	ppm
Effluent 1/22/01	EPA160.2	Total Suspended Solids	230	10	5	ppm
Effluent 1/22/01	NWTPHDX	#2 Diesel Fuel	910	3.4	0.2	ppm
Effluent 1/22/01	NWTPHDX	Motor Oil	15000	3	0.4	ppm
Effluent 1/22/01	EPA 6020	Arsenic	ND*	ND*	0.006	ppm
Effluent 1/22/01	EPA 6020	Cadmium	0.0018	ND*	0.0005	ppm
Effluent 1/22/01	EPA 6020	Chromium	0.013	0.0044	0.001	ppm
Effluent 1/22/01	EPA 6010	Copper	0.077	ND*	0.01	ppm
Effluent 1/22/01	EPA 6010	Lead	0.011	ND*	0.01	ppm
Effluent 1/22/01	EPA 6020	Nickel	0.0032	0.0082	0.001	ppm
Effluent 1/22/01	EPA 6010	Zinc	2.1	0.85	0.01	ppm

*ND – not detected at or above the method detection limit

Conclusions

As can be seen in the table above, X-TEX *sorbent was highly effective in removing organic pollutants and suspended solids* from the sample. Especially notable is the reduction in oil and grease, diesel and motor oil between the filtered and unfiltered samples.

Removal of Emulsified Oil Using X-TEX

Introduction

Oil-water emulsions, where the oil is so dispersed that the water becomes translucent is one of the most difficult industrial effluents to treat. Because the oil is partially dissolved, many filtration products and sorbents are completely ineffective. Tests of effluent from Cascade Hardwood Corporation, a local company that operates a vehicle washing facility, had indicated that X-TEX sorbent material works well for emulsified oils. A series of experiments were performed to further determine the ability of X-TEX to remove the emulsified oil component in an effluent stream.

Method

An emulsified stock solution was made by adding 5.0 ml of used motor oil and 5.0 ml of diesel fuel to 200 ml of water. Ten mls of citrus-based degreaser was added as an emulsifying agent and mixed vigorously. From the emulsified-oil stock solution, three different concentrations of emulsified oil-water mix were tested:

- Low – 1.0 ml of stock solution into 1.0 liter of water
- Medium - 10 ml of stock solution into 1.0 liter of water
- High - 100 ml of stock solution into 1.0 liter of water

A 15cm by 6cm diameter cylinder filter housing was constructed for this test and filled with 20 grams of bulk X-TEX. The filter media was wetted prior to the start of the test. The test solution was run through the filter at a rate of 500 ml per minute and the first filtrate was discarded. An additional portion of the test solution was filtered and a sample was taken. Unfiltered and filtered samples were analyzed using EPA Method 418.
EPA Method 418 is an oil and grease analysis that measures hydrocarbons as well as fatty soaps. The samples were extracted and a silica gel cleanup was performed. This cleanup step removes fatty acids and soaps from the sample, leaving the diesel and motor oil components to be measured.
Standard solutions were made using motor oil.

Results

The results from these tests confirmed that X-TEX can dramatically reduce the emulsified oil portion in an effluent stream. Table 1 summarizes the results of these tests.

Table 1 - Summary of Results

Sample	Result (ppm)	Percent Oil Removal
Low Level (before X-TEX)	**24**	
Low Level (after X-TEX)	**3.2**	**87%**
Med Level (before X-TEX)	**140**	
Med Level (after X-TEX)	**7**	**95%**
High Level (before X-TEX)	**960**	
High Level (after X-TEX)	**24**	**97%**

continued…

Conclusions

At the medium and high levels X-TEX removed greater than 90 percent of the oil. Competing products that remove floating oil have generally proven ineffective with partially dissolved or emulsified oil. The potential use of X-TEX sorbent material where emulsified oils exist include:

- Vehicle wash facilities
- Bilge water
- Petrochemical and Refineries wastewater
- Ocean oil drilling platform process water
- Tank ballast water, de-oiling
- Retrofitting existing oil water separators on existing pollution prevention equipment (final polishing)
- Food processing effluent discharge

Polynuclear Aromatic Hydrocarbons Removal

Introduction

There are many groundwater remediation projects throughout the country that have contamination from polynuclear aromatic hydrocarbons (PAH's). Tests have shown that PAH's can be removed efficiently through filtering with X-TEX. Laboratory generated samples containing varied amounts of PAH compounds, plus actual samples from a pentachlorophenol-contaminated site, were tested using X-TEX media with dramatic results.

Method

Sound Analytical Services created spiked blanks containing low-levels of PAH's. Twenty grams of X-TEX were placed into a filter device and one of the samples was poured through the filter. Both samples were then analyzed for PAH compounds using USEPA method 8270.

