Selection Criteria and Laboratory Evaluation of Oilspill Sorbents

Update IV

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Abstract

Sixteen commercially available oil spill sorbents, both organic and synthetic, were tested in three different petroleum products and two hydrocarbon solvents. Some of the test liquids were aged for periods of one and seven days. The sorbents were evaluated in terms of initial and maximum capacities, water pickup, and reuse potential.

Synthetic sorbents generally exhibited higher capacities and potential for reuse than the organic sorbents tested. Lower sorbent capacities and higher water pickup also were observed with decreasing test liquid layer thickness.

Résumé

Seize sorbants (organiques et synthétiques) disponibles sur le marché pour le nettoyage de nappes d'hydrocarbures ont été mis à l'essai en laboratoire contre trois produits pétroliers et deux solvants hydrocarbonés. Certains de ces produits ont été vieillis pour des périodes d'un et de sept jours. Les sorbants ont été évalués avec chacun des hydrocarbures d'essai en fonction de capacités initiales et maximales, de quantité d'eau récupérée et en fonction du nombre de réutilisation possible.

En générale, les sorbants synthétiques ont démontré une capacité plus élevée et un plus grand potentiel de réutilization que les produits organiques. Les essais sur les couches d'hydrocarbures moins épaisses ont indiqué que, dans la plupart des cas, la capacité du sorbant diminue tandis que la quantité d'eau récupérée augmente avec les nappes moins épaisses.

List of Tables

Acknowledgements

This report is an update of previous sorbent studies and was performed by S.L. Ross Environmental Research Limited under contract to the Environmental Emergencies Technology Division. Ms. M. Punt of the Emergencies Engineering Division was the scientific authority for this project.

This report was prepared by Ms. C. Guénette who extends thanks to Mr. C. Seeley for performing the laboratory work.

Section 1

Introduction

1.1 Background

In 1974, Environment Canada initiated an ongoing program to evaluate commercially available oil sorbents. Many new sorbents have been introduced to the market since the first study.

Twelve new sorbents and four sorbents from the previous study (for comparison) were evaluated in this study, which is the fourth update of the original study. The test liquids used included three oils: diesel, crude, and Bunker C; and two solvents: cyclohexane and toluene. The testing of oil spill sorbents in these solvents was introduced in the third update.

While laboratory testing cannot cover the wide range of environmental conditions and oil characteristics encountered in the field, it can provide a quantitative comparison of sorbent performance. Combined with practical field experience, this study should serve as a useful guide to sorbent selection for given spill conditions.

1.2 Sorbents

Sorbents can be categorized by material type into the following classes: inorganic, natural organic, and synthetic or polymeric sorbents. Six organic sorbents, one inorganic sorbent, and nine synthetic sorbents were used in this study (see Table 1). Further details on these sorbents can be found in Appendix B.

Table 1 Organic and Synthetic Sorbents Tested

Organic	Synthetic
1. Alfob	8. Alsorb II*
2. CCD Wood Chips	9. Eco Oil Sorbent
3. Clay•	10. E100 (Ergon)
4. Cork*	11. Foam "X"
5. Oclansorb*	12. Graboil*
6. Sawdust	13. Hazorb*
7. Wool	14. Matasorb
	15. Pig Skimmer
	16. Slikwik (Anderson S100)

* Denotes sorbents previously tested in Environment Canada studies.

• Although clay is a naturally occurring inorganic material, it has been grouped with the organic sorbents for the purposes of this report.

1.3 Study Parameters

The same methodology and approach as used in previous studies was used for this study. Sorbents were evaluated quantitatively on their ability to adsorb and/or absorb test liquids from test liquid/water interface. A qualitative test was also performed to determine the physical state of the sorbents after long-term exposure to the test liquids.

To facilitate the handling of hydrocarbon soaked sorbents, it is important that the weight ratio of hydrocarbon pickup to sorbent material is high and that the weight ratio of water pickup to sorbent material is low. Therefore the characteristics used in the quantitative analysis of each sorbent/liquid combination were as follows:

- Initial Capacity (g test liquid/g sorbent): the amount of test liquid a sorbent picked up upon initial exposure to the test liquid - water system.
- Maximum Capacity (g test liquid/g sorbent): the maximum amount of test liquid a sorbent picked up either on initial exposure to the hydrocarbon-water system or on subsequent exposures.
- Water Pickup (g water/g sorbent): the quantity of water picked up by a sorbent during testing.
- Maximum Water Pickup (g water/g sorbent): the maximum amount of water picked up either on initial exposure to the hydrocarbon-water system or on subsequent exposures.

Each sorbent was tested using an average hydrocarbon thickness on water, where the sorbent's initial and maximum hydrocarbon and water capacities were determined. A "thin-film" test of hydrocarbon on water was also conducted. In this case only the sorbent's initial hydrocarbon and water capacities were determined.

Section 2

Laboratory Evaluation

The procedure used in this sorbent evaluation was similar to that followed in the two previous studies (Environment Canada, 1978, 1985).

2.1 Materials and Apparatus

An improvised press consisting of a hydraulic jack and various plates designed to suit the test liquid was used along with:

- Standard labware
- Various sorbents
- Test liquids:
  - Cyclohexane (technical grade)
  - Toluene (technical grade)
  - Diesel
  - Crude Oil (high sulphur)
  - Bunker C
  - Tap Water

2.2 Procedure

The oils were aged by continuous aeration and heating until the desired viscosity was obtained. Crude oil and diesel were aged for periods of one and seven days. Bunker C, toluene, and cyclohexane were used as received, without weathering. Only a slight increase in viscosity was observed with diesel weathered beyond one day. Therefore, the diesel tests were performed using the diesel aged for one day only, as it was assumed that results with the diesel aged for seven days would be essentially the same. The physical properties of the test liquids are shown in Table 2.

Two baths, each consisting of nine test cells filled to a depth of 30 cm with tap water, were maintained at 10°C throughout the testing. The test liquids were layered on the water and pre-weighed sorbent samples were placed in

Table 2 Physical Properties of Test Liquids at 10 °C

Test Liquid	Specific Gravity	Viscosity (mPa·s)
Cyclohexane	0.78	1.02 (17°C)
Toluene	0.87	0.61 (17°C)
1-day Diesel	0.83	3.3
7-day Diesel	0.84	3.5
1-day Crude	0.86	70
7-day Crude	0.87	940
Bunker C	0.99	6450

the test system and left to stand for half an hour. A cover was placed over the baths to prevent evaporation of the test liquids.

Agitation was not applied to the system; however, the samples were turned over once. After a given standing period, the samples were removed from the bath, drained flat for five minutes and re-weighed. It is important to note here that the sorbents must be drained while laying flat to replicate the results of earlier studies. Our initial tests were conducted so that sheet sorbents were drained while being held from their corners in a vertical orientation. This results in a much smaller estimate of sorbent capacity when compared to horizontal drainage results. The water content in the recovered fluid was determined by normal separation and volume measurement or via liquid extraction using toluene when necessary. Volumes were measured using a graduated cylinder.

Two types of quantitative evaluations were performed: "reuse" tests and "thin-film" tests. The thin-film trials consisted of testing the sorbent in a 0.1-mm layer of petrochemical placed on water. Each sorbent was tested only once. The reuse experiments tested the reusability of a particular sorbent in 2.5 mm (toluene, cyclohexane, and diesel) and 5.0 mm (crude oil, Bunker C) layers of hydrocarbon.* Each sorbent sample was repeatedly tested until it disintegrated or until the amount of test fluid recovered fell below 50% of the initial capacity (to a maximum of ten reuses for cyclohexane and toluene, and five reuses for diesel, crude and Bunker C). The test liquid was replenished after each trial to maintain the desired layer thickness. Table 3 summarizes the test types and layer thicknesses used in this study.

Oil and water were recovered from the sorbents using a hydraulic press and various

Table 3 Summary of Test Type and Liquid Layer Thicknesses Used

Liquid	Weathering Period (days)	Test Type	Layer Thickness (mm)
Cyclohexane	N/A	reuse	2.5
Cyclohexane	N/A	thin-film	0.1
Toluene	N/A	reuse	2.5
Toluene	N/A	thin-film	0.1
Diesel	1	reuse	2.5
Diesel	1	thin-film	0.1
Crude	1	reuse	5.0
Crude	1	thin-film	0.1
Bunker C	N/A	reuse	5.0
Bunker C	N/A	thin-film	0.1

* as tested in the previous study

plates which were altered to suit each test fluid. For Bunker C tests, the plate was heated to facilitate recovery.

Each sorbent was tested in triplicate and the results averaged for each parameter calculated. The calculations were as shown below.

A separate qualitative sorbent test was also completed. In this test two samples of each sorbent were exposed to each test liquid for a period of 48 hours. No mixing or stirring was applied to the system and the mat type sorbents were not turned over in this test. A handful of each particulate or granular-type sorbent was evenly spread out on the test liquid to a thickness of roughly 6 mm (0.25 inch) when possible. (With the lighter test liquid most loose sorbents almost immediately dispersed into a thin layer.) Observations were made during and at the end of the 48-hour immersion period to define parameters such as amount of sample still afloat, integrity of sample, and changes in physical characteristics of the sorbent.

$$\text{Initial Capacity} = \frac{\left(\begin{array}{l}\text{weight of test liquid, water and}\\ \text{sorbent after initial exposure}\end{array}\right) - \left(\begin{array}{l}\text{weight of}\\ \text{water recovered}\end{array}\right) - \left(\begin{array}{l}\text{initial sorbent}\\ \text{weight}\end{array}\right)}{\text{initial sorbent weight}}$$

$$\text{Maximum Capacity} = \frac{\left(\begin{array}{l}\text{maximum weight of test liquid,}\\ \text{water and sorbent}\end{array}\right) - \left(\begin{array}{l}\text{weight of}\\ \text{water recovered}\end{array}\right) - \left(\begin{array}{l}\text{weight of}\\ \text{sorbent used}\end{array}\right)}{\text{initial sorbent weight}}$$

$$\text{Water Pickup} = \frac{\text{weight of water recovered}}{\text{initial sorbent weight}}$$

Section 3

Results

The experimental data collected are summarized in Tables 4 to 6 and Appendix A. These data are represented graphically in Figures 1 to 8.

The results obtained in this study agree with those in previous sorbent studies. In general, synthetic sorbents exhibited greater initial capacities and reuse potential than the organic sorbents. In heavy oils, some sorbents showed a "priming" effect whereby higher oil capacities were obtained upon reuse than on initial use. Finally, decreasing hydrocarbon layer thickness resulted in an increase in water pickup.

A summary of the initial oil capacity and the reusability of each sorbent is found in Table 4. The potential reuse has been classified as:

- N/A - not applicable or not reusable;
- LOW - 1 to 2 reuses;
- MEDIUM - 3 to 4 reuses; and
- HIGH - 5 or more reuses.

The results are discussed in further detail in Sections 3.1 and 3.2. The thin-film test results are summarized in Table 5. Table 6 shows the sorbents exhibiting the highest water pickup during the reuse and thin-film tests. The 48-hour immersion results are presented in Table 7 and discussed in Section 3.3.

3.1 Organic Sorbents

All organic sorbents were provided in loose form, either contained or uncontained in manufacturer packaging. For the purposes of this study, the sorbent material was contained in improvised screen bags or in the package material provided by the manufacturer, when available. Sawdust and Foam "X" were tested uncontained, in loose form, and therefore could not be tested for reuse. The initial oil capacity and water pickup data for organic sorbents have been plotted in Figures 1 and 2.

Among the seven organic sorbents tested, wool exhibited the highest capacity and maximum reusability. Wool could be used for a maximum of ten reuses in cyclohexane and toluene, and five reuses in diesel, crude oil and Bunker C.

Two wood products, sawdust and CCD wood chips, were tested. Wood products adsorb the oil and therefore, sawdust exhibited much greater capacities than the wood chips due to its larger surface area. No reuse was possible with the sawdust, but the wood chips could be reused with cyclohexane. Several sizes of CCD wood chips were available. The smallest size was chosen for testing since it was better suited for recovering oil by pressing than were the larger chips.

As in previous studies, Oclansorb--a modified peat moss product--showed a higher capacity for toluene and diesel than for the other test liquids. Reuse was low with the lighter hydrocarbons and high with the heavier oils.

Alfob, a processed cellulose fibre product, exhibited a higher capacity with Bunker C than with the other oils. However, reusability of this sorbent was low in all test liquids.

Cork showed highest initial capacities with toluene and diesel, and a low capacity with Bunker C. Reusability was medium to high in all test liquids.

Low absorbent capacities were obtained with clay and no reuse was possible. This product does not lend itself very well to pressing as a

Table 4 Summary of Reusability and Initial Hydrocarbon Capacity (g/g sorbent)

Sorbent	Cyclohexane		Toluene		Diesel		Crude - 1 Day		Crude - 7 Day		Bunker C	
	Reuse	Avg.	Reuse	Avg.	Reuse	Avg.	Reuse	Avg.	Reuse	Avg.	Reuse	Avg.
1. Alfob	LOW	2.36	LOW	2.78	LOW	2.51	LOW	2.88	LOW	3.71	LOW	5.84
2. CCD Wood Chips	LOW	0.51	N/A	0.82	N/A	0.54	N/A	0.78	N/A	1.84	N/A	3.65
3. Clay	N/A	0.69	N/A	0.76	N/A	N/A	N/A	0.76	N/A	1.21	N/A	1.59
4. Cork	HIGH	3.73	MED	5.00	HIGH	4.65	HIGH	3.78	MED	3.82	HIGH	2.14
5. Oclansorb	LOW	8.38	LOW	9.36	LOW	9.07	HIGH	6.16	HIGH	6.76	HIGH	5.51
6. Sawdust	N/A	5.28	N/A	5.20	N/A	4.08	N/A	5.29	N/A	6.65	N/A	9.75
7. Wool	HIGH	9.51	HIGH	11.62	HIGH	9.54	HIGH	14.07	HIGH	19.80	HIGH	11.70
8. Alsorb II	HIGH	11.27	HIGH	11.76	HIGH	14.56	HIGH	16.15	HIGH	18.90	LOW	22.15
9. Eco Oil Sorbent	HIGH	10.97	HIGH	11.90	HIGH	13.23	HIGH	16.98	HIGH	23.15	MED	12.64
10. E100	MED	13.18	LOW	12.58	MED	11.04	LOW	9.99	LOW	16.01	LOW	14.73
11. Foam "X"	N/A	7.62	N/A	8.52	N/A	5.32	N/A	7.48	N/A	10.77	N/A	14.17
12. Graboil	HIGH	23.47	HIGH	26.82	HIGH	18.62	HIGH	10.17	HIGH	8.19	HIGH	6.71
13. Hazorb	LOW	9.01	LOW	10.89	LOW	9.52	LOW	8.49	LOW	7.03	LOW	4.36
14. Matasorb	HIGH	10.95	HIGH	10.74	MED	7.98	HIGH	9.16	LOW	11.91	LOW	10.34
15. Pig Skimmer	MED	7.02	MED	8.08	LOW	8.14	HIGH	4.94	MED	5.93	LOW	5.57
16. S100	HIGH	11.53	HIGH	10.50	HIGH	8.98	MED	9.90	HIGH	12.76	HIGH	9.12

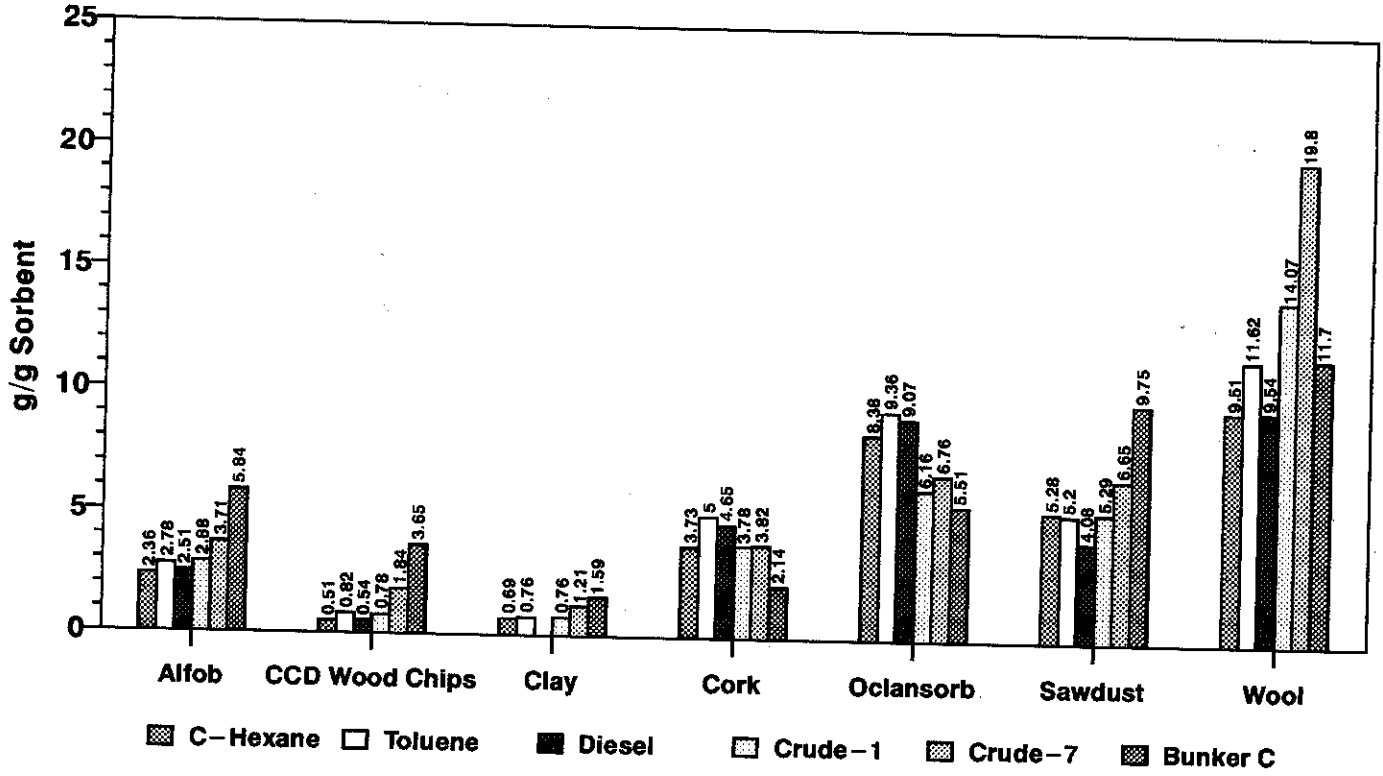

Figure 1 Average Initial Capacities for Organic Sorbents (reuse test)

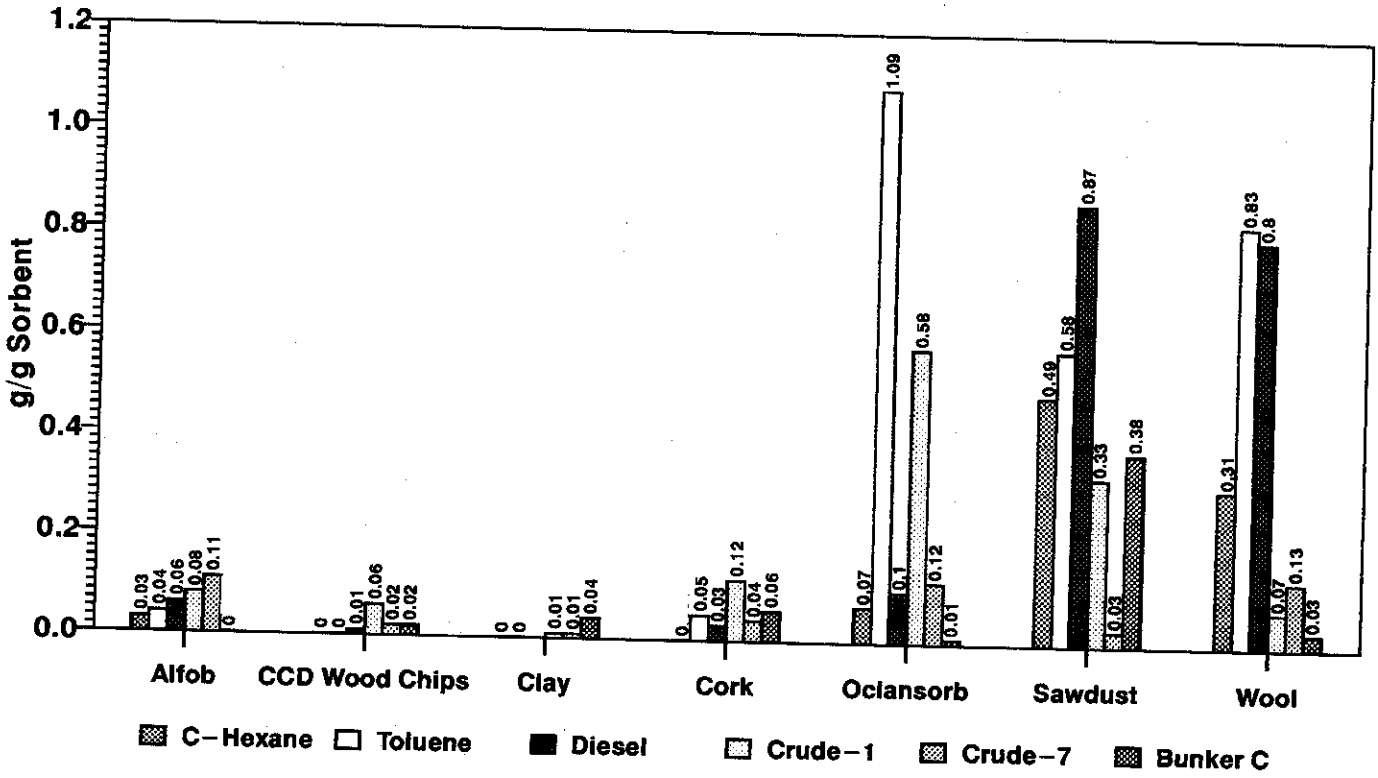

Figure 2 Summary of Initial Water Pickup for Organic Sorbents (reuse test)

Table 5 Summary of Thin-Film Test - Average Initial Capacity (g/g Sorbent)

Sorbent		Cyclo-hexane	Toluene	1-day Diesel	1-day Crude	Bunker C
1.	Alfob	0.75	0.83	0.48	0.55	0.81
2.	CCD WoodChips	0.66	0.73	0.49	0.43	0.70
3.	Clay	0.92	0.95	0.72	0.89	1.11
4.	Cork	0.32	0.57	0.46	0.39	0.51
5.	Oclansorb	0.65	2.12	2.43	0.72	1.80
6.	Sawdust *	-	-	-	-	-
7.	Wool	0.68	1.48	1.24	0.84	1.62
8.	Alsorb II	1.28	1.93	1.19	1.38	1.98
9.	Eco Oil Sorbent	2.62	2.37	2.05	1.57	2.10
10.	E100	0.27	0.53	0.67	0.93	1.10
11.	Foam "X"	0.70	1.10	0.85	0.81	0.94
12.	Graboil	0.83	0.99	1.15	1.88	1.63
13.	Hazorb	1.73	1.57			
14.	Matasorb	0.29	0.71	0.86	0.92	1.20
15.	Pig Skimmer	0.45	0.59	0.40	0.42	0.65
16.	S100	0.35	0.82	0.94	0.62	1.06

* Sawdust sank during testing

method of removing oil as it is not compressible. The clay sample sank almost immediately in diesel; therefore no data were recorded.

