

**RECOVERIT
SORBENT TESTING
PROJECT NUMBER: SOR-01-059**

FINAL REPORT
ENVIRONMENTAL TECHNOLOGIES PROGRAM



SAIC Canada
*Science Applications International
Corporation (SAIC Canada)*

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Table Of Contents

Introduction	1
Objective	1
Procedures	1
Materials and Equipment	1
Sorbent Description	1
Test Liquids	1
Equipment	2
Test Protocol	2
The Dynamic Degradation Test	2
The Oil Adsorption - Short Test (15 minutes)	3
The Oil Adsorption - Long Test (24 hours)	3
Results and Discussion	4
The Dynamic Degradation Test	4
The Oil Adsorption - Short Test	4
The Oil Adsorption - Long Test	4
Conclusions	5
Appendix A - Test Data Sheets	6

Introduction

SAIC Canada's Environmental Technologies Program is under contract to provide ongoing support and services to Environment Canada. As part of this support, a Sorbent Testing Program has been developed which offers manufacturers and distributors the ability to have their products tested, and the results made available in a database which is accessible to end users. In conjunction with its research partners, SAIC Canada plays an active role in the development of standards for evaluating response equipment as well as conducting product testing.

Objective

The purpose of these tests was to evaluate the sorbent's performance as per the Environment Canada Sorbent Performance Test Program, using ASTM Standard Method of Testing Sorbent Performance of Adsorbents (F726-99). This protocol is based, in part, upon test methods listed in the Canadian General Standards Board - Method for Testing Sorbents (CAN/CGSB-183.2-4), and internal standards initially developed in part by the Emergencies Engineering Technologies Office (formerly the Emergencies Engineering Division) of Environment Canada.

Procedures

Materials and Equipment

Sorbent Description

The following brief description of the sorbent is based on information supplied by the manufacturer and from the quantitative and qualitative observations obtained during testing. Such information is provided since it may be useful when interpreting or comparing results.

The Recoverit sorbent supplied for testing is described as a granular (non-metallic) material. Two samples of the sorbent particulate were received, one fully white and the other with a coloured fleck (indicated as being for safety reasons - made for defence and government departments only). The coloured fleck sample was used for testing purposes - having a measured density of approximately 0.090 g/cm³.

Test Liquids

The following test liquids were used:

Test Liquid	Density (g/cm ³)	Viscosity (cP)	Temperature (°C)
Diesel	0.829	3	20
Light Crude Oil	0.944	290	20
Heavy Crude Oil	0.995	2050	20

Equipment

The following apparatus was used to measure physical and chemical properties of the sorbent and/or test liquids.

Density	Anton-Paar DMA 35 hand-held digital densitometer. The unit contains a borosilicate U-shaped oscillating tube and a system for electronic excitation, frequency counting and display. An injected sample volume is kept constant and is vibrated. The density is calculated based on a measurement of the sample oscillation period and temperature. Replicate measurements are conducted and the average density is reported.
Viscosity	Brookfield DVII+ viscometer powered by a precision motor and equipped with a beryllium copper spring to measure torque. The degree to which the spring is wound is proportional to the viscosity of the fluid. Several of the following spindles are used per measurement when possible: LVT spindles (#1, #2, #3, #4),. Ultra Low viscosity Adapter (ULA) and spindle, Small Sample Adapter (SSA) and spindles SC4-18, SC4-31. Models are stated to be accurate to within 1% of their full scale range when employed in the specified manner. Readings should be reproducible to within 0.2% of full scale subject to environmental conditions such as variation in fluid temperature. Calibrations are conducted with Brookfield Standard Fluids.
Mass	Sample mass is measured using a Mettler PM 4000 analytical balance. The scale resolution is 0.01g and the reported reproducibility is 0.01g.
Test Cells	Pyrex 190 mm (diameter) x 100 mm (depth) crystallizing dishes are the typical test cells used although other vessels can be used in order to accommodate special materials.
Weighing Pans	Non-stick coated pans of 20 cm diameter.
Mesh Basket	Mesh baskets (mesh size approximately 1.1 mm diameter) are used to contain and drain Type II (particulate) samples.
Shaker Table	An Eberbach Corporation shaker table, modified to hold three 4L jars is used to agitate samples. The table is set at a frequency of 150 cycles per minute with an amplitude of 3 cm.

Test Protocol

The following summary test protocol which is applicable to Type II (particulate) sorbents was utilized.

The Dynamic Degradation Test

This procedure is designed to determine the buoyancy, hydrophobic and oleophilic

properties of a sorbent sample under dynamic conditions. A sorbent sample is placed in a sealed 4L jar which is half-filled with water. The jar is placed on its side and mounted on a shaker table, set at a frequency of 150 cycles per minute at an amplitude of 3 cm, for a duration of 15 minutes. The contents of the jar are allowed to settle for a period of 2 minutes, after which observations pertaining to the condition of the water and the sorbent sample are recorded. If greater than 10% of the sorbent is observed to sink or the water column is rendered contaminated with sorbent particles, then the sorbent is designated with a Failure and is not recommended for use on open water. The sorbent samples are removed from the jar and the water pick-up ratio is determined.