Results

The results from the PAH tests are tabulated below (Table 1). X-TEX removes more then 95 % of the carcinogenic PAH's.

Table 1 - PAH /Removal From Water

Analyte	Unfiltered (ppb)	Filtered (ppb)	% Removal
Benzo(a)anthracene	16	0.18	98.9
Chrysene	16	0.14	99.1
Benzo(b)fluoranthene	16	0.32	98.0
Benzo(k)fluoranthene	16.5	0.28	98.3
Benzo(a)pyrene	21	0.36	98.2
Indeno(1,2,3-cd)pyrene	20	0.54	97.3
Dibenz(a,h)anthracene	21.5	0.3	98.6
Benzo(g,h,i)perylene	18.5	0.38	98.0

Conclusions

X-TEX provides an effective means of removing contaminants from groundwater and industrial effluent, with efficiencies greater than 95 %. X-TEX works efficiently for low-level samples, and has the capacity to treat high-level samples.

X-TEX 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.

Table 1 – 10 grams Motor Oil Initial Loading

	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.

X-TEX and the Competition

Introduction

One of the most frequently asked questions about X-TEX is, "how does it compare with other sorbent products on the market?"
The answer is, "Fantastic! In fact our lipophilic and media surpass the competition in adsorbent ability and the following test data backup our claims".
A study was performed by an outside laboratory to compare the adsorbent properties of X-TEX to several popular adsorbents on the market.
X-TEX's adsorption capability was compared to leading polypropylene bulk material used as filter media and in sorbent pillows, oil pads (shredded), and the rubber particulate.
The competitor's pad was shredded to obtain a comparable surface area to that of the X-TEX Bulk Fibers.

Method

10 Grams of used motor oil was suspended in 300 mls of water in each of 15 - 500 ml beakers. Exact amounts of X-TEX and the competitions media were introduced to individually marked beakers. In each beaker the adsorbent material was stirred for 30 seconds to assist contact with all of the oil. Four different weights for the material were used: 5.0, 1.0, 0.5 and 0.25 grams. Care was taken to minimize contact of the oil to the sides of the glass jar. The remaining oil in the jars was extracted and gravimetrically measured.