3.2 Synthetic Sorbents

The nine synthetic sorbents evaluated in this study included five mat or pad type sorbents (Alsorb II, E100, Graboil, Matasorb and S100) and four granular or particulate-type sorbents (Eco Oil Sorbent, Foam "X" , Hazorb and Pig Skimmer). Two foam materials, Graboil and Foam "X" were studied, in mat form and in particulate form, respectively. The initial capacities for the synthetic sorbents appear in Figure 3 while Figure 4 illustrates the water pickup data.

Graboil clearly exhibited the greatest capacity of the synthetic sorbents when used on cyclohexane, toluene, and diesel. Average capacities were obtained with the heavier oils. It also showed the highest reuse potential in all test liquids. Eco Oil sorbent, a particulate polyethylene material, exhibited the greatest capacity with crude oil, while Alsorb II had the greatest capacity in Bunker C.

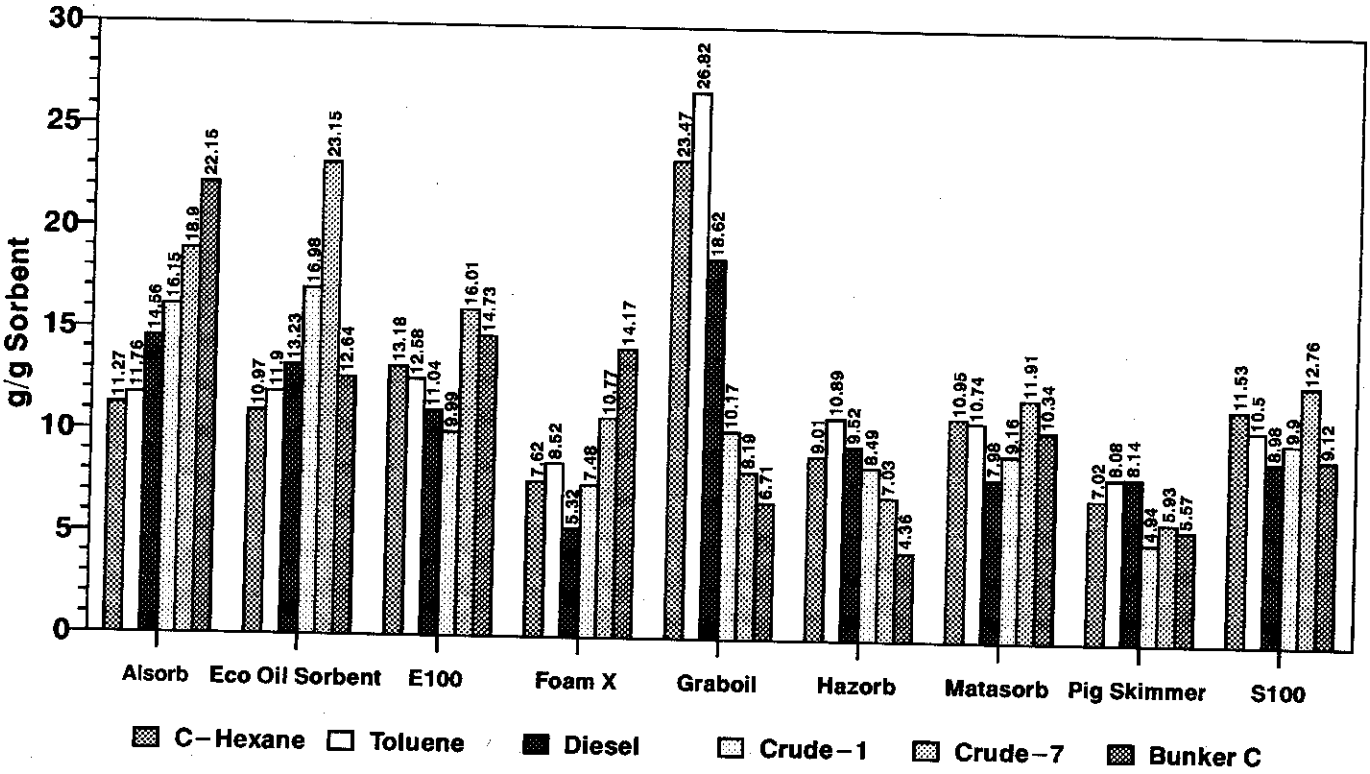

Figure 3 Average Initial Capacities for Synthetic Sorbents (reuse test)

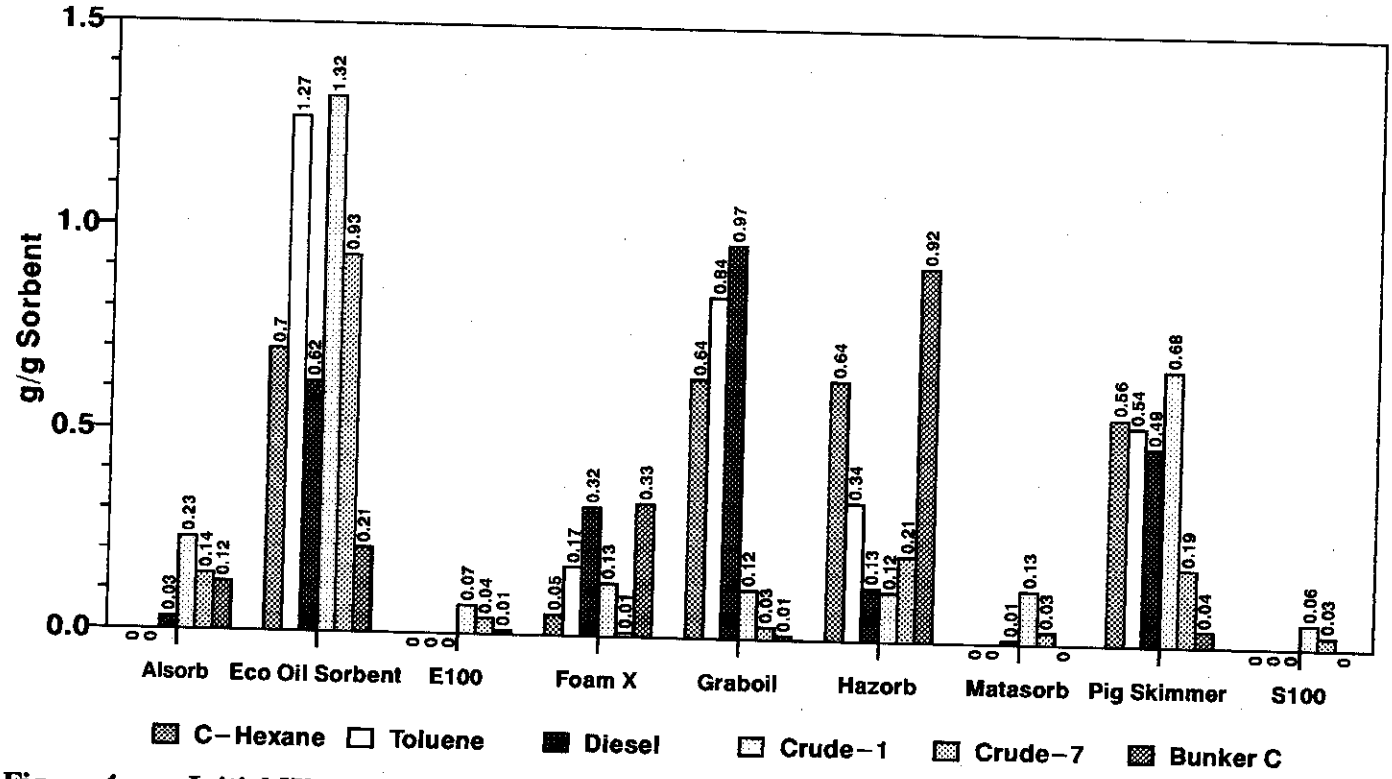

Figure 4 Initial Water Pick Up for Synthetic Sorbents (reuse test)

Alsorb II, Eco Oil Sorbent, Graboil, and S100 all demonstrated very good reuse potentials in all test liquids.

The E100 and S100 sorbents were very similar in appearance. The E100 showed better overall capacities in all hydrocarbons than the S100. However, the S100 exhibited high reuse potential in all test liquids while the E100 reuse ability ranged from medium to low. Matasorb, also a mat type sorbent, demonstrated capacities very similar to the S100. It showed higher reuse potential with the lighter oils than with the heavy oils. Some additional trends were observed with these three sorbents. Their greatest initial capacity was achieved with the seven-day aged crude oil. The E100, S100 and Matasorb showed similar decreasing capacities for cyclohexane, toluene, and diesel with cyclohexane being adsorbed the most and diesel being adsorbed the least.

The remaining three sorbents, Foam "X", Hazorb, and Pig Skimmer (all particulate sorbents) showed average or below average capacities and reuse potential. No reuse was possible with Foam "X" as it was tested uncontained, as supplied. This sorbent exhibited a higher than average capacity with Bunker C. Hazorb worked best with toluene, but reuse potential for this sorbent was low in all cases. The Pig Skimmer sorbent seemed better suited for lighter hydrocarbons than for the heavier oils.

3.3 General Qualitative Results

Table 6 briefly summarizes initial water pickup during the reuse and thin-film tests. Organic and synthetic sorbents exhibiting the greatest water pickup for each test liquid are listed in the table. It should be noted that some sorbents, particularly Graboil, show much higher water pickup after reuse than on initial exposure to a test liquid. Water pickup was also observed to increase with thinner layers of test liquids. The average capacity for organic sorbents to absorb the five test liquids and the corresponding water pickup is illustrated in Figures 5 and 6. Figures 7 and 8 illustrate the data recorded for synthetic sorbents during the same thin film tests. A comparison of the thin-film test and the reuse test results reveals that initial capacities are greater in thicker hydrocarbon layers.

Table 6 Summary of Sorbents Exhibiting Highest Water Pickup During Reuse and Thin-Film Tests

Test Liquid	Reuse Test		Thin-film Test	
	Organic	Synthetic	Organic	Synthetic
Cyclohexane	Sawdust	Eco Oil Sorbent	Wool	Hazorb
Toluene	Oclansorb	Eco Oil Sorbent	Oclansorb	Eco Oil Sorbent
Diesel	Sawdust	Graboil	Wool	Eco Oil Sorbent
One day Crude	Oclansorb	Eco Oil Sorbent	CCD Wood Chips	Eco Oil Sorbent
Seven day Crude	Wool	Eco Oil Sorbent	----------	----------
Bunker C	Sawdust	Hazorb	Wool	Eco Oil Sorbent

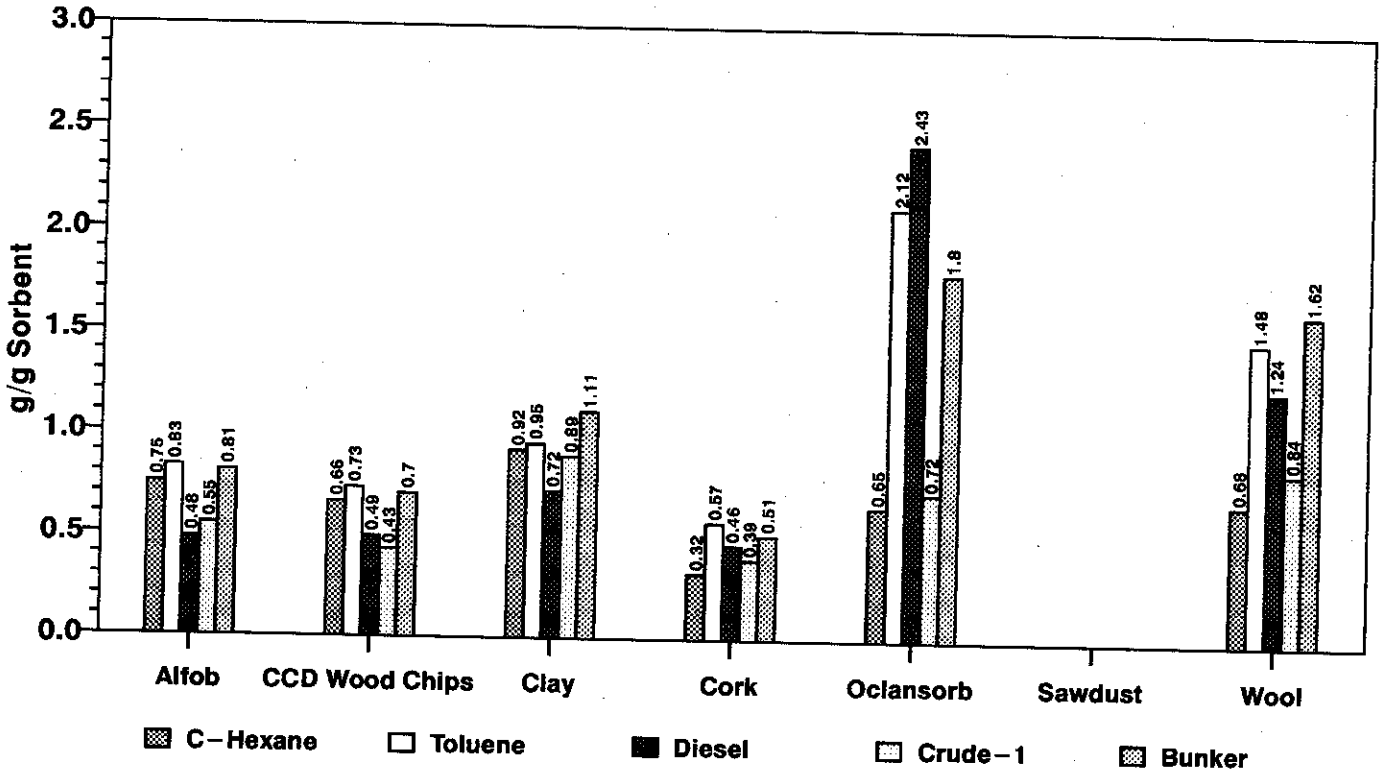

Figure 5 Average Capacities for Organic Sorbents (Thin-film Test)

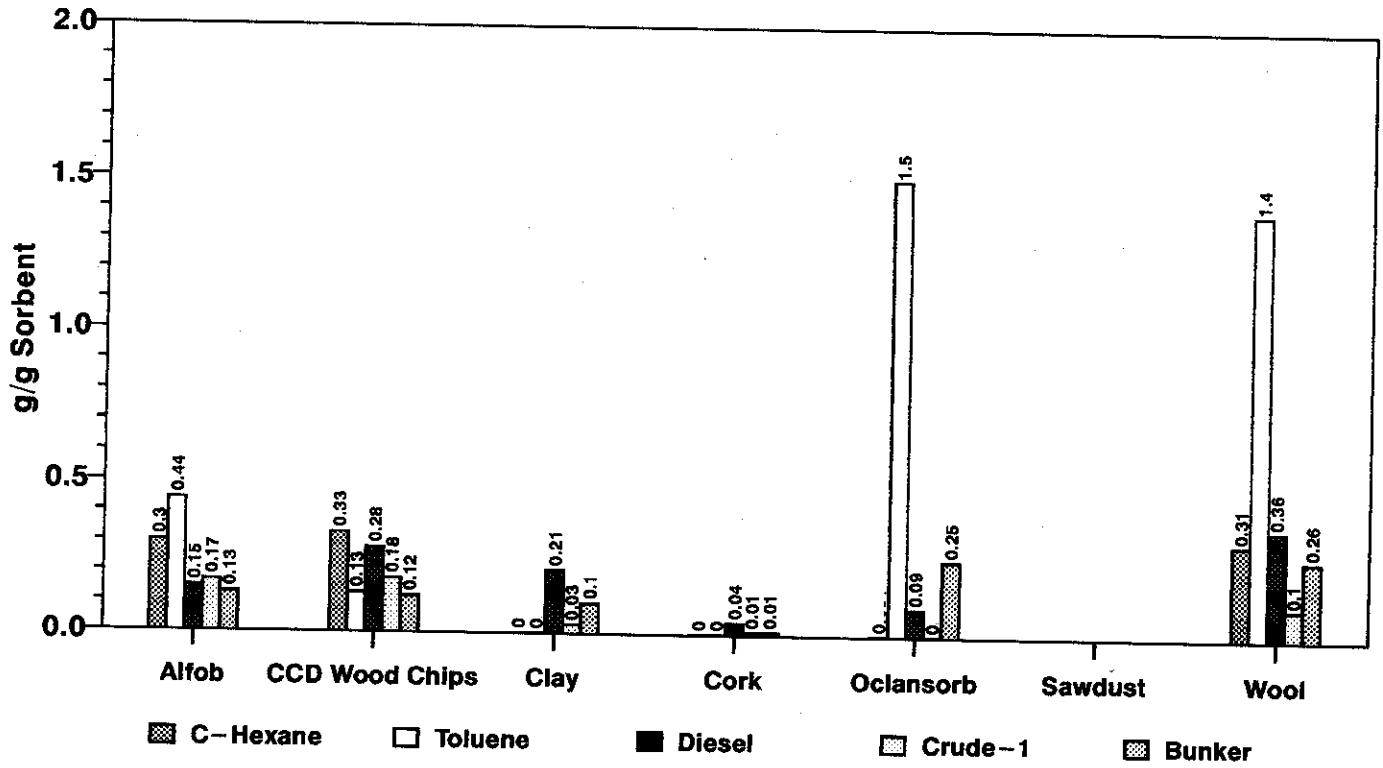

Figure 6 Average Water Pickup for Organic Sorbents (Thin-film Test)

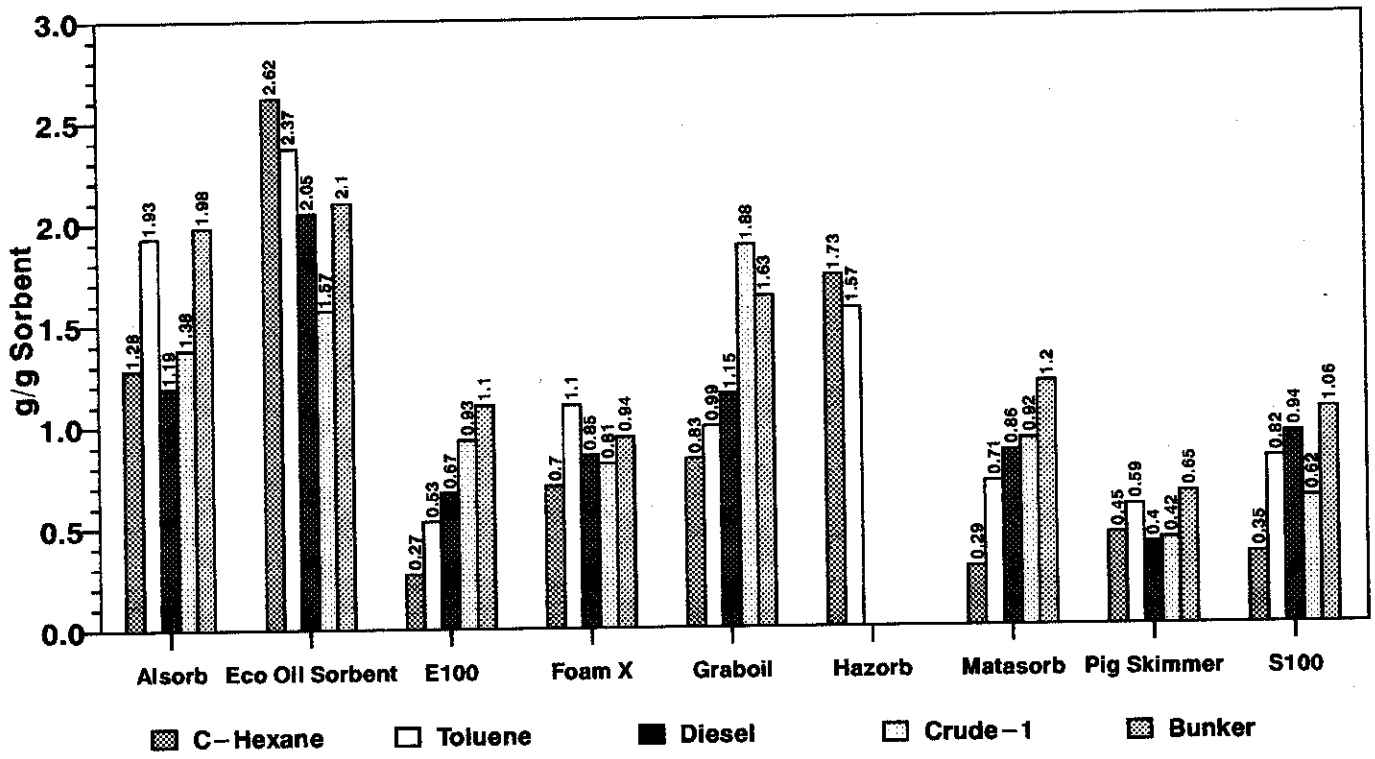

Figure 7 Average Capacities for Synthetic Sorbents (Thin-film Test)