3 mL of oil is added to the surface of the test jars which have been half-filled with water. The wetted sorbent samples used in the beginning of this procedure are returned to the jar and the container is placed on its side and mounted on the shaker table for an additional 15 minutes. The contents of the jar are allowed to settle for a period of 2 minutes and observations pertaining to the existence of any oil sheen on the surface of the water is noted.

The Oil Adsorption - Short Test (15 minutes)

This procedure is designed to determine a sorbent's pick-up ratio when placed in a pure test liquid under stagnant conditions. The sorbent sample is initially weighed and the value recorded. A test cell is filled with a layer of test liquid to a depth of approximately 80 mm. The sorbent sample is placed in a fine mesh basket and lowered into the test cell. After 15 minutes, the sorbent is removed from the cell and allowed to drain for 30 seconds (*sorbents tested in Heavy Oil are drained for 2 minutes*). The sorbent is then transferred to a weighing pan and the weight recorded. All tests are conducted in triplicate.

The Oil Adsorption - Long Test (24 hours)

This procedure is designed to determine a sorbent's pick-up ratio when placed in a pure test liquid under stagnant conditions. The sorbent sample is initially weighed and the value recorded. A test cell is filled with a layer of test liquid to a depth of approximately 80 mm. The sorbent sample is placed in a fine mesh basket and lowered into the test cell. After 24 hours, the sorbent is removed from the cell and allowed to drain for 30 seconds (*sorbents tested in Heavy Oil are drained for 2 minutes*). The sorbent is then transferred to a weighing pan and the weight recorded. All tests are conducted in triplicate.

Results and Discussion

Test results are listed in Laboratory Data Sheets, appended to this report

The Dynamic Degradation Test

After shaking for 15 minutes and settling for 2 minutes, the bulk of the sorbent material was observed to be floating on the water column. The bulk water remained clear, with little evidence of clouding or colour change.

After shaking for 15 minutes following the addition of 3 mL of oil, there was little evidence of clouding in the water column, however, trace amounts of oil sheen remained on the water surface. Due to these factors the sorbent was deemed to have passed this test and is therefore recommended for use on waterways and for land applications.

The Oil Adsorption - Short Test

Following completion of the above test, new sorbent samples were exposed to a range of test oils. Based on 15 minute exposure and 0.5 or 2 minute drain periods, the sorbent was observed to have the following oil sorption ratios:

Oil Type	Oil Viscosity (cP)	Pick-up Ratio (g oil/g sorbent)
Diesel Fuel	3	7.0
Medium Oil	290	10.7
Heavy Oil	2050	5.2

The Short L-Test (15 minutes) is the designated test which indicates standard performance.

The Oil Adsorption - Long Test

Oil Type	Oil Viscosity (cP)	Pick-up Ratio (g oil/g sorbent)
Diesel Fuel	3	5.8
Medium Oil	290	12.0
Heavy Oil	2050	13.2

Conclusions

The Recoverit sorbent material was tested using ASTM F726-99 Protocol in order to evaluate its performance. It passed the buoyancy test by having less than 10% of the product sink under dynamic (wave) conditions.

The sorbent appeared to have reached saturation in all tests except the Short Test in Heavy Oil. This was confirmed by the results of the Long Test, which showed higher values (over 50% higher pick-up ratio when compared to Short Test). There was variability in the testing results which forced repeat testing to be undertaken. Due to the relatively fine particle size of the sorbent it is thought that losses through the test baskets contributed greatly to this variability.

The oil sorption capacities, expressed as weight ratios of liquid sorbed per unit weight of sorbent, varied between 5.2 and 10.7 for the standard 15 minute tests. This product would rank average when compared to similar products for pick-up ratio.

Appendix A - Test Data Sheets



SAIC Canada 2002-2003 Sorbent Test Program - Data Sheet 1/3

COMPANY:	RP Manufacturing TPY/LTD	TYPE (I,II,III,IV):	II	DATE TESTED:	Dec 30, 02 - Jan 13
SORBENT:	Recoverit	MATERIAL:	synthetic - (blue/green/white)	TESTED BY:	LR
PROJECT #:	SOR-01-059	DENSITY:	0.090 g/cm ³	CHECKED BY:	DC

DYNAMIC: DEGRADATION PRE-TEST

	1	2	3
Temperature (°C)	21	21	21
Sample weight (g)	6.13	6.19	6.50
Weight of wetted sorbent (g)	33.66	35.74	21.61
Initial water pickup ratio (g liquid / g sorbent)	4.5	4.8	2.3
Average liquid up-take (g liquid / g sorbent)	3.9		
Standard Deviation (g liquid / g sorbent)	34.7%		
Buoyancy test (Pass / Fail)	pass		