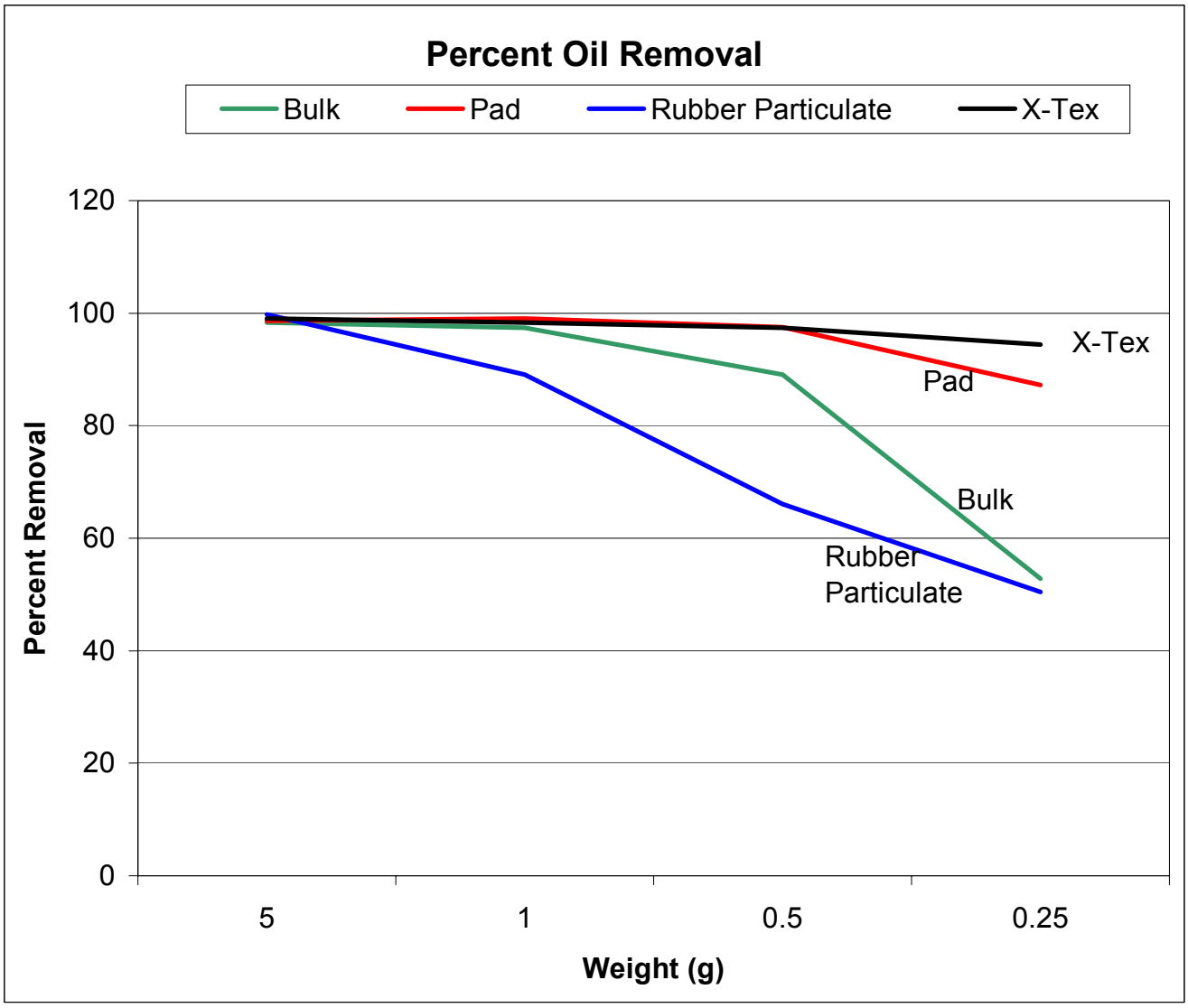
Results

The results demonstrate that X-TEX's oil adsorbent media has a greater capacity by weight than the competition. The percent removal of oil by all materials tested are contained in a table below:

Using 10 grams of oil **Percent Removed**

Weight of Media (g)	Bulk	Pad	Rubber Particulate	X-TEX
5.0	98.3	98.6	99.8	99.0
1.0	97.4	99.0	89.1	98.3
0.5	89.1	97.5	66.1	97.4
0.25	52.8	87.2	50.4	94.4
Combined average:	84.4	95.6	76.4	97.3

The table shows that all the materials adsorb very well, at a 1 to 2 ratio of media to oil. As expected, performance suffers as the amount of media decreases. The X-TEX oil adsorbent capacity excels below a 1 to 10 ratio of media to oil. The chart on the next page graphically demonstrates this claim.



Conclusion

This test demonstrates that a little X-TEX goes a long way, much further than other products. What does this test mean to you? It means three things: *saving the environment, saving labor and saving money*.

X-TEX Sorbent's Impact on the Environment

Introduction

Sorbents used in the environment should be environmentally benign. A standard test of potential environmental harm is the *Toxicity Characteristics Leachate Procedure (TCLP test)*, which measures the concentration of chemicals of concern released into the environment from solid substances.

Method

X-TEX sorbent material was submitted to an analytical laboratory with NELAP (National Environmental Laboratory Accreditation Program) accreditation for the full suite of TCLP analyzes. The results of the tests are summarized below.

Results

Volatile Organic Compounds / EPA Method 1311 / 8260B

Parameter	Result	Detection Limit	Units	Maximum Contaminant Level
Vinyl Chloride	ND	0.2	mg/L	0.2
1,1-Dichloroethene	ND	0.2	mg/L	0.7
2-Butanone	ND	1	mg/L	200
Chloroform	ND	0.2	mg/L	6.0
Carbon Tetrachloride	ND	0.2	mg/L	0.5
Benzene	ND	0.2	mg/L	0.5
1,2-Dichloroethane	ND	0.2	mg/L	0.5
Trichloroethene	ND	0.2	mg/L	0.5
Tetrachloroethene	ND	0.2	mg/L	0.7
Chlorobenzene	ND	0.2	mg/L	100

RCRA Metals / EPA Method 1311 / 6010 / 7470

Parameter	Result	Detection Limit	Units	Maximum Contaminant Level
Arsenic	ND	0.2	mg/L	5.0
Barium	0.25	0.005	mg/L	100
Cadmium	ND	0.05	mg/L	1.0
Chromium	ND	0.01	mg/L	5.0
Lead	ND	0.1	mg/L	5.0
Selenium	ND	0.5	mg/L	1.0
Silver	ND	0.2	mg/L	5.0
Mercury	ND	0.002	mg/L	0.2

continued…

Chlorinated Pesticides / EPA Method 1311 / 8081

Parameter	Result	Detection Limit	Units	Maximum Contaminant Level
gamma-BHC (Lindane)	ND	0.001	mg/L	0.4
Heptachlor	ND	0.001	mg/L	0.008
Heptachlor epoxide	ND	0.001	mg/L	0.008
Endrin	ND	0.002	mg/L	0.02
Methoxychlor	ND	0.01	mg/L	10
Chlordane (technical)	ND	0.01	mg/L	0.03
Toxaphene	ND	0.1	mg/L	0.5

Chlorinated Herbicides / EPA Method 1311 / 8151

Parameter	Result	Detection Limit	Units	Maximum Contaminant Level
2,4-D	ND	0.001	mg/L	10
Silvex (2,4,5-TP)	ND	0.001	mg/L	1.0