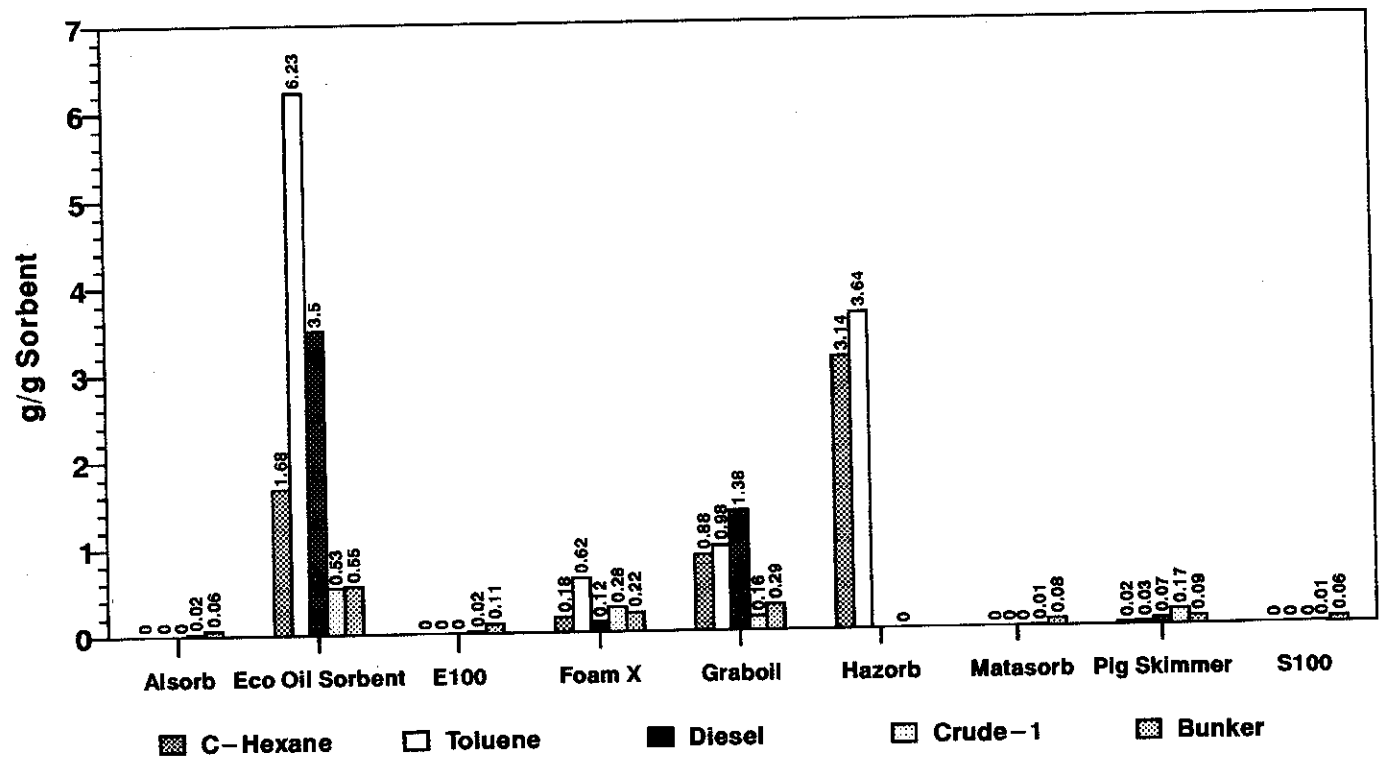

Figure 8 Average Water Pickup for Synthetic Sorbents (Thin-film Test)

3.4 Qualitative Study

A summary of the observations made during the qualitative 48-hour immersion test is presented in Table 7. The purpose of this test was to obtain an indication of sorbent performance after long-term exposure to the test liquids. Parameters considered included: buoyancy, strength, and physical characteristics of the sorbents over the 48-hour immersion period.

The following qualitative observations were made:

- Afloat (F), Sank (S): sample afloat or sunk after immersion period;
- Weakened (W): mat type sorbents were tested for strength by pulling on opposite corners of the sample;
- Saturated (Sat): the degree to which a sorbent absorbed the test liquid. This indicated the ability of a sorbent to absorb a spilled hydrocarbon without any mechanical intervention (such as mixing, turning sorbent over, dragging across spill, pushing sorbent into hydrocarbon); or

Table 7 Summary of Observations for 48-hour Immersion Test

Sorbent	Cyclohexane	Toluene	Diesel	1-Day Crude	7-Day Crude	Bunker C
1. Alfob	F, Sat	F, Sat	F, Sat	F, Sat	F, Sat	F,Sat
2. CCD Wood Chips	F	F	F	F	F	F
3. Clay	S	S	S	S	F	F
4. Cork	F, Pd, CSat	F, CD, CSat	F, CD, Csat	F, PD, CSat	F, PD, CSat	F, PD, PSat
5. Oclansorb	F, CD	F, CD	F, CD	F, CD	F	F
6. Sawdust	F, PD	F, PD	F, PD	F, PD	F, PD	S
7. Wool	F	F	F	F	F	F
8. Alsorb II	F	F	F, PW	F	F	F
9. Eco Oil Sorbent	F	F	F	F	F	F
10. E100	F	F	F, W	F, PW, PSat	F, PW	F, PW
11. Foam "X"	F, PD	F, PD	F, PD	F, PD	F	F, PSat
12. Graboil	F	F	F, PW	F, PSat	F, PSat	F, PSat
13. Hazorb	F, PD	F, CD	F, CD	F, PD, PSat	F, PSat	F, PSat
14. Matasorb	F	F	F	F	F	F
15. Pig Skimmer	F	F	F	F	F	F
16. S100	F	F	F	F	F	F

Legend: F = Sample Afloat, S = Sank, W = Weakened, Sat = Saturated,
Prefixes: D = Dispersed, C = Completely, P = Partially

- Dispersed (D): dispersal of the loose sorbent into the hydrocarbon layer.

While the 48-hour immersion test does not account for many environmental conditions to which sorbents can be exposed to in a true field trial (i.e., wind, waves, temperature fluctuations, rain), some useful information can be derived from this experiment.

Sorbent strength after immersion was compared to that of unexposed sorbents. This observation could only be made for mat-type sorbents (Alsorb II, E100, Graboil, Matasorb, and S100). It was discovered that Matasorb and S100 did not weaken after exposure to any of the test liquids. The remaining sorbents weakened in diesel. Alsorb II tore quite easily after exposure to diesel while Graboil and E100 were partially weakened in crude oil and Bunker C.

Many sorbents were not completely saturated after 48 hours in the heavier oils, particularly with Bunker C. Also, sorbents applied in loose form dispersed very little if at all in the heavier oils. This result would likely differ in rough waters where further saturation and dispersion would be expected. This observation also reflects the increased capacity of some sorbents following initial use or after priming. An increase in saturation and dispersion can be expected with these sorbents after priming.

Section 4

Discussion

This sorbent evaluation program was initiated to provide comparative data which could serve as a reference for potential sorbent users. Combined with practical field experience, this report is intended to be used as a guide to those who use oil spill sorbents to absorb hydrocarbon spills.

The number of test repetitions performed during the reuse tests for this report were reduced from a maximum of ten for cyclohexane and toluene to a maximum of five for remaining test oils. The purpose of this study was to comparatively evaluate sorbents and provide some guidance in their selection and application under given spill conditions. For the practical application of the sorbent products, five test repetitions were considered to be sufficient for proper evaluation. Experience from previous test results and initial test results from this update indicated that the efficiency of a sorbent following five test repetitions did not vary appreciably. In fact, test results followed the same trend observed in previous repetitions. During an actual spill cleanup, sorbents are normally not reused to the same extent as they were in this test program and in most cases, they are not reused at all.

References

Environment Canada (1976). "Selection Criteria and Laboratory Evaluation of Oil Spill Sorbents", Environmental Protection Service, Environment Canada, Report EPS 4-EC-76-5 .

Environment Canada (1978). "Selection Criteria and Laboratory Evaluation of Oil Spill Sorbents: An Update", Environmental Protection Service, Environment Canada, Report EPS 4-EC-78-8 .

Environment Canada (1983). "Selection Criteria and Laboratory Evaluation of Oil Spill Sorbents: Update II", Environmental Protection Service, Environment Canada, Report 4-EP-83-4.

Environment Canada (1985). "Selection Criteria and Laboratory Evaluation of Oil Spill Sorbents: Update III", Environmental Protection Service, Environment Canada, Report EPS 3/SP/1.

Appendix A

Sorbent Test Data

This appendix contains all the data collected for each test performed during this sorbent evaluation. This includes initial and maximum oil capacity and water pickup for the reuse tests, and initial oil capacity and water pickup for the thin-film tests. Figures A1 to A6 compare sorbent performances in each of the test liquids. The collected data are found in Tables A1 to A9.

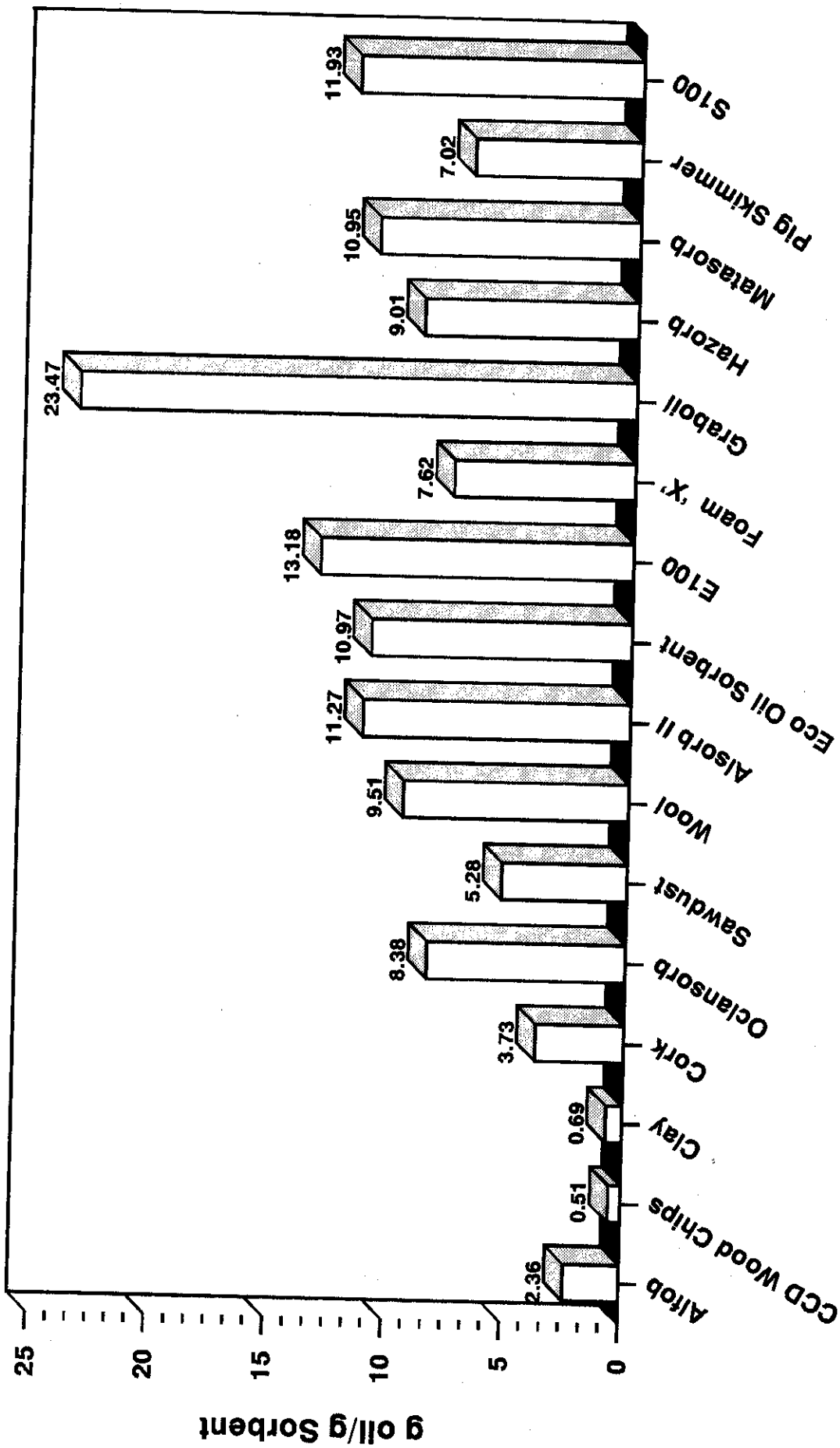

Figure A1 Average Initial Sorbent Capacity for Cyclohexane

Table A1 Initial and Maximum Capacities and Water Pickup (Cyclohexane)

Sorbent	Reuses	Initial Oil Capacity (g oil/g sorbent)				Maximum Oil Capacity (g oil/g sorbent)				Initial Water Pickup (g water/g sorbent)				Maximum Water Pickup (g water/g sorbent)			
		1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
1. Alfob	1	2.44	2.40	2.24	2.36	2.44	2.40	2.24	2.36	0.04	0.03	0.03	0.03	0.04	0.03	0.03	0.03
2. CCD Wood Chips	1	0.48	0.54	0.52	0.51	0.48	0.54	0.52	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Clay	0	0.69	0.73	0.65	0.69	0.69	0.73	0.65	0.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Cork	8	4.00	3.93	3.26	3.73	4.10	4.39	4.20	4.23	0.00	0.00	0.00	0.00	0.16	0.03	0.01	0.07
5. Oclansorb	1	8.29	8.44	8.42	8.38	8.29	8.44	8.42	8.38	0.09	0.05	0.05	0.07	0.09	0.05	0.05	0.07
6. Sawdust	0	5.39	5.32	5.14	5.28	5.39	5.32	5.14	5.28	0.21	0.28	0.99	0.49	0.21	0.28	0.99	0.49
7. Wool	10	9.50	9.73	9.30	9.51	10.77	10.63	10.83	10.74	0.10	0.37	0.47	0.31	0.20	0.20	0.53	0.31
8. Alsorb II	8	10.86	11.79	11.16	11.27	10.86	11.79	11.16	11.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9. Eco Oil Sorbent	10	9.60	12.00	11.30	10.97	14.10	11.90	11.73	12.58	0.55	1.20	0.35	0.70	0.55	1.20	0.35	0.70
10. E100	4	13.29	13.29	12.96	13.18	13.29	13.29	12.96	13.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11. Foam "X"	0	7.35	7.62	7.90	7.62	7.35	7.62	7.90	7.62	0.07	0.00	0.08	0.05	0.07	0.00	0.08	0.05
12. Graboil	10	22.83	24.33	23.24	23.47	22.83	24.33	23.24	23.47	0.67	0.67	0.59	0.64	2.28	1.44	1.33	1.68
13. Hazorb	1	9.11	8.64	9.27	9.01	9.11	8.64	9.27	9.01	0.56	0.69	0.67	0.64	0.56	0.69	0.67	0.64
14. Matasorb	8	11.45	10.56	10.84	10.95	11.45	10.56	10.84	10.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15. Pig Skimmer	4	6.50	7.43	7.12	7.02	6.50	7.43	7.12	7.02	0.62	0.48	0.57	0.56	0.62	0.48	0.57	0.56
16. S100	5	11.75	11.30	11.54	11.53	11.75	11.30	11.54	11.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

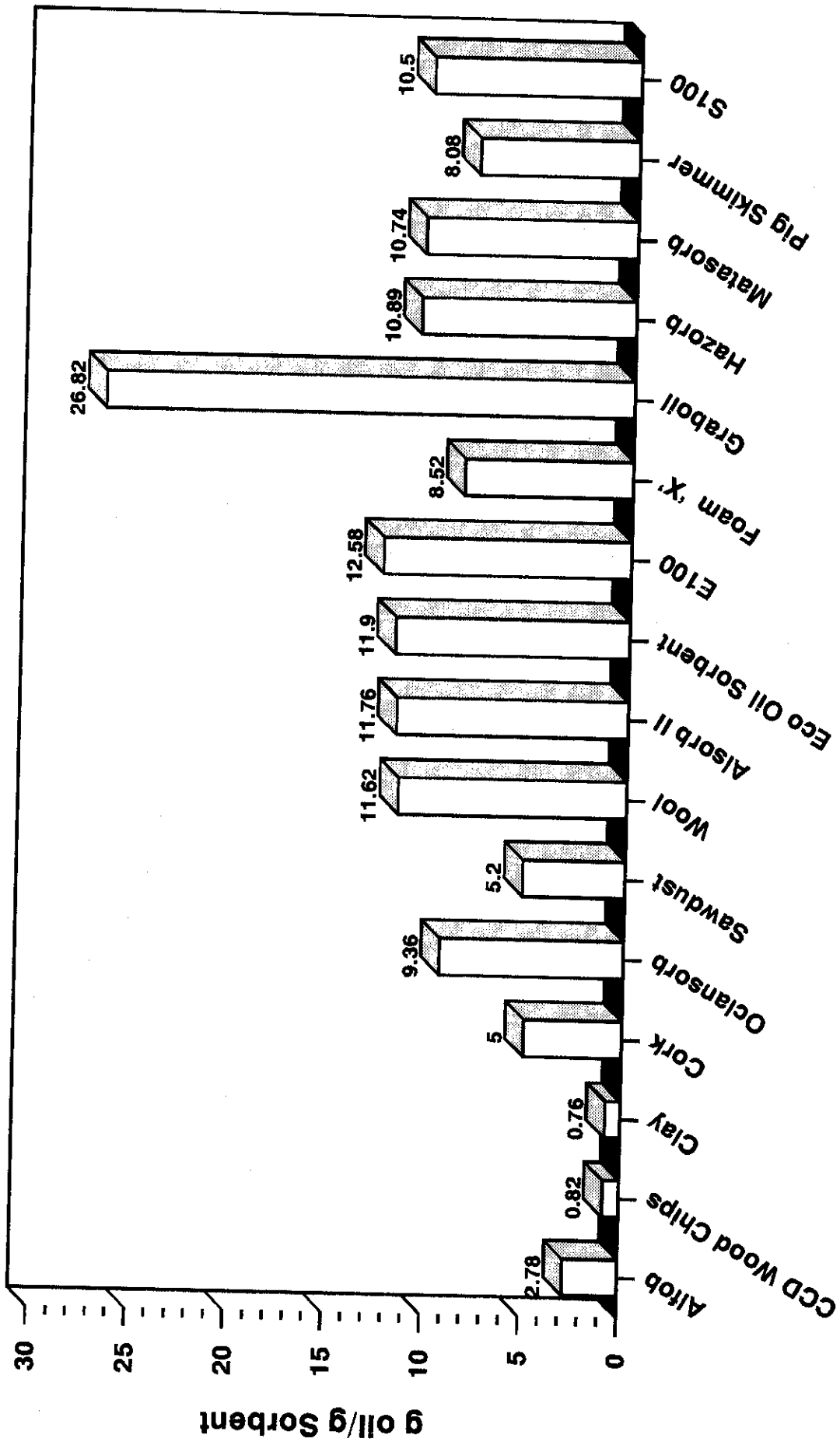

Figure A2 Average Initial Sorbent Capacity for Toluene

Table A2 Initial and Maximum Capacities and Water Pickup (Toluene)