COMMENTS:

<i>sorbent floats</i>
<i>lost a significant amount of sorbent through filter</i>

DYNAMIC: DEGRADATION TEST

	1	2	3
Temperature (°C)	23	21	19
Sample weight (g)	as above		
Persistence of oil sheen on surface (Yes / No)	yes	yes	yes

COMMENTS:

<i>sorbent floats freely / water remains clear</i>
<i>VERY SMALL oil sheen remains on surface: stirred</i>
<i>containers after 2 minutes and sheen got smaller</i>

List of possible comments: Sorbent: floats freely, 25%/50%/75% submerged; sorbent still floating, sinks, dissolves.
 Water: remains clear, becomes slightly coloured, becomes cloudy, becomes murky.
 Oil: sheen remains on surface, no sheen on surface.

COMMENTS:	Oil Used	Density (g/cm ³)	Viscosity (cP)	Temperature (°C)	Comments
	<i>Medium (Crude Oil)</i>	<i>0.944</i>	<i>290</i>	<i>20</i>	



SAIC Canada 2002-2003 Sorbent Test Program

- Data Sheet 2/3

COMPANY: *RP Manufacturing TPY/LTD*
 SORBENT: *Recoverit*
 PROJECT #: *SOR-01-059*

TYPE (I,II,III,IV): *II*
 MATERIAL: *synthetic - (blue/green/white)*
 DENSITY: *0.090 g/cm3*

DATE TESTED: *Dec 30, 02 - Jan 13, 03*
 TESTED BY: *LR*
 CHECKED BY: *DC*

Short L TEST

15 Minutes

	Liquid #1			Liquid #2			Liquid #3		
	Sample			Sample			Sample		
	1	2	3	1	2	3	1	2	3
Temperature (°C)	19	19	19	19	19	19	19	19	19
Sample weight (g)	5.63	5.71	5.61	6.10	6.07	6.43	4.87	5.99	4.81
Wet sample weight (g)	40.99	47.05	48.06	70.14	72.12	74.69	34.21	33.17	28.67
Initial Sorption Capacity (g liquid / g sorbent)	6.28	7.24	7.57	10.50	10.88	10.62	6.02	4.54	4.96
Average liquid up-take (g liquid / g sorbent)	7.0			10.7			5.2		
Standard Deviation (g liquid / g sorbent)	9.5%			1.8%			14.8%		

COMMENTS:	Liquid Used	Density (g/cm ³)	Viscosity (cP)	Temperature (°C)	Comments
	<i>Light (Diesel)</i>	<i>0.829</i>	<i>3</i>	<i>20</i>	<i>float</i>
	<i>Medium (Crude Oil)</i>	<i>0.944</i>	<i>290</i>	<i>20</i>	<i>sorbent floats</i>
	<i>Heavy (Crude/Bunker)</i>	<i>0.995</i>	<i>2050</i>	<i>20</i>	<i>floats, not fully saturated</i>



SAIC Canada 2002-2003 Sorbent Test Program

- Data Sheet 3/3

COMPANY: *RP Manufacturing TPY/LTD*
 SORBENT: *Recoverit*
 PROJECT #: *SOR-01-059*

TYPE (I,II,III,IV): *II*
 MATERIAL: *synthetic - (blue/green/white)*
 DENSITY: *0.090 g/cm3*

DATE TESTED: *Dec 30, 02 - Jan 13, 03*
 TESTED BY: *LR*
 CHECKED BY: *DC*

Long L TEST

24 hours

	Liquid #1			Liquid #2			Liquid #3		
	Sample			Sample			Sample		
	1	2	3	1	2	3	1	2	3
Temperature (°C)	19	19	19	19	19	19	19	19	19
Sample weight (g)	5.14	5.34	5.29	5.76	5.58	7.24	7.42	7.62	6.30
Wet sample weight (g)	33.22	36.30	38.48	71.43	75.28	95.50	104.71	107.37	91.41
Initial Sorption Capacity (g liquid / g sorbent)	5.46	5.80	6.27	11.40	12.49	12.19	13.11	13.09	13.51
Average liquid up-take (g liquid / g sorbent)	5.8			12.0			13.2		
Standard Deviation (g liquid / g sorbent)	7.0%			4.7%			1.8%		

COMMENTS:	Oil Used	Density (g/cm ³)	Viscosity (cP)	Temperature (°C)	Comments
	<i>Light (Diesel)</i>	<i>0.829</i>	<i>3</i>	<i>20</i>	<i>float</i>
	<i>Medium (Crude Oil)</i>	<i>0.944</i>	<i>290</i>	<i>20</i>	<i>float / sorbent came out mostly in one chunk</i>
	<i>Heavy (Crude/Bunker)</i>	<i>0.995</i>	<i>2050</i>	<i>20</i>	<i>float</i>