Semivolatile Organic Compounds / EPA Method 1311 / 8270C

Parameter	Result	Detection Limit	Units	Maximum Contaminant Level
1,4-Dichlorobenzene	ND	0.005	mg/L	7.5
2-Methylphenol	ND	0.005	mg/L	200
3- & 4-Methylphenol	ND	0.005	mg/L	200
Hexachloroethane	ND	0.005	mg/L	3.0
Nitrobenzene	ND	0.005	mg/L	2.0
Hexachlorobutadiene	ND	0.005	mg/L	0.5
2,4,6-Trichlorophenol	ND	0.005	mg/L	2.0
2,4,5-Trichlorophenol	ND	0.005	mg/L	400
2,4-Dinitrotoluene	ND	0.005	mg/L	0.13
Hexachlorobenzene	ND	0.005	mg/L	0.13
Pentachlorophenol	ND	0.005	mg/L	100
Pyridine	ND	0.005	mg/L	5.0

Conclusions

All parameters were well below the limits required by the test, showing that the X-TEX sorbent material does not contribute to pollution of the environment.

Residual Ash and Heating Value

Samples of the X-TEX sorbent material were tested to determine the residue and the heating value. The ash was determined to 0.65% by ASTM method D482 and the heating value was determined to be 7600 BTU/lb by ASTM method D240.

Oil Sorption Properties of X-TEX vs Polypropylene for Stormwater Catch Basin Inserts

Introduction

Both industry and municipalities are increasingly utilizing stormwater basin inserts as a best management practice (BMP) control for stormwater 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 stormwater 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 "Rolled Fabric" has superior oil adsorption and absorption, physical attributes that withstand the rigors of the environment and is cost effective. The textile Rolled Fabric and blended fiber material are registered under the trade name X-TEX *(patent pending).*

X-TEX gives engineers, designers and manufactures an innovative recycled material for their stormwater inserts. X-TEX is currently being used successfully in stormwater 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 Rolled Fabric 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 Rolled Fabric 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.

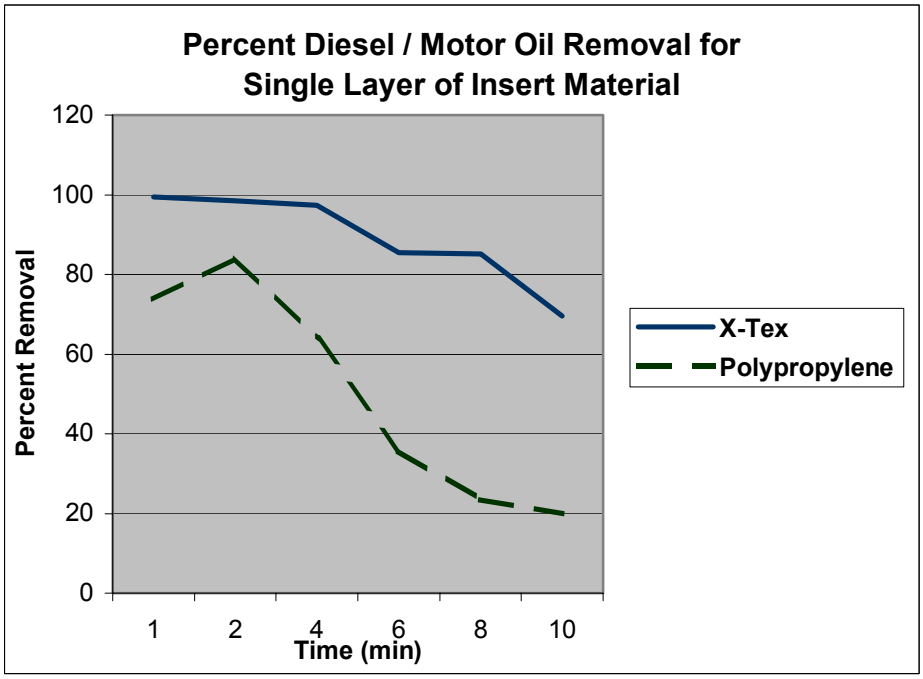
Diesel / Motor Oil Removal from Water – Polypropylene (PPL) Textile vs. X-TEX Rolled Fabric

	Amount of Diesel / Oil Added		*Amount of Diesel / Oil Removed (ppm)*		*Amount of Diesel / Oil Removed (percent)*	
Time(min)	Grams / Total	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**

Table 1

Percent of removal for single layer test

Graph 1



Conclusions

The test data illustrates that the polypropylene textile material initially retains about 80% of the oil/diesel blend while the X-TEX Rolled Fabric 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 Rolled Fabric 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 Rolled Fabric 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.

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