Sorbent	Reuses	Initial Oil Capacity (g oil/g sorbent)				Maximum Oil Capacity (g oil/g sorbent)				Initial Water Pickup (g water/g sorbent)				Maximum Water Pickup (g water/g sorbent)			
		1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
1. Alfob	1	2.63	2.81	2.89	2.78	2.63	2.81	2.89	2.78	0.06	0.04	0.03	0.04	0.06	0.04	0.03	0.04
2. CCD Wood Chips	0	0.90	0.79	0.76	0.82	0.78	0.79	1.00	0.85	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
3. Clay	0	0.80	0.77	0.72	0.76	0.80	0.77	0.72	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Cork	4	4.61	5.33	5.04	5.00	4.94	5.36	4.97	5.09	0.09	0.01	0.06	0.05	0.16	0.03	2.23	0.80
5. Oclansorb	1	9.18	9.60	9.29	9.36	9.18	9.60	9.29	9.36	0.91	1.45	0.91	1.09	0.91	1.45	0.91	1.09
6. Sawdust	0	5.30	4.86	5.44	5.20	5.30	4.86	5.44	5.20	0.58	0.28	0.89	0.58	0.58	0.28	0.89	0.58
7. Wool	10	12.90	11.27	10.70	11.62	12.90	11.27	10.70	11.62	0.97	0.93	0.60	0.83	0.97	0.93	0.60	0.83
8. Alsorb II	6	11.05	12.38	11.84	11.76	11.05	12.38	11.84	11.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9. Eco Oil Sorbent	10	11.70	12.25	11.75	11.90	11.70	12.25	11.75	11.90	1.40	1.90	0.50	1.27	1.40	1.90	0.50	1.27
10. E100	2	12.22	12.27	13.26	12.58	12.22	12.27	13.26	12.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11. Foam "X"	0	8.85	8.55	8.17	8.52	8.85	8.55	8.17	8.52	0.08	0.23	0.20	0.17	0.08	0.23	0.20	0.17
12. Graboil	10	26.38	27.89	26.19	26.82	26.38	27.89	26.19	26.82	0.87	0.72	0.94	0.84	1.00	2.61	2.87	2.16
13. Hazorb	1	10.38	10.95	11.35	10.89	10.38	10.95	11.35	10.89	0.45	0.15	0.43	0.34	0.45	0.15	0.43	0.34
14. Matasorb	6	10.88	10.42	10.92	10.74	10.88	10.42	10.92	10.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15. Pig Skimmer	3	8.15	8.62	7.48	8.08	8.15	8.62	7.48	8.08	0.43	0.82	0.37	0.54	0.43	0.82	0.37	0.54
16. S100	7	10.66	10.64	10.19	10.50	10.66	10.64	10.19	10.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

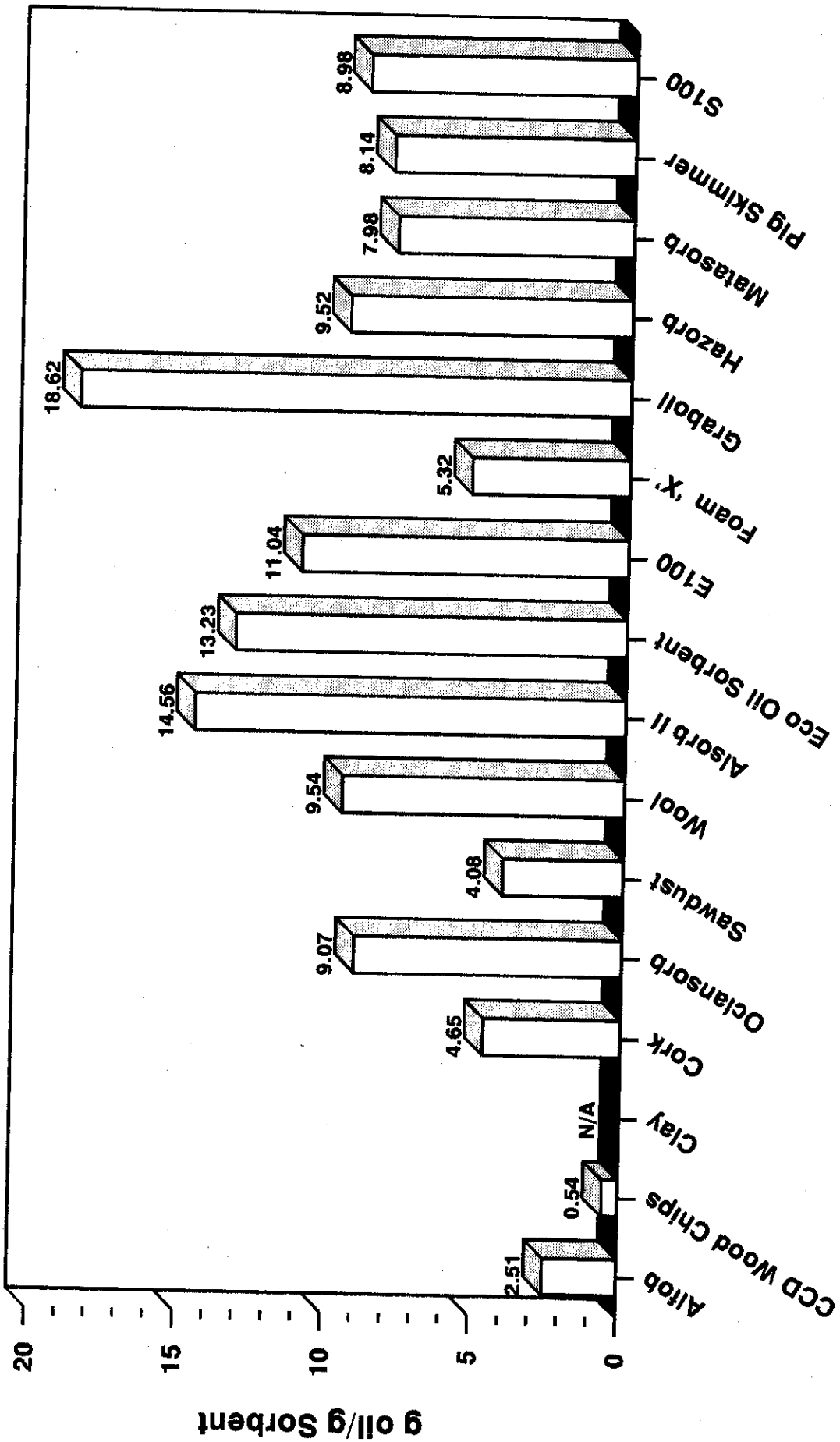

Figure A3 Average Initial Sorbent Capacity for Diesel

Table A3 Initial and Maximum Capacities and Water Pickup (Diesel)

Sorbent	Reuses	Initial Oil Capacity (g oil/g sorbent)				Maximum Oil Capacity (g oil/g sorbent)				Initial Water Pickup (g water/g sorbent)				Maximum Water Pickup (g water/g sorbent)			
		1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
1. Alfob	1	2.49	2.46	2.60	2.51	2.49	2.46	2.60	2.51	0.04	0.06	0.07	0.06	0.04	0.06	0.07	0.06
2. CCD Wood Chips	0	0.56	0.49	0.58	0.54	0.56	0.49	0.58	0.54	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01
3. Clay	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4. Cork	5	4.61	4.79	4.54	4.65	4.61	4.79	4.54	4.65	0.01	0.04	0.04	0.03	0.01	0.04	0.04	0.03
5. Oclansorb	1	8.82	9.56	8.82	9.07	8.82	9.56	8.82	9.07	0.07	0.02	0.20	0.10	0.07	0.02	0.20	0.10
6. Sawdust	0	3.94	4.44	3.86	4.08	3.94	4.44	3.86	4.08	1.89	0.50	0.23	0.87	1.89	0.50	0.23	0.87
7. Wool	5	9.80	8.97	9.87	9.54	9.80	8.97	9.87	9.54	0.83	0.90	0.67	0.80	0.83	0.90	0.67	0.80
8. Alsorb II	5	15.20	13.54	14.93	14.56	15.20	13.54	14.93	14.56	0.02	0.04	0.02	0.03	0.18	0.00	0.04	0.08
9. Eco Oil Sorbent	5	13.95	11.25	14.50	13.23	13.95	11.25	14.50	13.23	0.65	0.80	0.40	0.62	0.65	0.80	0.40	0.62
10. E100	3	11.19	10.45	11.48	11.04	11.19	10.45	11.48	11.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11. Foam "X"	0	5.45	5.68	4.82	5.32	5.45	5.68	4.82	5.32	0.32	0.35	0.30	0.32	0.32	0.35	0.30	0.32
12. Graboil	5	20.06	16.33	19.47	18.62	26.50	26.17	23.47	25.38	1.33	1.11	0.47	0.97	0.83	5.28	1.35	2.49
13. Hazorb	1	9.70	9.45	9.40	9.52	9.70	9.45	9.40	9.52	0.08	0.08	0.23	0.13	0.08	0.08	0.23	0.13
14. Matasorb	4	8.31	8.02	7.62	7.98	8.31	8.02	7.62	7.98	0.02	0.02	0.00	0.01	0.02	0.04	0.04	0.03
15. Pig Skimmer	1	8.08	8.20	8.15	8.14	8.08	8.20	8.15	8.14	0.60	0.43	0.43	0.49	0.60	0.43	0.43	0.49
16. S100	5	9.22	8.86	8.86	8.98	9.22	8.86	8.86	8.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

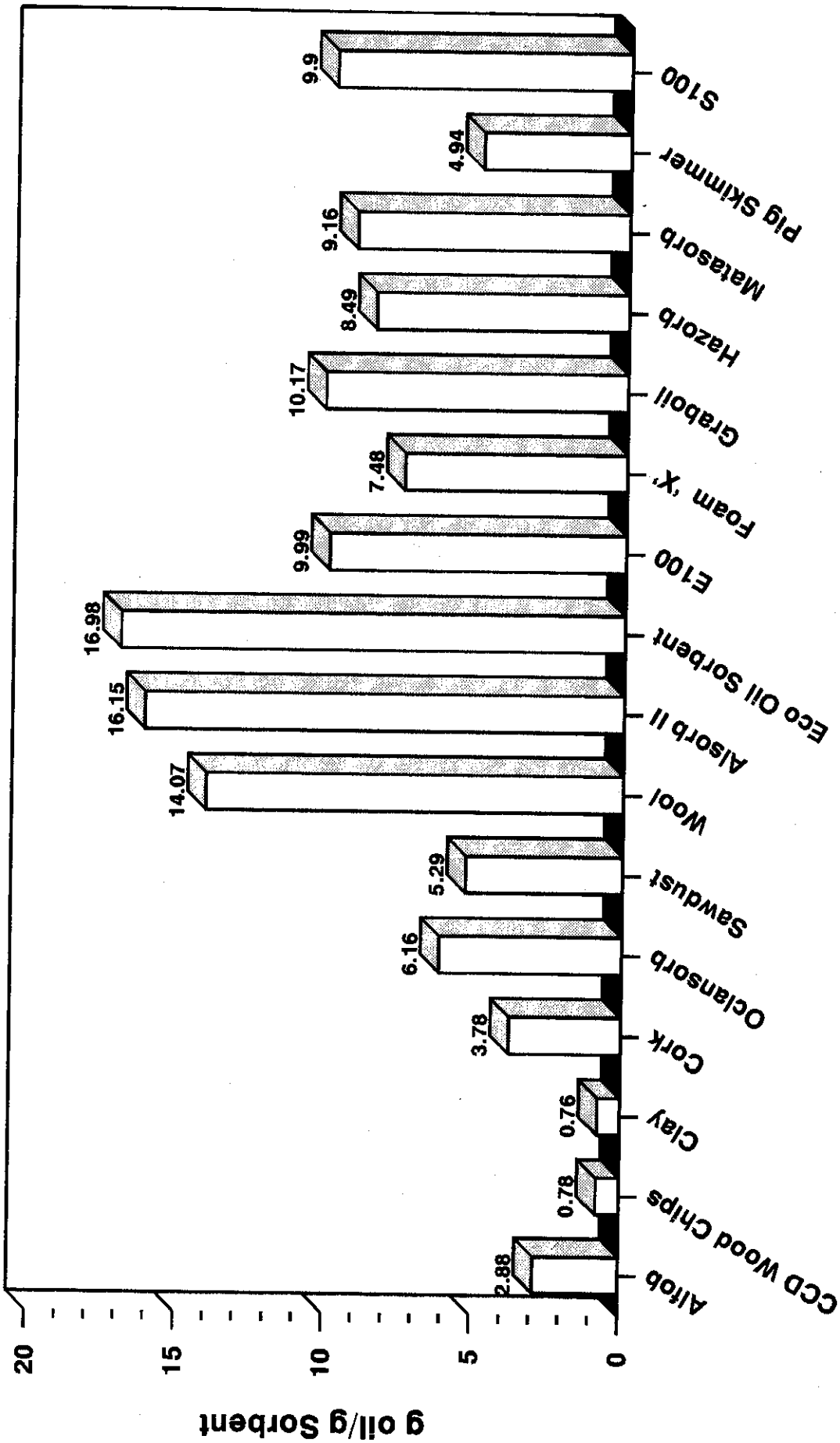

Figure A4 Average Initial Sorbent Capacity for Crude Oil - 1 Day Aged

Table A4 Initial and Maximum Capacities and Water Pickup (Crude - 1 Day Aged)

Sorbent	Reuses	Initial Oil Capacity (g oil/g sorbent)				Maximum Oil Capacity (g oil/g sorbent)				Initial Water Pickup (g water/g sorbent)				Maximum Water Pickup (g water/g sorbent)			
		1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
1. Alfob	2	3.01	2.99	2.63	2.88	3.01	2.99	2.63	2.88	0.03	0.06	0.16	0.08	0.03	0.06	0.16	0.08
2. CCD Wood Chips	0	0.81	0.77	0.76	0.78	0.79	0.65	0.85	0.76	0.09	0.05	0.04	0.06	0.09	0.05	0.04	0.06
3. Clay	0	0.79	0.65	0.85	0.76	0.79	0.65	0.85	0.76	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4. Cork	5	3.80	3.60	3.93	3.78	3.80	3.60	3.93	3.78	0.14	0.10	0.13	0.12	0.14	0.10	0.13	0.12
5. Oclansorb	5	6.11	5.67	6.69	6.16	6.11	5.67	6.69	6.16	0.76	0.35	0.62	0.58	0.76	0.35	0.62	0.58
6. Sawdust	0	5.00	4.99	5.89	5.29	5.00	4.99	5.89	5.29	0.04	0.49	0.46	0.33	0.04	0.49	0.46	0.33
7. Wool	5	14.45	14.87	12.90	14.07	14.45	14.87	12.90	14.07	0.02	0.13	0.07	0.07	0.37	1.17	1.03	0.86
8. Alsorb II	5	15.29	16.95	16.20	16.15	15.29	16.96	16.20	16.15	0.14	0.33	0.20	0.23	0.14	0.33	0.20	0.23
9. Eco Oil Sorbent	5	17.50	15.90	17.55	16.98	17.50	15.90	17.55	16.98	1.35	0.95	1.65	1.32	2.20	2.75	0.95	1.97
10. E100	1	9.97	9.50	10.52	9.99	9.97	9.50	10.52	9.99	0.10	0.06	0.05	0.07	0.10	0.06	0.05	0.07
11. Foam "X"	0	7.60	7.50	7.33	7.48	7.60	7.50	7.33	7.48	0.12	0.15	0.13	0.13	0.12	0.15	0.13	0.13
12. Graboil	5	11.05	8.78	10.70	10.17	11.05	8.78	10.70	10.17	0.05	0.08	0.25	0.12	0.09	0.30	0.25	0.21
13. Hazorb	1	8.85	8.65	7.98	8.49	8.85	8.65	7.98	8.49	0.15	0.10	0.10	0.12	0.15	0.10	0.10	0.12
14. Matasorb	5	8.48	10.21	8.80	9.16	8.48	10.21	8.80	9.16	0.15	0.17	0.08	0.13	0.15	0.17	0.08	0.13
15. Pig Skimmer	5	5.12	4.80	4.90	4.94	5.12	4.80	4.90	4.94	0.82	0.55	0.68	0.68	0.82	0.55	0.68	0.68
16. S100	3	9.62	10.37	9.71	9.90	9.62	10.37	9.71	9.90	0.08	0.02	0.07	0.06	0.08	0.02	0.07	0.06

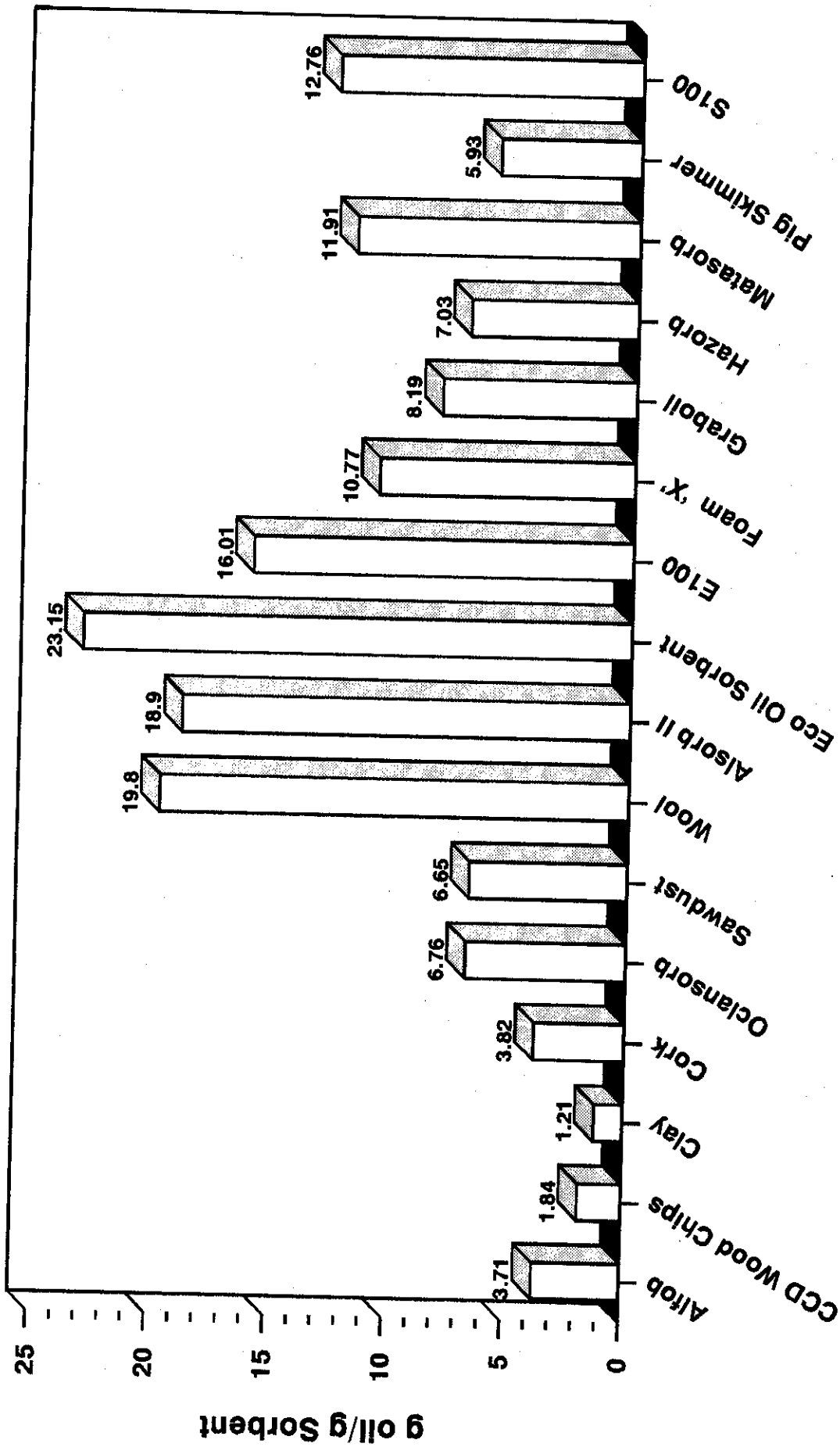

Figure A5 Average Initial Sorbent Capacity for Crude Oil - 7 Day Aged

Table A5 Initial and Maximum Capacities and Water Pickup (Crude - 7 Day Aged)

Sorbent	Reuses	Initial Oil Capacity (g oil/g sorbent)				Maximum Oil Capacity (g oil/g sorbent)				Initial Water Pickup (g water/g sorbent)				Maximum Water Pickup (g water/g sorbent)			
		1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
1. Alfob	1	3.76	3.89	3.49	3.71	3.76	3.89	3.49	3.71	0.14	0.11	0.09	0.11	0.14	0.11	0.09	0.11
2. CCD Wood Chips	0	1.85	1.99	1.67	1.84	1.85	1.99	1.67	1.84	0.03	0.03	0.01	0.02	0.03	0.03	0.01	0.02
3. Clay	0	1.25	1.11	1.27	1.21	1.25	1.11	1.27	1.21	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4. Cork	3	4.01	3.39	4.07	3.82	4.01	3.39	4.07	3.82	0.03	0.04	0.06	0.04	0.17	0.04	0.04	0.08
5. Oclansorb	5	7.07	6.24	6.96	6.76	6.93	7.60	6.93	7.15	0.16	0.09	0.09	0.12	0.44	0.82	0.69	0.65
6. Sawdust	0	6.05	7.06	6.85	6.65	6.05	7.05	6.85	6.65	0.05	0.03	0.01	0.03	0.05	0.03	0.01	0.03
7. Wool	5	19.67	20.43	19.30	19.80	19.67	20.43	19.30	19.80	0.13	0.13	0.13	0.13	0.20	0.33	0.40	0.31
8. Alsorb II	5	18.52	18.95	19.22	18.90	18.52	18.95	19.22	18.90	0.05	0.16	0.22	0.14	0.05	0.16	0.22	0.14
9. Eco Oil Sorbent	5	23.45	23.25	22.75	23.15	23.45	23.25	22.75	23.15	0.80	0.140	0.60	0.93	0.80	1.40	0.60	0.93
10. E100	1	17.48	14.81	15.74	16.01	17.48	14.81	15.74	16.01	0.05	0.02	0.04	0.04	0.05	0.02	0.04	0.04
11. Foam "X"	0	11.62	11.07	9.63	10.77	11.62	11.07	9.63	10.77	0.03	0.00	0.01	0.01	0.03	0.00	0.01	0.01
12. Graboil	5	7.12	7.86	9.60	8.19	25.58	29.84	26.72	27.38	0.04	0.02	0.04	0.03	0.65	2.00	2.80	1.82
13. Hazorb	2	7.15	6.90	7.03	7.03	7.15	6.90	7.03	7.03	0.20	0.18	0.25	0.21	0.20	0.18	0.25	0.21
14. Matasorb	2	11.42	11.92	12.39	11.91	11.42	11.92	12.39	11.91	0.05	0.03	0.00	0.03	0.05	0.03	0.00	0.03
15. Pig Skimmer	4	5.63	6.22	5.93	5.93	5.63	6.22	5.93	5.93	0.20	0.25	0.13	0.19	0.20	0.25	0.13	0.19
16. S100	5	13.23	13.33	11.72	12.76	13.23	13.33	11.72	12.76	0.03	0.05	0.02	0.03	0.03	0.05	0.02	0.03

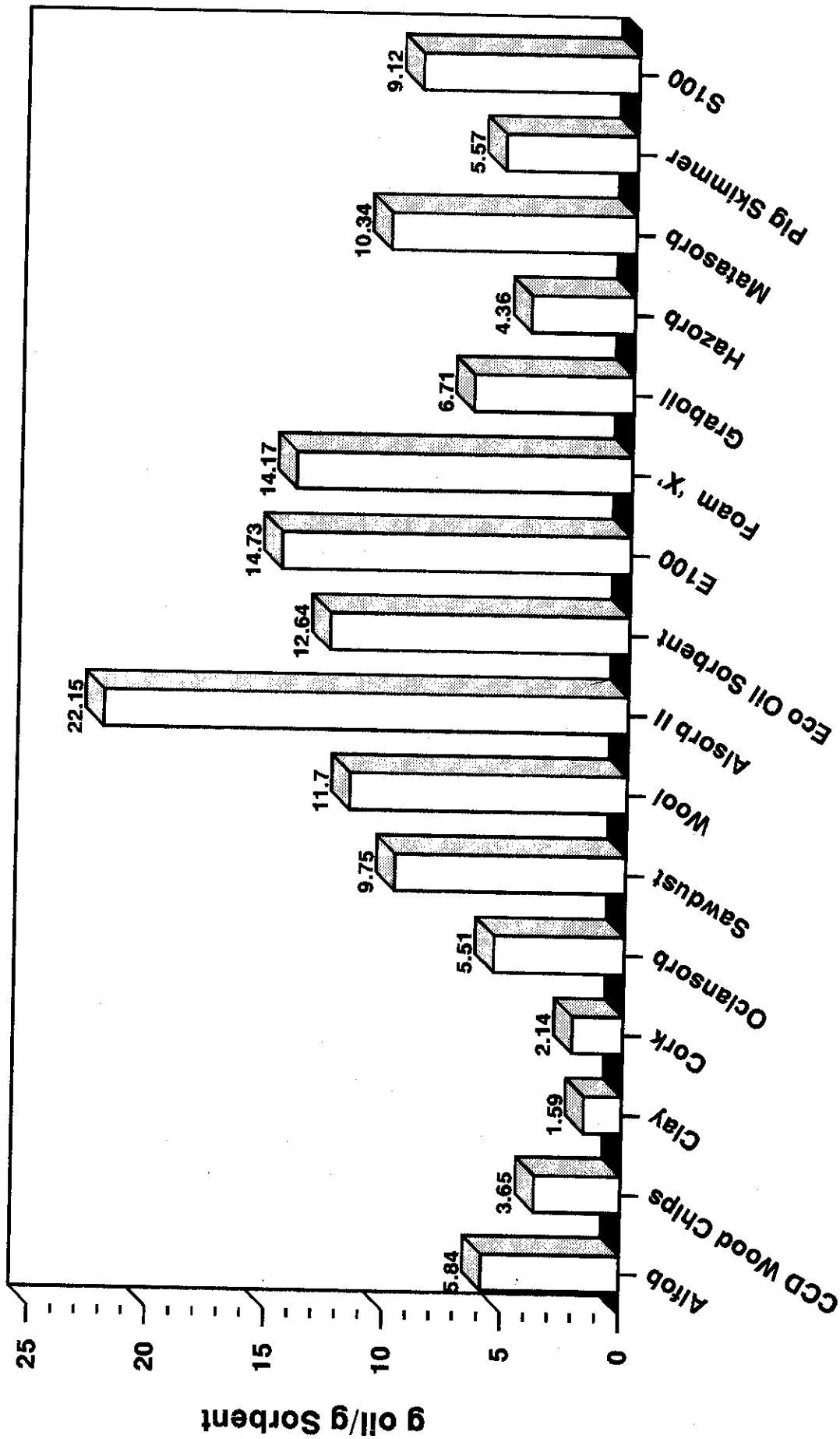

Figure A6 Average Initial Sorbent Capacity for Bunker C

Table A6 Initial and Maximum Capacities and Water Pickup (Bunker C)

Sorbent	Reuses	Initial Oil Capacity (g oil/g sorbent)				Maximum Oil Capacity (g oil/g sorbent)				Initial Water Pickup (g water/g sorbent)				Maximum Water Pickup (g water/g sorbent)			
		1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
1. Alfob	2	5.01	6.54	5.96	5.84	5.01	6.54	5.96	5.84	0.00	0.00	0.00	0.00	0.02	0.01	0.13	0.05
2. CCD Wood Chips	0	3.55	4.18	3.24	3.65	3.55	4.18	3.24	3.65	0.03	0.00	0.03	0.02	0.03	0.00	0.03	0.02
3. Clay	0	1.58	1.81	1.37	1.59	1.58	1.81	1.37	1.59	0.03	0.05	0.03	0.04	0.03	0.05	0.03	0.04
4. Cork	5	1.91	2.14	2.36	2.14	3.03	2.83	2.14	2.67	0.10	0.04	0.04	0.06	0.66	0.07	0.11	0.28
5. Oclansorb	5	5.48	5.43	5.63	5.51	5.48	5.43	5.63	5.51	0.01	0.01	0.01	0.01	0.29	0.29	0.29	0.29
6. Sawdust	0	11.19	10.59	7.49	9.75	11.19	10.59	7.49	9.75	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
7. Wool	5	8.37	13.87	12.87	11.70	16.30	18.63	24.23	19.72	0.10	0.00	0.00	0.03	0.40	0.33	0.30	0.34
8. Alsorb II	1	23.09	22.83	20.55	22.15	23.09	22.83	20.55	22.15	0.05	0.17	0.14	0.12	0.18	0.02	0.09	0.10
9. Eco Oil Sorbent	4	13.45	13.65	10.83	12.64	22.65	17.85	15.70	18.73	0.45	0.10	0.08	0.21	0.45	0.10	0.08	0.21
10. E100	2	15.41	14.12	14.67	14.73	15.41	14.12	14.67	14.73	0.02	0.00	0.02	0.01	0.02	0.00	0.02	0.01
11. Foam "X"	0	14.85	15.12	12.53	14.17	14.85	15.12	12.53	14.17	0.30	0.33	0.35	0.33	0.30	0.33	0.35	0.33
12. Graboil	5	6.76	6.21	7.17	6.71	44.18	43.53	29.39	39.03	0.00	0.03	0.00	0.01	0.18	0.12	0.39	0.23
13. Hazorb	2	4.00	5.00	4.08	4.36	3.93	5.03	4.20	4.38	1.20	0.83	0.75	0.92	1.20	0.83	0.75	0.92
14. Matasorb	2	10.35	9.96	10.72	10.34	10.35	9.96	10.72	10.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15. Pig Skimmer	1	4.72	6.07	5.92	5.57	4.72	6.07	5.92	5.57	0.07	0.02	0.05	0.04	0.07	0.02	0.05	0.04
16. S100	5	8.11	9.61	9.65	9.12	8.11	9.61	9.65	9.12	0.00	0.00	0.00	0.00	0.04	0.21	0.04	0.10

Table A7 Thin-film Test - Initial Capacity and Water Pickup

Sorbent	0-Day Aged Cyclohexane								0-Day Aged Toluene							
	Initial Oil Capacity (g oil/g sorbent)				Initial Water Pickup (g water/g sorbent)				Initial Oil Capacity (g oil/g sorbent)				Initial Water Pickup (g water/g sorbent)			
	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
1. Alfob	0.80	0.69	0.77	0.75	0.04	0.40	0.47	0.30	0.89	0.91	0.69	0.83	0.39	0.34	0.59	0.44
2. CCD Wood Chips	0.55	0.73	0.71	0.66	0.24	0.31	0.44	0.33	0.80	0.63	0.78	0.73	0.19	0.09	0.11	0.13
3. Clay	0.91	0.93	0.91	0.92	0.00	0.00	0.00	0.00	0.98	0.89	0.98	0.95	0.00	0.00	0.00	0.00
4. Cork	0.37	0.29	0.30	0.32	0.00	0.00	0.00	0.00	0.57	0.60	0.54	0.57	0.00	0.00	0.00	0.00
5. Oclansorb	0.51	0.45	1.00	0.65	0.00	0.00	0.00	0.00	1.51	1.45	3.40	2.12	0.00	2.24	2.27	1.50
6. Sawdust *																
7. Wool	0.70	0.70	0.63	0.68	0.20	0.20	0.53	0.31	1.77	1.87	0.80	1.48	1.57	2.03	0.60	1.40
8. Alsorb II	0.95	1.76	1.14	1.28	0.00	0.00	0.00	0.00	2.17	1.94	1.68	1.93	0.00	0.00	0.00	0.00
9. Eco Oil Sorbent	3.90	1.95	2.00	2.62	0.45	2.40	2.20	1.68	2.15	2.00	2.95	2.37	6.50	4.45	7.75	6.23
10. E100	0.28	0.37	0.16	0.27	0.00	0.00	0.00	0.00	0.50	0.46	0.62	0.53	0.00	0.00	0.00	0.00
11. Foam "X"	0.68	0.72		0.70	0.13	0.22		0.18	1.20	1.00		1.10	0.63	0.60		0.62
12. Graboil	1.00	0.79	0.69	0.83	0.88	0.82	0.94	0.88	0.91	1.12	0.94	0.99	0.78	0.79	1.36	0.98
13. Hazorb	1.93	1.72	1.55	1.73	3.23	2.85	3.35	3.14	1.28	1.35	2.10	1.57	3.30	3.60	4.03	3.64
14. Matasorb	0.20	0.29	0.38	0.29	0.00	0.00	0.00	0.00	0.64	0.84	0.64	0.71	0.00	0.00	0.00	0.00
15. Pig Skimmer	0.45	0.45	0.45	0.45	0.07	0.00	0.00	0.02	0.63	0.63	0.50	0.59	0.03	0.05	0.02	0.03
16. S100	0.41	0.31	0.35	0.35	0.00	0.00	0.00	0.00	1.04	0.83	0.60	0.82	0.00	0.00	0.00	0.00

* Sawdust sank during testing

Table A8 Thin-film Test - Initial Capacity and Water Pickup

Sorbent	1-Day Aged Diesel								1-Day Aged Crude							
	Initial Oil Capacity (g oil/g sorbent)				Initial Water Pickup (g water/g sorbent)				Initial Oil Capacity (g oil/g sorbent)				Initial Water Pickup (g water/g sorbent)			
	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
1. Alfob	0.63	0.36	0.44	0.48	0.13	0.07	0.26	0.15	0.50	0.59	0.56	0.55	0.14	0.16	0.20	0.17
2. CCD Wood Chips	0.50	0.49	0.48	0.49	0.31	0.33	0.19	0.28	0.43	0.46	0.41	0.43	0.15	0.15	0.23	0.18
3. Clay	0.75	0.69	0.71	0.72	0.21	0.22	0.21	0.21	0.89	0.89		0.89	0.04	0.03		0.03
4. Cork	0.40	0.53		0.46	0.07	0.01		0.04	0.34	0.38	0.45	0.39	0.03	0.01	0.01	0.01
5. Oclansorb	2.32	2.55		2.43	0.01	0.16		0.09	0.56	0.87	0.71	0.72	0.00	0.00	0.00	0.00
6. Sawdust *																
7. Wool	1.20	1.33	1.20	1.24	0.13	0.67	0.27	0.36	1.10	1.00	0.43	0.84	0.13	0.10	0.07	0.10
8. Alsorb II	1.47	1.09	1.00	1.19	0.00	0.00	0.00	0.00	1.29	1.45	1.41	1.38	0.00	0.02	0.05	0.02
9. Eco Oil Sorbent	2.40	1.85	1.90	2.05	3.20	3.65	3.65	3.50	1.65	1.40	1.65	1.57	0.30	0.70	0.60	0.53
10. E100	0.52	0.56	0.94	0.67	0.00	0.00	0.00	0.00	1.07	0.84	0.87	0.93	0.00	0.03	0.02	0.02
11. Foam "X"	0.87	0.83		0.85	0.15	0.08		0.12	1.07	0.55		0.81	0.48	0.08		0.28
12. Graboil	1.24	1.15	1.06	1.15	1.73	0.67	1.76	1.38	1.61	2.00	2.03	1.88	0.33	0.11	0.03	0.16
13. Hazorb																
14. Matasorb	0.55	0.90	1.13	0.86	0.00	0.00	0.00	0.00	0.66	1.00	1.11	0.92	0.02	0.00	0.02	0.01
15. Pig Skimmer	0.43	0.38	0.38	0.40	0.02	0.12	0.08	0.07	0.48	0.40	0.38	0.42	0.12	0.20	0.18	0.17
16. S100	0.97	0.80	1.07	0.94	0.00	0.00	0.00	0.00	0.59	0.62	0.65	0.62	0.00	0.03	0.00	0.01

Sawdust sank during testing

Table A9 Thin-film Test - Initial Capacity and Water Pickup

	1-Day Aged Bunker C							
	Initial Oil Capacity (g oil/g sorbent)				Initial Water Pickup (g water/g sorbent)			
	1	2	3	Avg.	1	2	3	Avg.
1. Alfob	0.90	0.81	0.71	0.81	0.17	0.10	0.11	0.13
2. CCD Wood Chips	0.69	0.74	0.66	0.70	0.14	0.10	0.11	0.12
3. Clay	1.13	1.02	1.19	1.11	0.05	0.14	0.11	0.10
4. Cork	0.56	0.51	0.45	0.51	0.01	0.01	0.01	0.01
5. Oclansorb	1.75	2.22	1.44	1.80	0.07	0.45	0.24	0.25
6. Sawdust *								
7. Wool	1.60	1.80	1.47	1.62	0.30	0.30	0.17	0.26
8. Alsorb II	1.80	2.18	1.95	1.98	0.10	0.05	0.05	0.06
9. Eco Oil Sorbent	2.10	2.15	2.05	2.10	0.60	0.25	0.80	0.55
10. E100	0.77	1.17	1.36	1.10	0.12	0.13	0.08	0.11
11. Foam "X"	1.07	0.87	0.88	0.94	0.03	0.40	0.23	0.22
12. Graboil	1.35	1.50	2.05	1.63	0.25	0.17	0.45	0.29
13. Hazorb								
14. Matasorb	1.28	1.08	1.25	1.20	0.12	0.08	0.04	0.08
15. Pig Skimmer	0.70	0.63	0.62	0.65	0.08	0.12	0.07	0.09
16. S100	1.29	0.96	0.93	1.06	0.08	0.07	0.04	0.06

* Sawdust sank during testing

Appendix B

Information on Sorbent Use and Characteristics

This appendix contains summary data sheets for each sorbent compiled from available manufacturer's literature. The data sheets include a photograph of the sorbent and a figure depicting initial capacity and water pickup for each test liquid (from this study's results). A list of physical properties, "claimed performance"* and application data are also included where provided by the manufacturer.

Sorbents are in the same order as they appear in the report. Data sheets are also provided for two sorbents that could not be tested.

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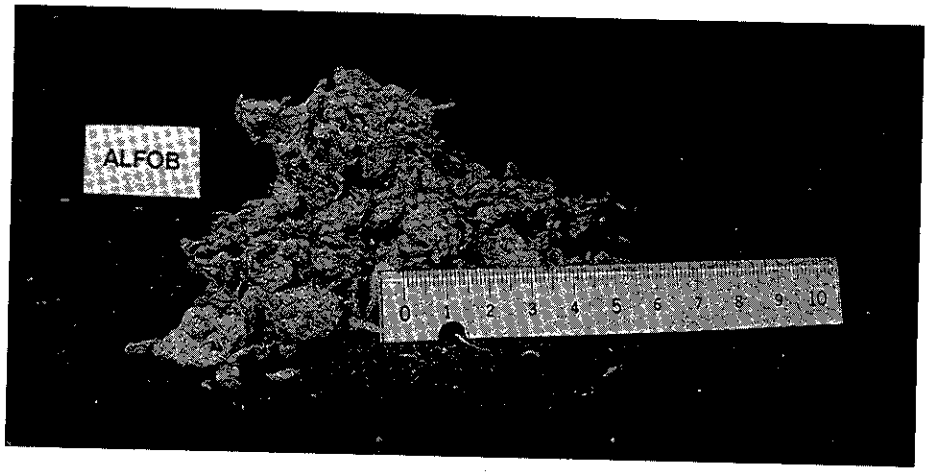
* Claimed performance standards refer to data which were obtained by the manufacturers of the sorbent product. The data in this section, therefore, have not been verified by a third party.

1. Trade Name: ***Alfob W (all purpose)***



Type: Processed cellulose fibre

Available Geometry: Wicks, socks, pillows or booms, 50-L plastic bags

Distributor:

Mr. Ray Little, Mr. Larry Kopp
Total Absorb Inc.
101-11471 Blacksmith Place
Richmond, British Columbia
V7A 4T7
(604) 275-5171

Mr. David Smith
Absorption Corp.
Suite 820
1130 West Pender Street
Vancouver, British Columbia
V6E 4A4
(604) 681-6181

Cost:

Physical Properties

Bulk Density: 6.35 kg/50 L

Shelf Life: Indefinite

Storage Requirements:

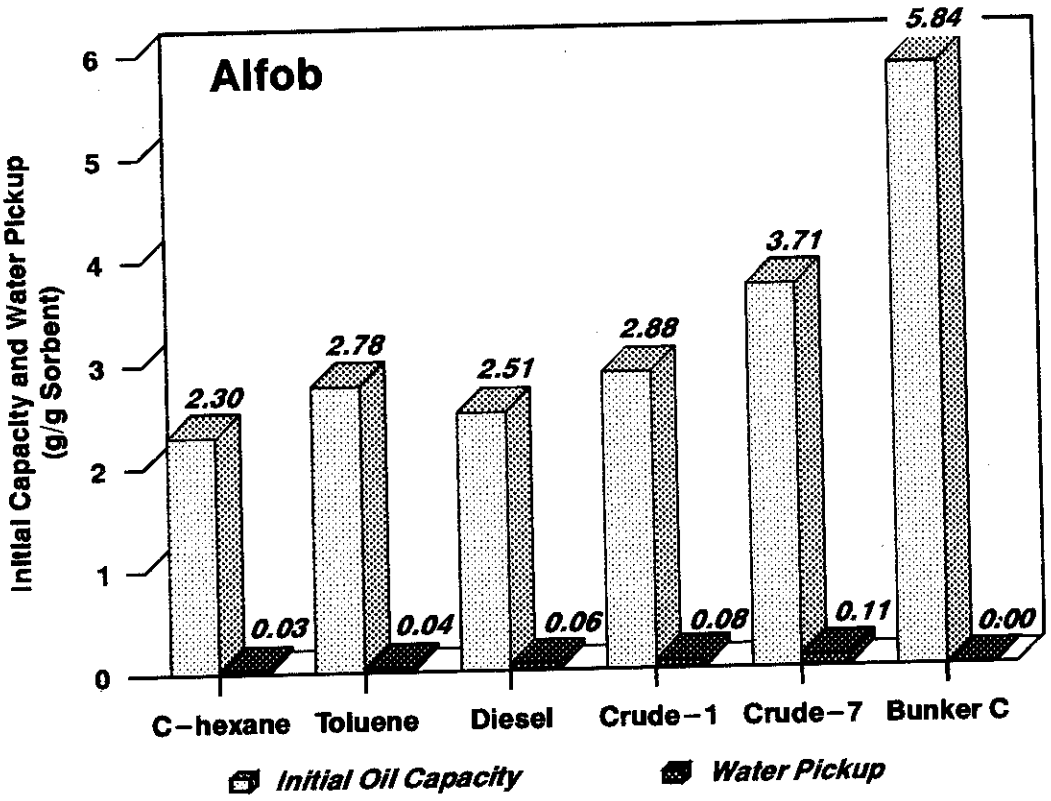
Performance

Oil Pickup Ratio: 1:3 sorbent: oil, by weight

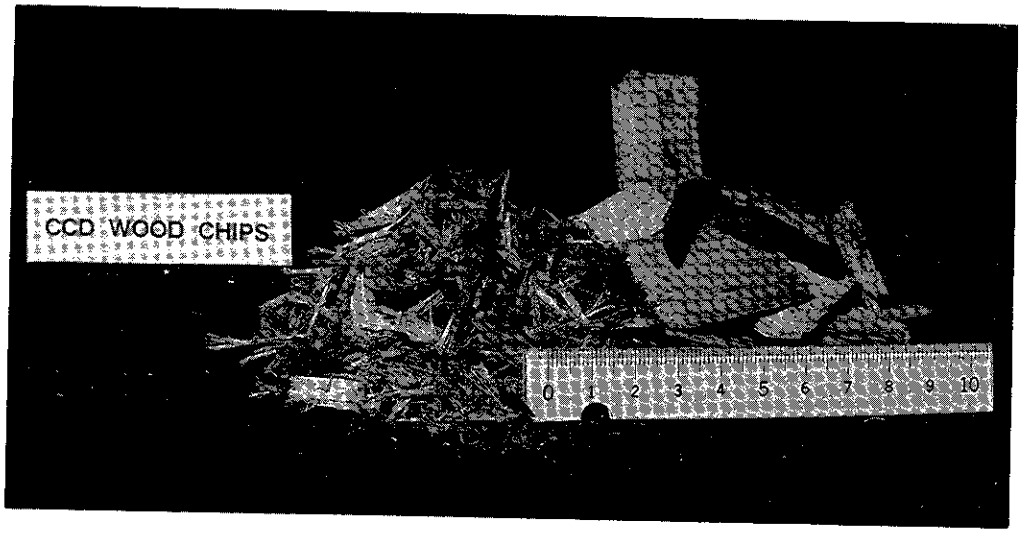
Reusability: Until saturation

Application

Type of Spill:	Emergency shore and seashore cleanup of oils, emulsions, detergents, fuels, effluents, chemicals
Recommended Dosage:	1:3
Equipment Required:	Manual, mechanical blower, heavy equipment
Reaction Time:	Works on contact
Retrieval Method:	Industrial vacuum, manual, heavy equipment
Disposal:	Incineration
Toxicity:	Nontoxic



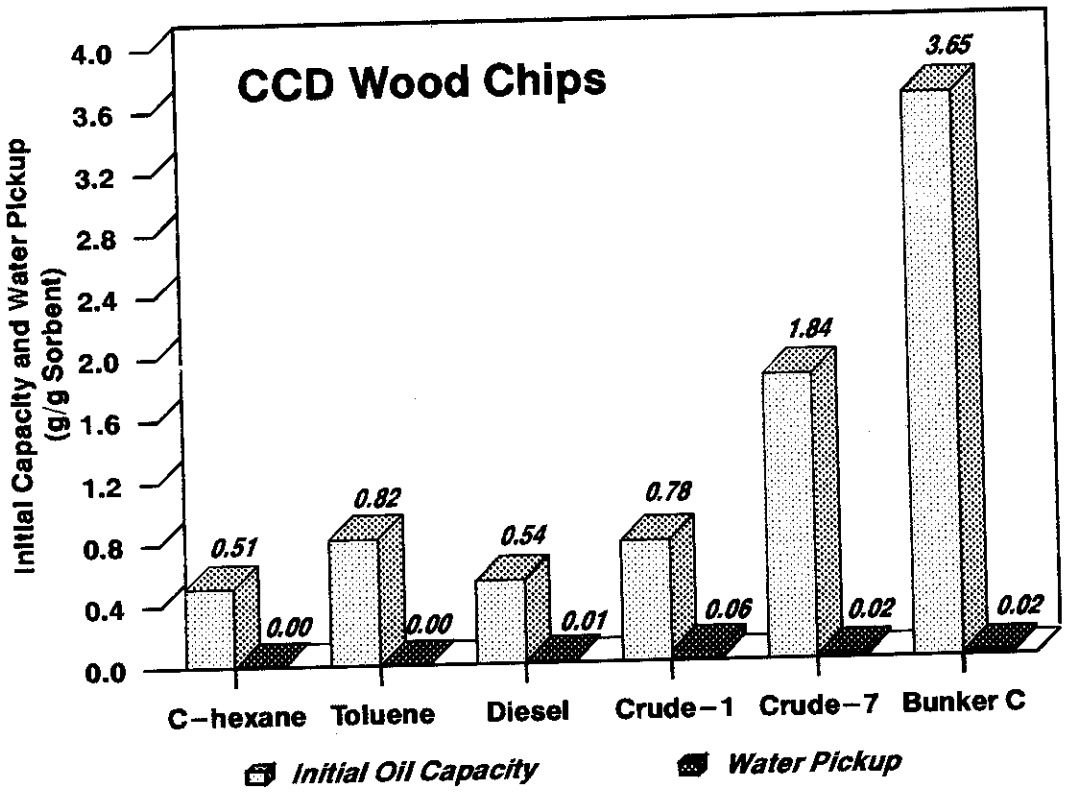
2. Trade Name: ***CCD Wood Chips***



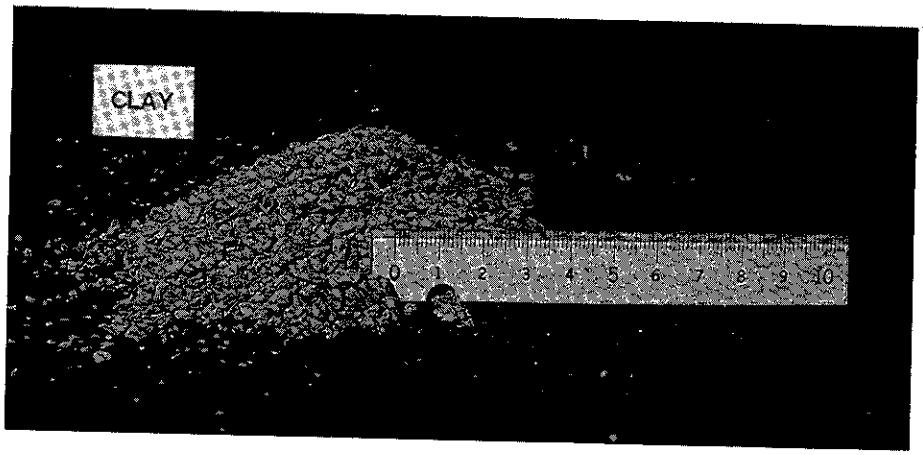
Type:	Processed and treated wood products
Available Geometry:	Grade 1 Grade 2 Grade 3
Distributor:	Jane Simmons, Vice President, Marketing Carbontec Industries Inc. 400 East Broadway Bismark, North Dakota 58501 Tel: (701) 224-9989 Fax: (701) 224-1720
Cost:	Available on request
Physical Properties	
Bulk Density:	17 lb/ft^3 (272 kg/m^3)
Shelf Life:	Indefinite
Storage Requirements:	Dry storage
Performance	
Oil Pickup Ratio:	Grades 1 and 2; 1:1 to 1:4 by weight sorbent: oil Grades 3; 1:3 to 1:10 by weight sorbent:oil
Reusability:	Subject to separation techniques

Application

Type of Spill:	Crude oil, Bunker C, gasoline and some light distillates
Recommended Dosage:	Up to 1:10 by weight depending on grade and oil viscosity
Equipment Required:	Broadcast manually or by mechanical blower, and aerially by helicopter and airplane
Reaction Time:	Immediate
Retrieval Method:	Mechanical recovery and *in situ* burning
Disposal:	Incineration, landfill
Toxicity:	Nontoxic

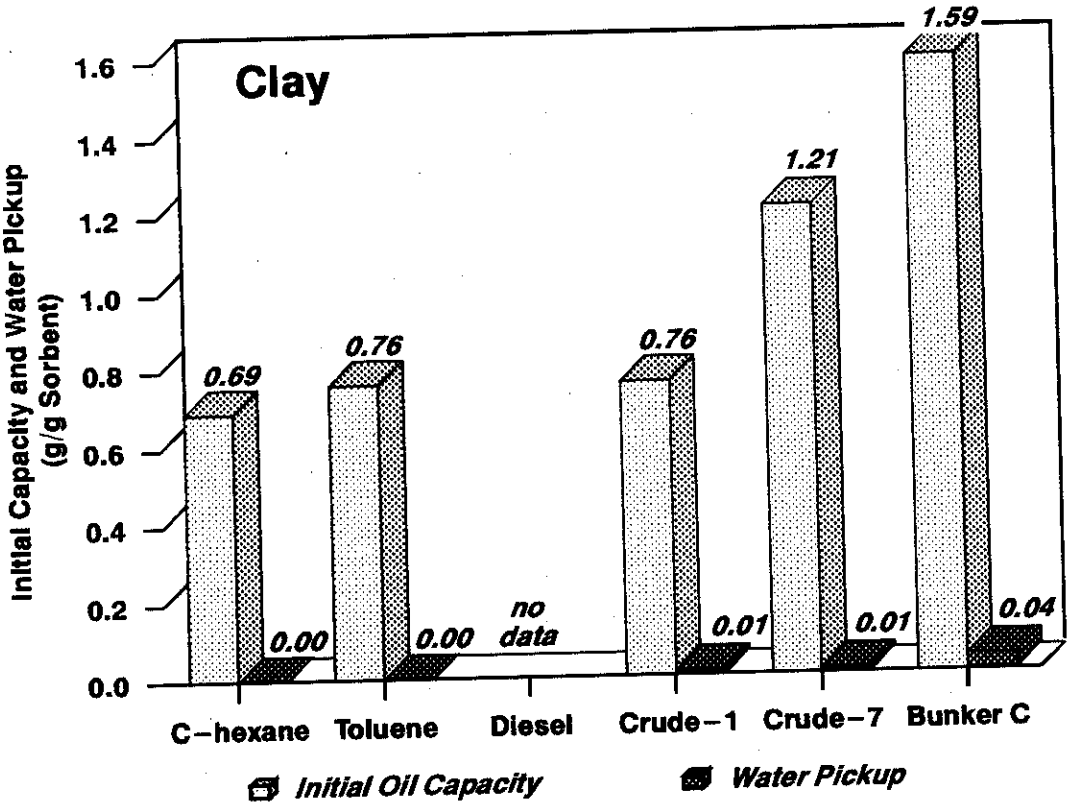


3. Trade Name: ***ABSORB+***

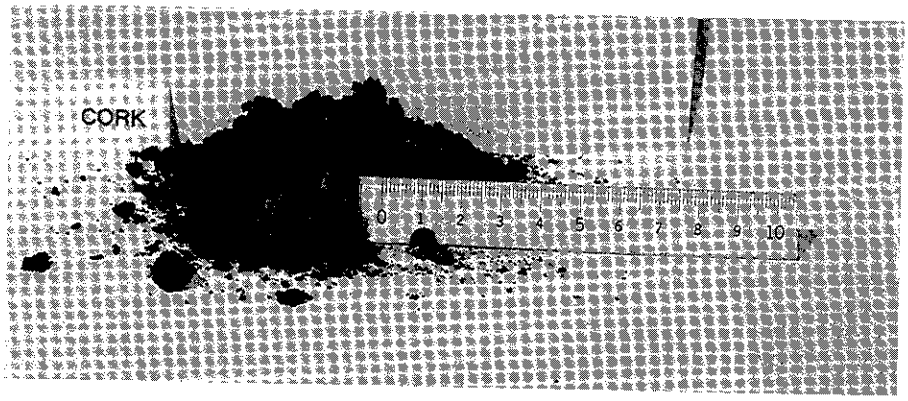


Type:	Clay
Available Geometry:	4 ply paper bag of 40 or 50 lb (18 or 23 kg)
Distributor:	Mr. Pierre Beauregard Sales Representative Lignum Sawdust Products (Canada) Inc. 5204 Salaberry Carignan, Quebec J3L 3P9 (514) 658-4047; Fax: (514) 447-3254
Cost:	
Physical Properties	
Bulk Density:	37 to 42 lb/ft^3 (592 to 672 kg/m^3)
Shelf Life:	Indefinite
Storage Requirements:	Dry place to keep efficiency
Performance	
Oil Pickup Ratio:	Up to 1:15 (sorbent:oil ratio)
Reusability:	Until complete saturation
Application	
Type of Spill:	Light or heavy oils and chemical spills any places
Recommended Dosage:	1:5 depending on viscosity of oil

Equipment Required:	Manual labour or mechanical
Reaction Time:	Immediate to fast
Retrieval Method:	Manual or mechanical
Disposal:	Dispose in agreement with provincial and federal regulations (depending on type of spill)
Toxicity:	Nontoxic



4A. Trade Name: ***CAP^{TM} Cork Absorbent Products***



Type:	Heat-treated natural cork
Available Geometry:	Bulk, socks, pillows, booms, 10-lb (4.54 kg) bags
Distributor:	Sevenson Environmental Products Inc. 2749 Lockport Road Niagara Falls, New York 14302 Fax: U.S. - (716) 284-7645 Fax: CAN - (416) 333-5411 Phone: 1-800-777-3836
Cost:	

Physical Properties

Bulk Density:	6 lb/ft^3 (96 kg/m^3)
Shelf Life:	Indefinite
Storage Requirements:	None

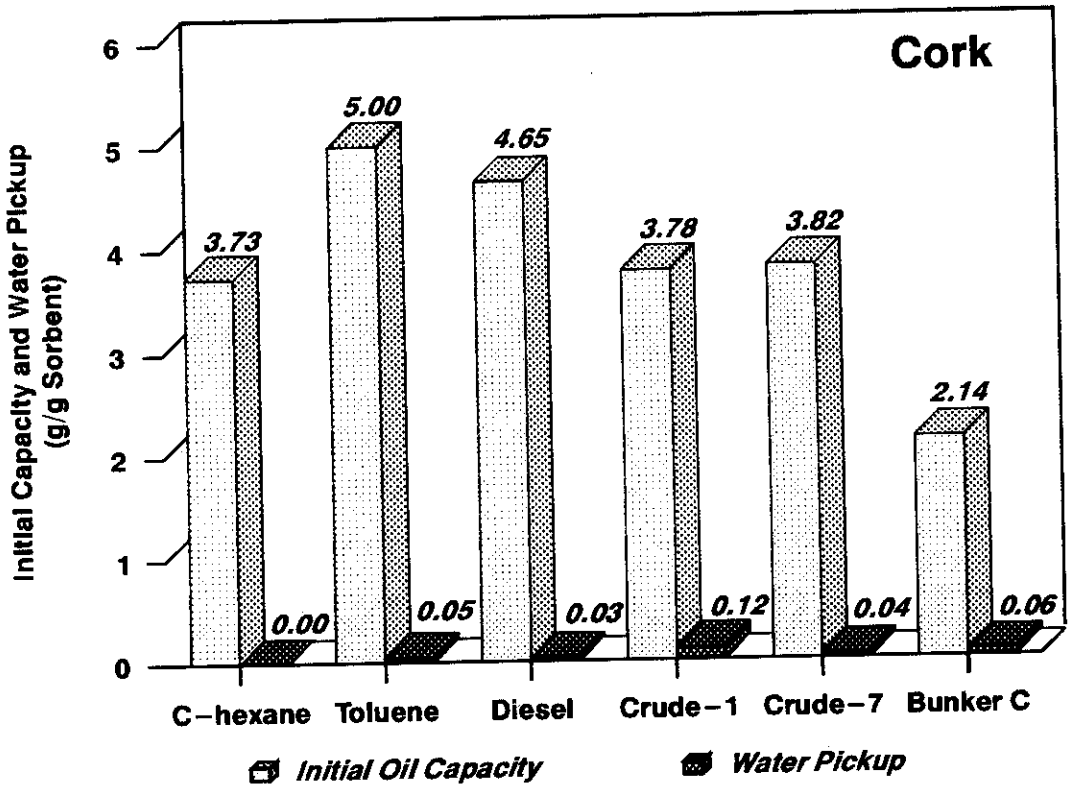
Performance

Oil Pickup Ratio:	Average 1:10 by weight sorbent to hydrocarbon, depending on viscosity
Reusability:	Reusable

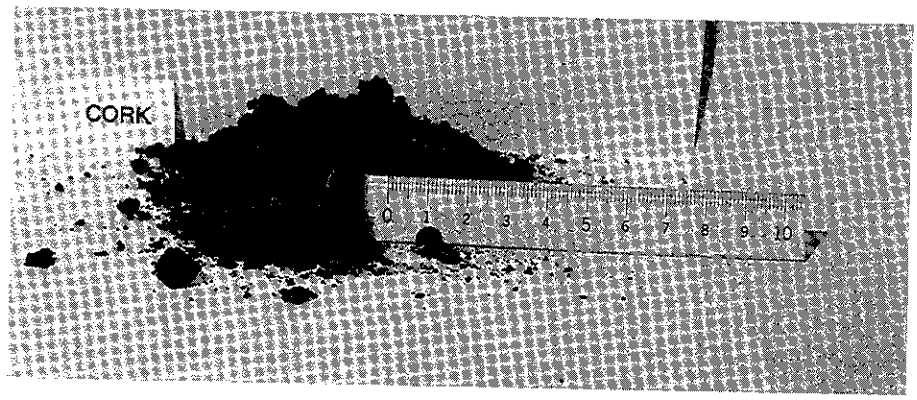
Application

Type of Spill:	Oil/hydrocarbons, non polar solvents
Recommended Dosage:	1 L (0.1 kg) to 1 L of oil
Equipment Required:	Nonspecific, manual-mechanical blower

Reaction Time:	Immediate to several minutes depending on viscosity
Retrieval Method:	Nets or surface skimmers
Disposal:	Incineration, biodegradation, landfill
Toxicity:	Nontoxic

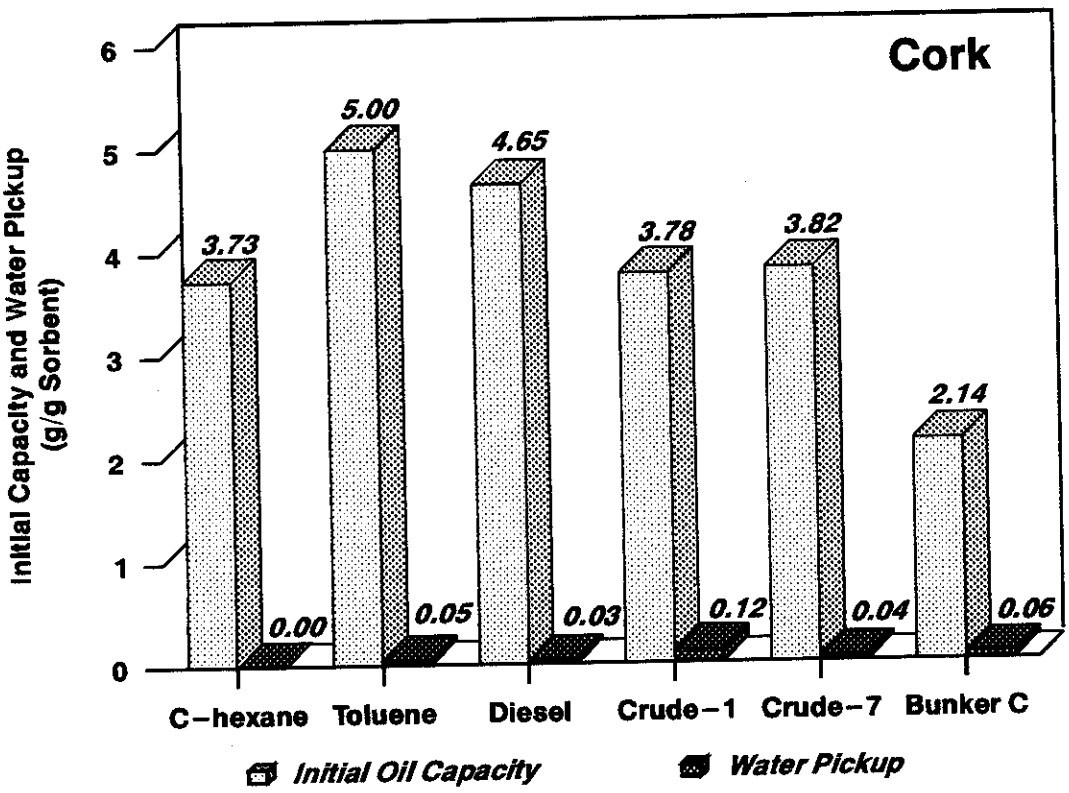


4B. Trade Name: ***CORK CLEAN***

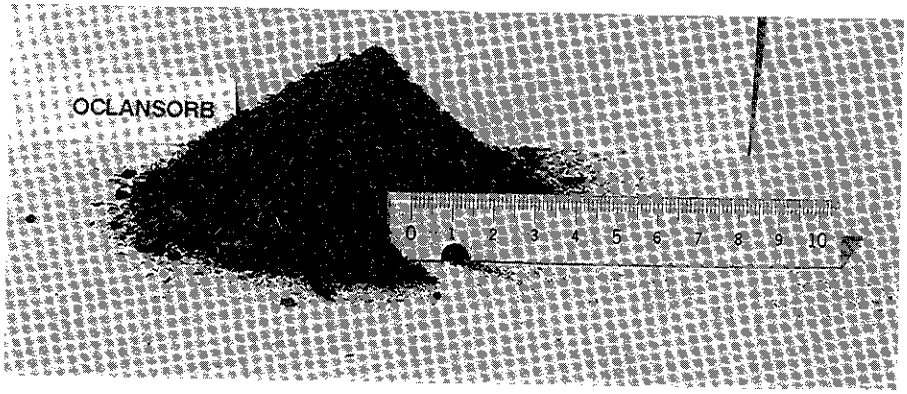


Type:	Heat-treated cork
Available Geometry:	Granulated RK 8 Socks RK 10 Pads RK 12
Product for this test supplied by:	Cork Can. Inc. Box 636 Montague, P.E.I. C0A 1R0 (902) 838-4464
Cost:	Granulated form - $7.70/kg ($3.50/lb) quantity discount applicable
Physical Properties	
Bulk Density:	7 lb/ft^3 (112 kg/m^3)
Shelf Life:	Indefinite
Storage Requirements:	None
Performance	
Oil Pickup Ratio:	1:8 by weight of sorbent to hydrocarbon/solvent
Reusability:	Up to eight times dependent on hydrocarbon/solvent
Application	
Type of Spill:	All hydrocarbon/solvent that are not water soluble. Absorbs hydrocarbon/solvents from soil,off water, and solid surfaces

Recommended Dosage:	1 L or 0.12 kg/L of oil
Equipment Required:	Can vary with different applications of cleanup
Reaction Time:	Several minutes
Retrieval Method:	Manual or mechanical
Disposal:	Incineration, biodegradation, landfill (leachate test Ontario Regulation 309), low temperature burn (cork acts as a wick and is reusable)
Toxicity:	Nontoxic



5. Trade Name: ***Oclansorb***



Type:	Process treated natural peat fibre
Available Geometry:	Loose fibre, 13L and 44 L bags
Distributor:	Mr. Ron Meyers President and Technical Director AF Pollution Abatement Systems 174 Colonnade Road, Unit 35 Nepean, Ontario K2E 7J5 (613) 723-1847
Manufacturer:	Hi-Point Industries Ltd. P.O. Box 2535, Postal Station M Calgary, Alberta T2P 2N6 Inquiries: Mark Brown Director of Marketing 1-800-661-1675 Fax: (403) 290-6650
Cost:	$9.30/13L; $27.05/44 L

Physical Properties

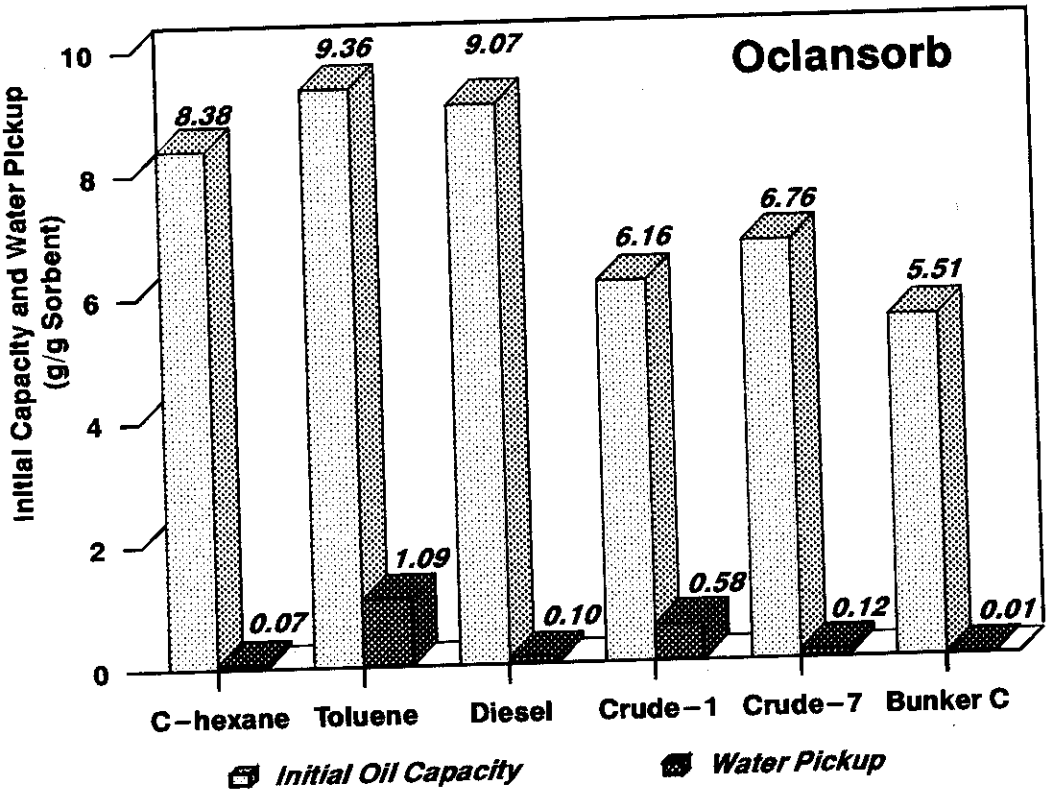
Bulk Density:	100 g/cm^3
Shelf Life:	Indefinite
Storage Requirements:	Dry place

Performance

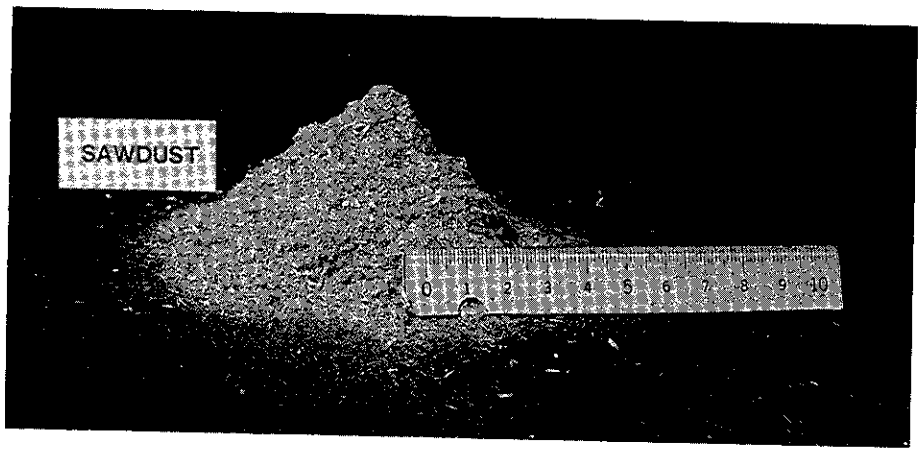
Oil Pickup Ratio:	Up to 1:12 sorbent:oil ratio,
Reusability:	No

Application

Type of Spill:	All hydrocarbon products including jet fuel, diesel fuel, oil etc. on land, water and around equipment
Recommended Dosage:	
Equipment Required:	Manual labour, Oclansorb spreader, power blower
Reaction Time:	Instant for all viscosities of oil
Retrieval Method:	Manual labour, suction, skimmers
Disposal:	Incineration or landfill, composting, landfarming
Toxicity:	Nontoxic, environmentally safe

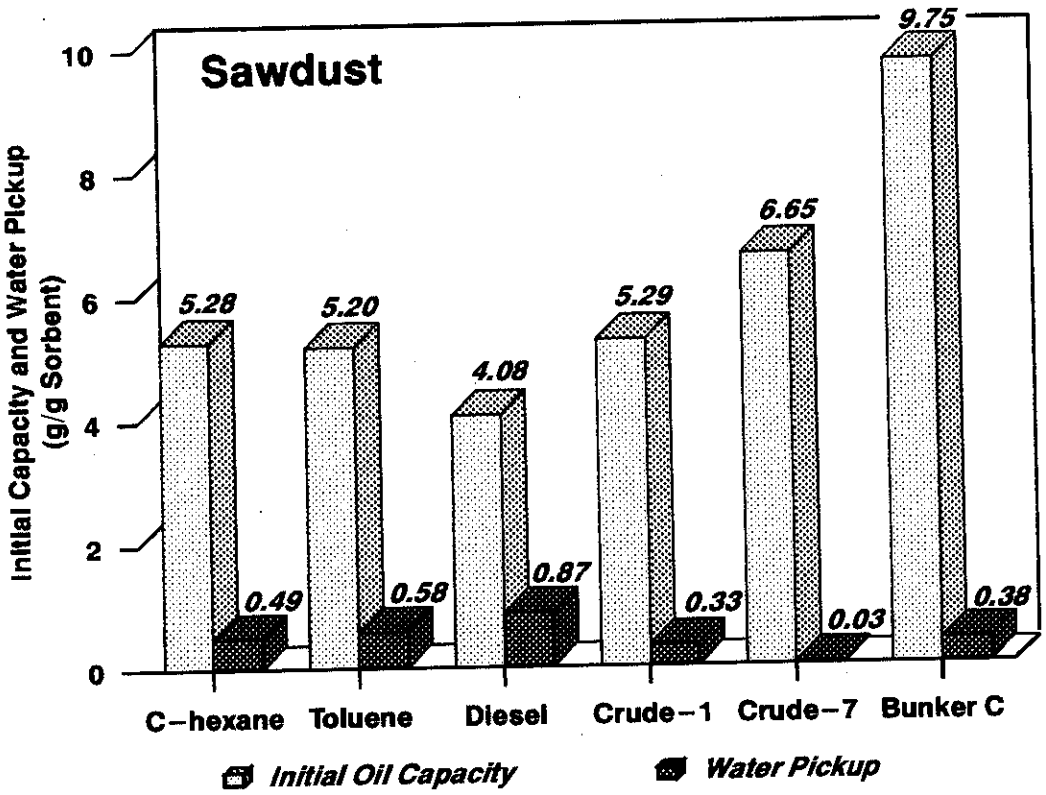


6. Trade Name: ***Lignum Products***

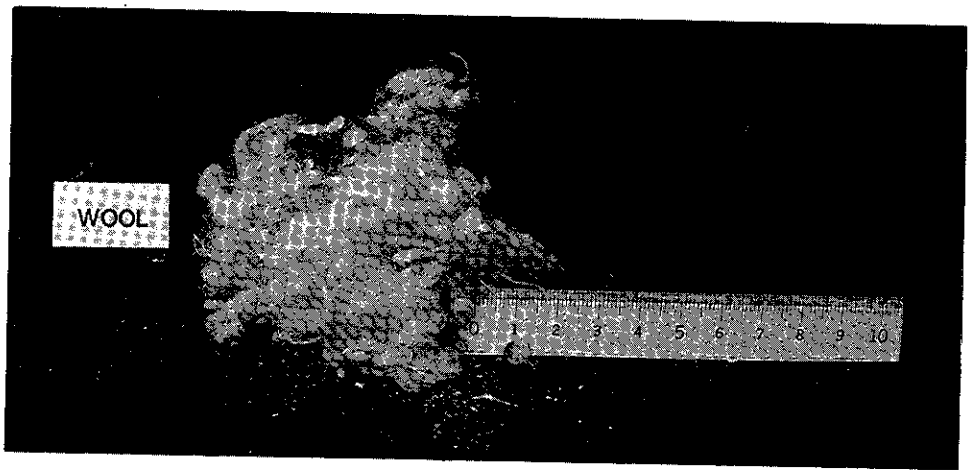


Type:	Sawdust
Available Geometry:	1.75 ft^3 (50 L) paper bags, bulk
Distributor:	Lignum Sawdust Products (Canada) Inc. 5204 Salaberry Carignan, Quebec J3L 3P9 (514) 658-4047 Fax: (514) 447-3254
Cost:	
Physical Properties	
Bulk Density:	25 to 30 lb/ft^3 (400 to 480 kg/m^3)
Shelf Life:	Indefinite
Storage Requirements:	Dry place
Performance	
Oil Pickup Ratio:	Up to 20:1 (oil:sawdust ratio) depending on viscosity of oil
Reusability:	Until complete saturation
Application	
Type of Spill:	Any type (oil, water, chemical)
Recommended Dosage:	20:1 depending on type of spill
Equipment Required:	Manual labour or mechanical

Reaction Time:	Immediate to fast
Retrieval Method:	Manual labour or mechanical
Disposal:	Dispose in agreement with provincial and federal regulations (depending on type of spill)
Toxicity:	Nontoxic



7. Trade Name: ***Wool Kmop***

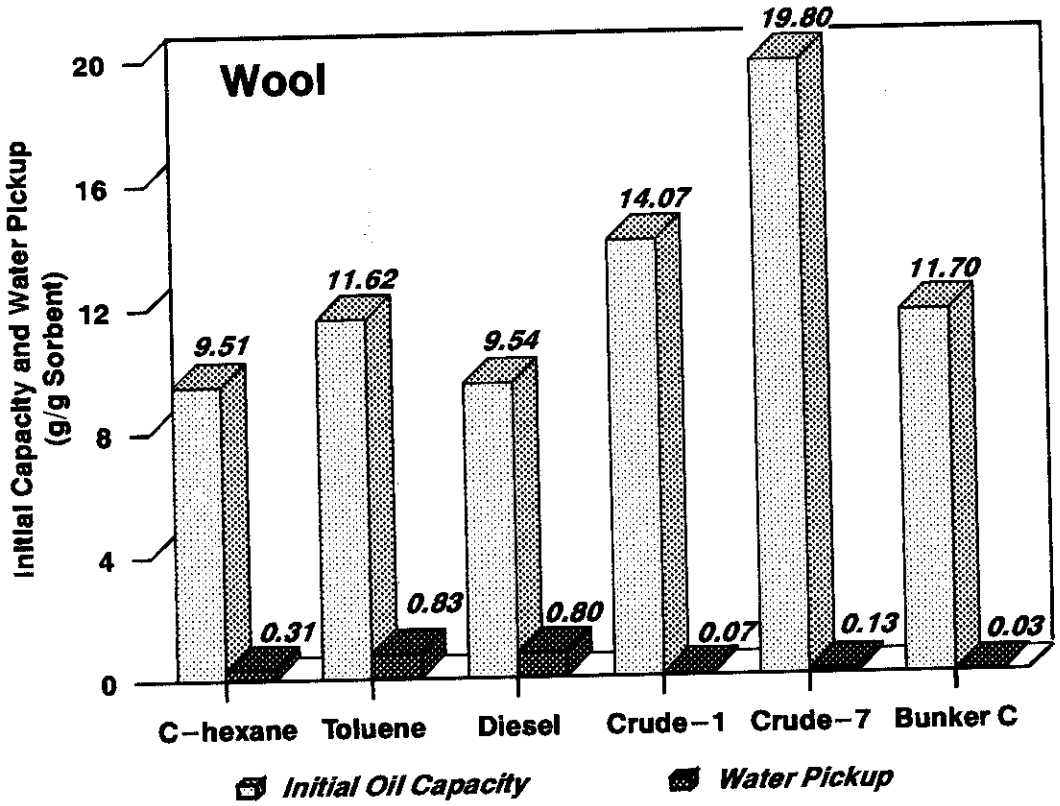


Type:	Treated wool
Available Geometry:	Bulk, loose form
Distributor:	Wool Research Organization of New Zealand (Inc.) Private Bag, Christchurch, New Zealand Tel: (011-643) 252-421 Fax: (011-643) 252-717
Cost:	
Physical Properties	Small spheres of wool fibre
Specific Volume:	Compressible uncompressed bulk, 30 cm^3/g
Shelf Life:	20 years plus
Storage Requirements:	Dry, rodent, and insect free
Performance	
Oil Pickup Ratio:	Up to 35x
Reusability:	Yes
Application	
Type of Spill:	Viscous oils
Recommended Dosage:	
Equipment Required:	May either be used loose or in boom or pillow form
Reaction Time:	Immediate with agitation

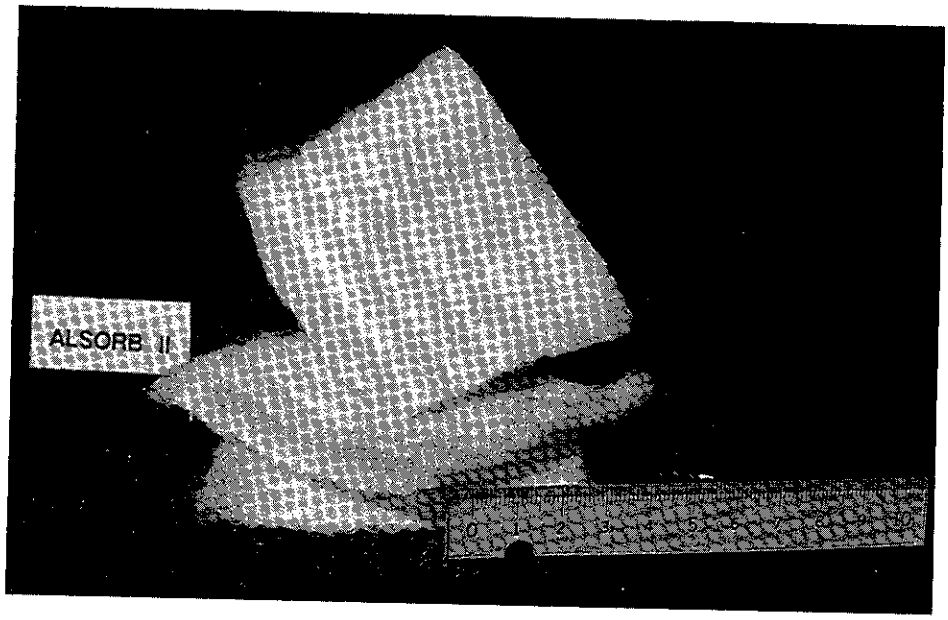
Retrieval Method: Variable

Disposal: Recycle or dispose using recommended standard methods

Toxicity: Nontoxic



8. Trade Name: ***ALSORB II***



Type: Stitch bonded polypropylene fibers

Available Geometry: Rolls 18" × 150' (0.5 × 46 m), 36" × 150' (1 × 46 m), 36" × 300' (1 × 91 m), perforations optional on 18" (0.5 m), 36" (1 m) rolls (sheets)

Distributors:

Mr. John Misener
Cdn. Sales Rep
Applied Fabric
Technologies Inc.
Box 9 Albino Hills,
Ridgeway, Ontario
L0S 1N0
(416) 894-4012

CFA Industries Inc.
110 Snow Blvd.
Unit 1
Concord, Ontario
L4K 4B8
Fax: (416) 660-7747

Cost:
18" × 150' (0.5 × 46 m) = $108.00
36" × 150' (1 × 46 m) = $216.00
36" × 300' (1 × 91 m) = $432.00

Physical Properties

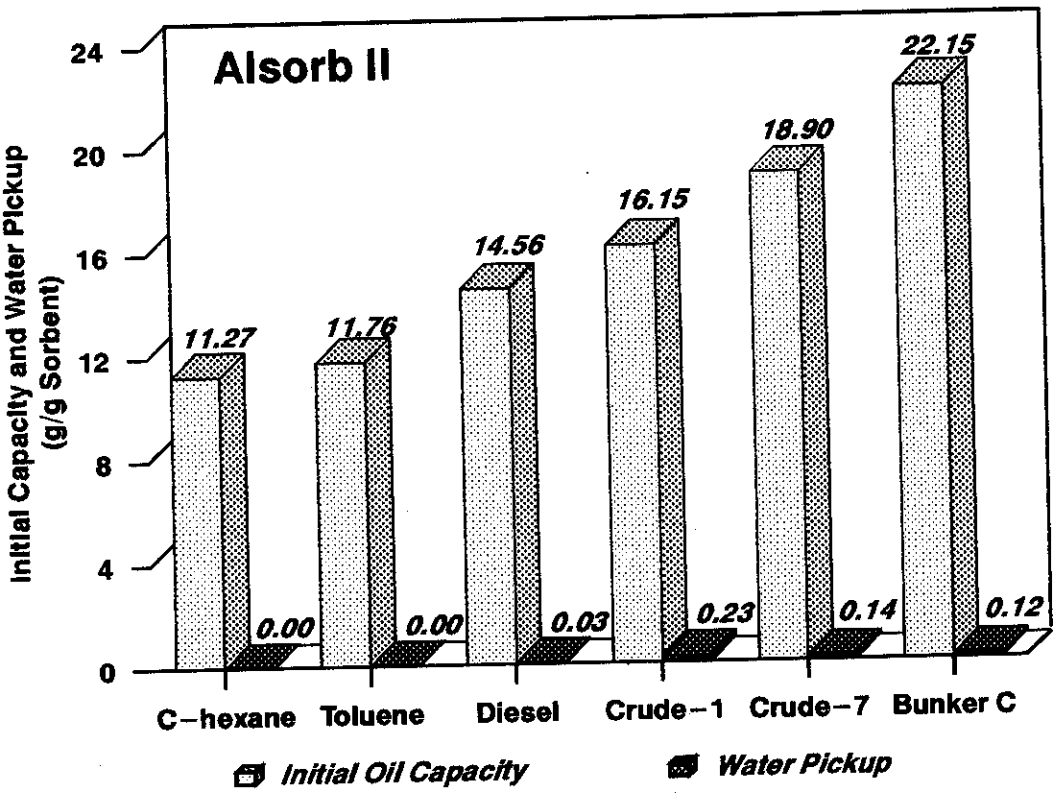
Bulk Density: 9.8 lb/ft^3 (156.8 kg/m^3)
Shelf Life: Indefinite
Storage Requirements: None

Performance

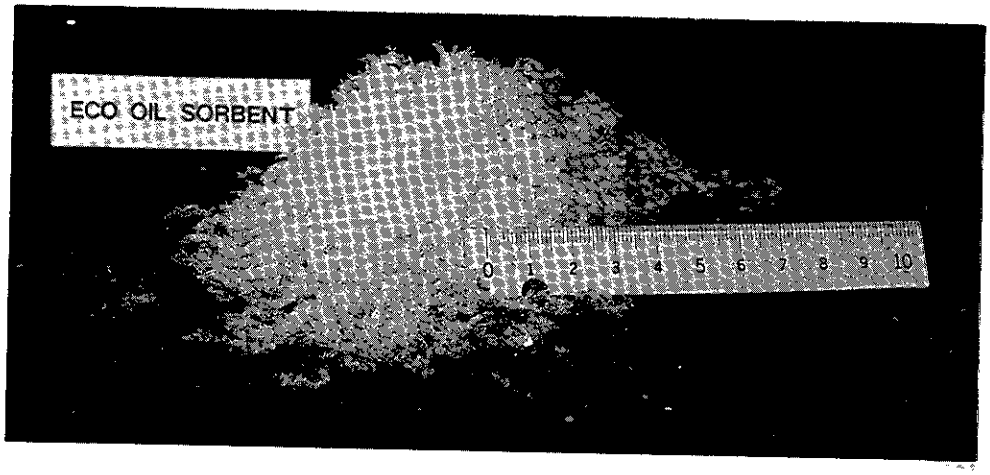
Oil Pickup Ratio: 1:4 to 1:20 by weight sorbent:solvent/oil
Reusability: Reusable - can remove oil with wringer or centrifuge

Application

Type of Spill:	Petroleum spill on sea and ashore, around machinery
Recommended Dosage:	1:4 to 1:20 part sorbent to parts of oil, depending on viscosity
Equipment Required:	Manual labour
Reaction Time:	Instantaneous
Retrieval Method:	Manual
Disposal:	Incineration or landfill
Toxicity:	Nontoxic, nonirritating



9. Trade Name: ***Eco Oil Sorbent***



Type:	Scrap polyolefin
Available Geometry:	Loose fill or packaged in netting
Distributor:	Ecoplastics Ltd. 518 Gordon Baker Road Willowdale, Ontario M2H 3B4 (416) 499-3060 Fax: (416) 499-3087
Cost:	

Physical Properties

Bulk Density:	16 kg/m^3; can be packed to 125 kg/m^3
Shelf Life:	Indefinite
Storage Requirements:	Keep from open flame

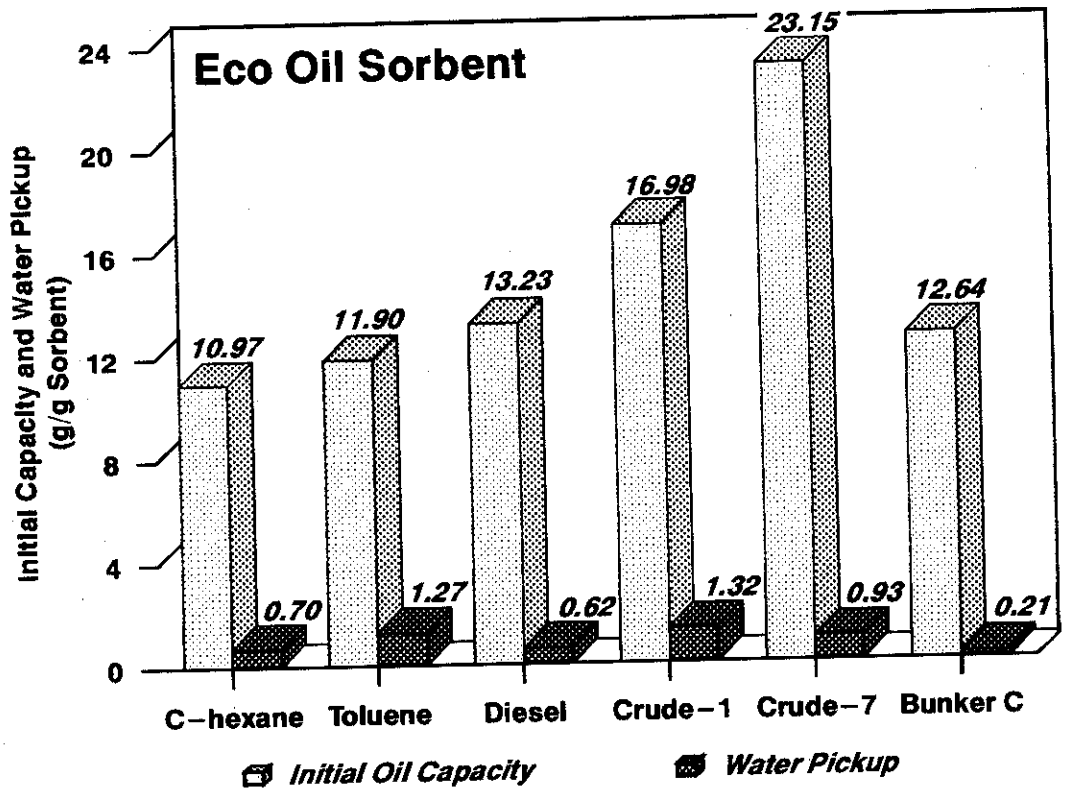
Performance

Oil Pickup Ratio:	1:9 to 1:23 by weight sorbent:oil depending on viscosity
Reusability:	Reusable

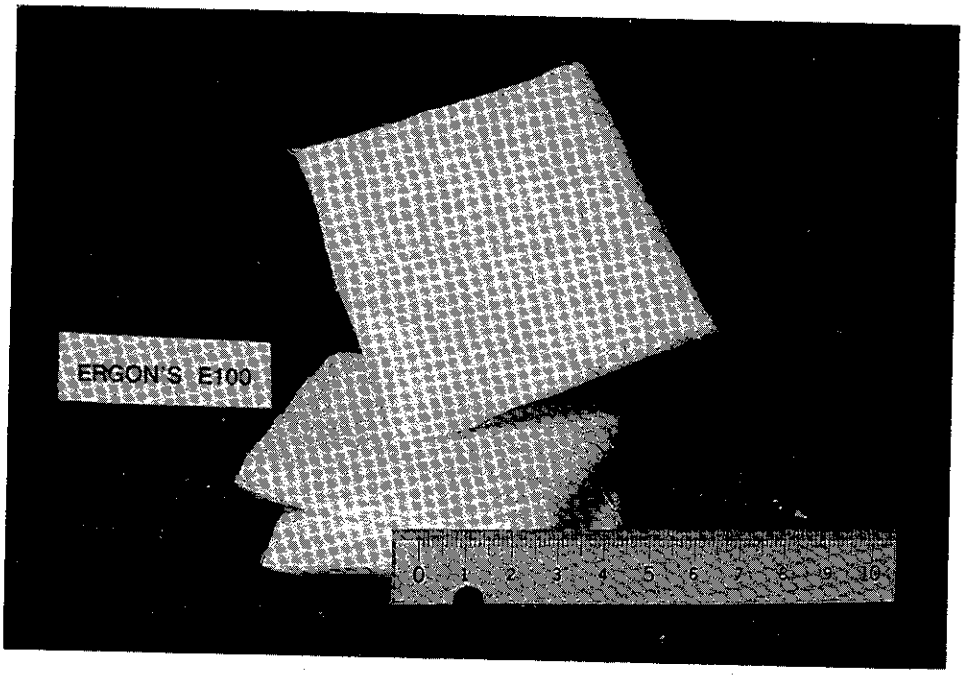
Application

Type of Spill:	Light to heavy oil, oil-soaked wildlife
Recommended Dosage:	1:9 to 1:23 by weight sorbent:oil
Equipment Required:	Manual labour

Reaction Time:	10 to 30 minutes to reach maximum capacity absorption depending on viscosity
Retrieval Method:	Manual, vacuum
Disposal:	Incineration, landfill
Toxicity:	Nontoxic



10. Trade Name: ***Ergon Oil Sorbents***



Type:	Nonwoven melt-blown polypropylene
Available Geometry:	Pads, rolls, pillows, booms (single and double - 8" (20 cm) and 4" (10 cm)) sweeps and loose particulate
Distributor:	Mr. Ronald Smith Pigmalion Environmental Services 1600 Aimco Blvd., Unit 9 Mississauga, Ontario L4W 1V1 (416) 629-9577
Manufacturer:	Ergon Nonwovens and Pigmalion Environmental Services (Oilwik)
Cost:	

Physical Properties

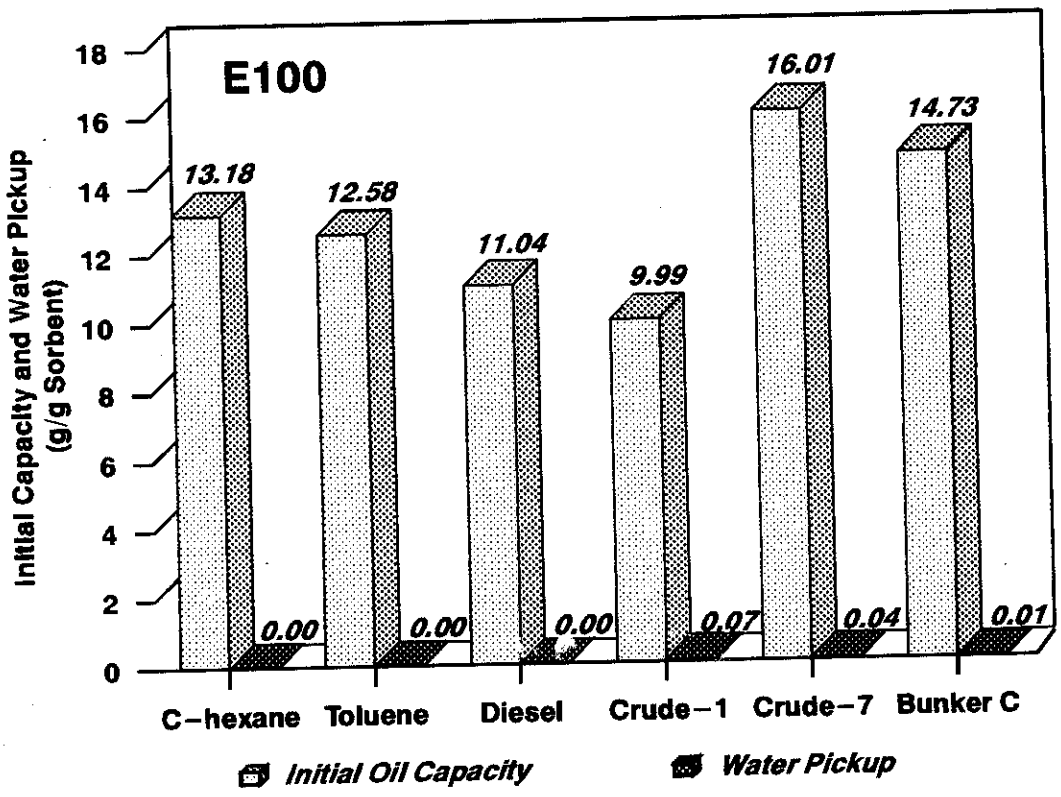
Bulk Density:	N/A
Shelf Life:	Indefinite
Storage Requirements:	None

Performance

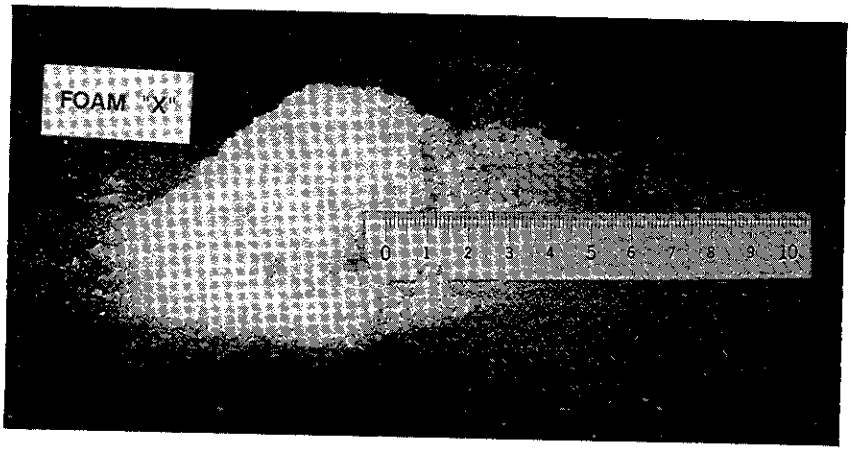
Oil Pickup Ratio:	Up to 1:25 by weight sorbent:oil depending on viscosity
Reusability:	Reusable at least ten times

Application

Type of Spill:	Oil and chemical spills on land or water, oil sheens in ponds and interceptors, around and underneath machinery, inside or outside of plants
Recommended Dosage:	1:10 to 1:25 by weight sorbent to oil/chemical
Equipment Required:	Manual labour
Reaction Time:	Immediate
Retrieval Method:	Manual labour
Disposal:	Incineration, landfill
Toxicity:	Nontoxic



11. Trade Name: ***Foam "X"***



Type: Ground open cell polyurethane

Available Geometry: Particulate

Manufacturer: Mr. Bill Mitchell
Mitchell Enterprises
P.O. Box 841, Station J
Calgary, Alberta
T2A 6A6
(403) 287-1171 or (403) 287-1176

Cost:

Physical Properties

Bulk Density:

Shelf Life:

Storage Requirements:

Performance

Oil Pickup Ratio: 1:12 to 1:17.5 by weight sorbent:oil reusable

Reusability:

Application

Type of Spill:

Recommended Dosage:

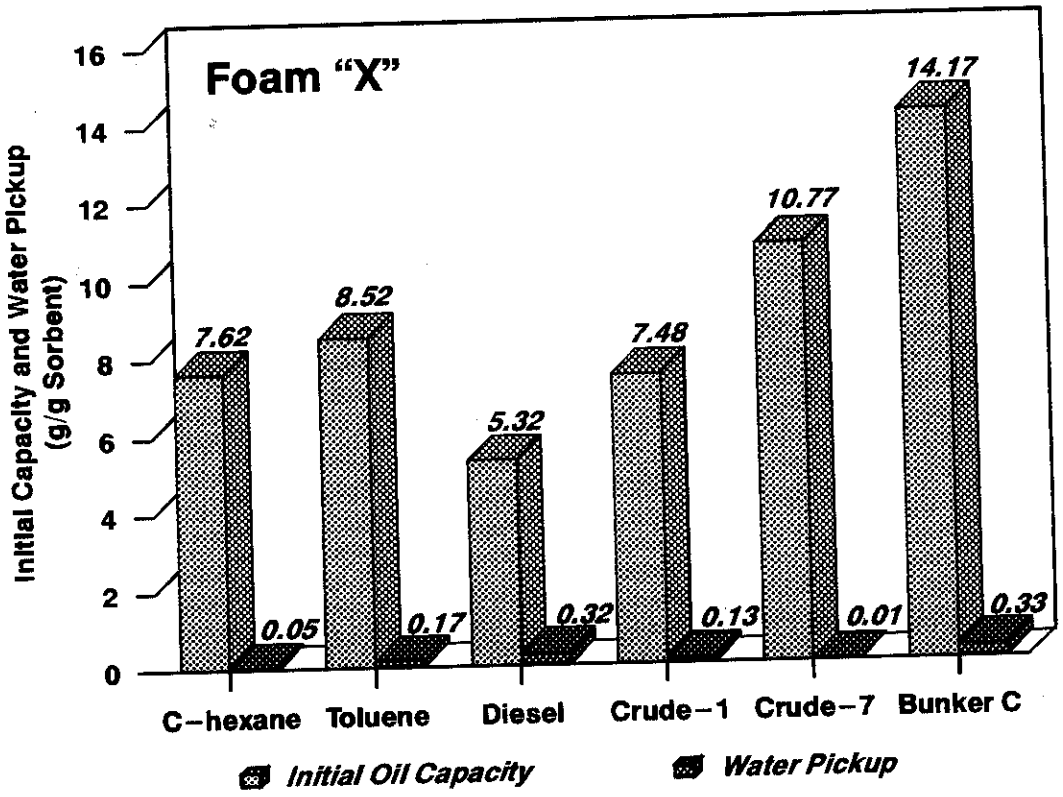
Equipment Required:

Reaction Time:

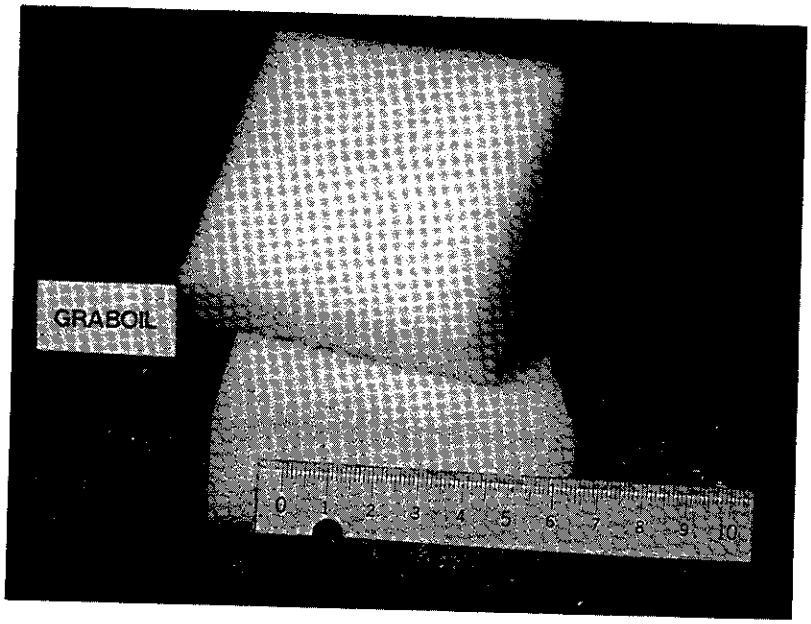
Retrieval Method:

Disposal:

Toxicity: Inhalation hazard



12. Trade Name: ***Graboil***



Type: Treated polyurethane foam

Available Geometry: Batts, rolls, booms packed in 0.25 m^3 corrugated cardboard containers

Distributors:

R.B.H. Cybernetics (1970) Ltd.
P.O. Box 4205
Station A
Victoria, B.C.
V8X 3X8
(604) 478-3122

Key Oilfield Supply and Rentals Ltd.
200, 707-7th Avenue SW
Calgary, Alberta
T2P 3H6
(403) 269-7788

Versatech Products Inc.
2749 Bellevue Avenue
North Vancouver, B.C.
V7V 1E1
(604) 922-5357

Foss Martin
660 W. Ewing Street
Seattle, WA 98119
(206) 281-4728

Manufacturer:

R.B.H. Cybernetics (1970) Ltd.
P.O. Box 4205, Station A
Victoria, British Columbia
V8X 3X8
(604) 478-3122

Cost: Available on request

Physical Properties

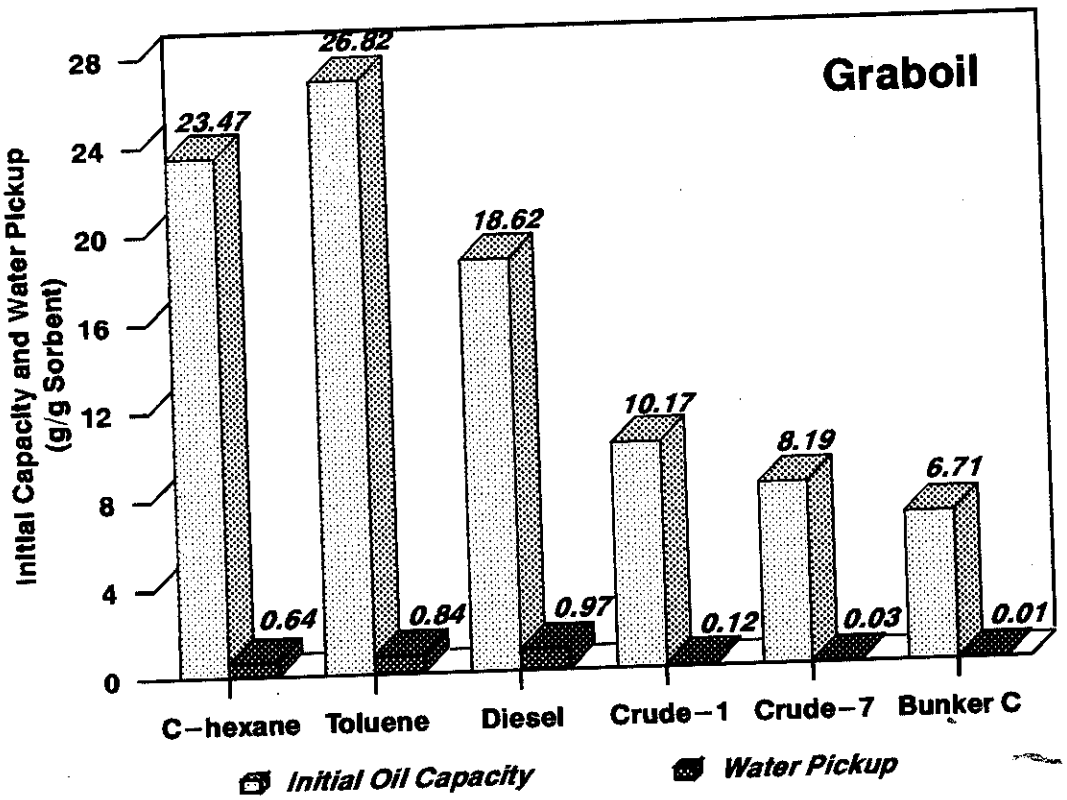
Bulk Density:	19 kg/m^3
Shelf Life:	Indefinite
Storage Requirements:	None if stored in closed cartons; avoid exposure to light when not in use

Performance

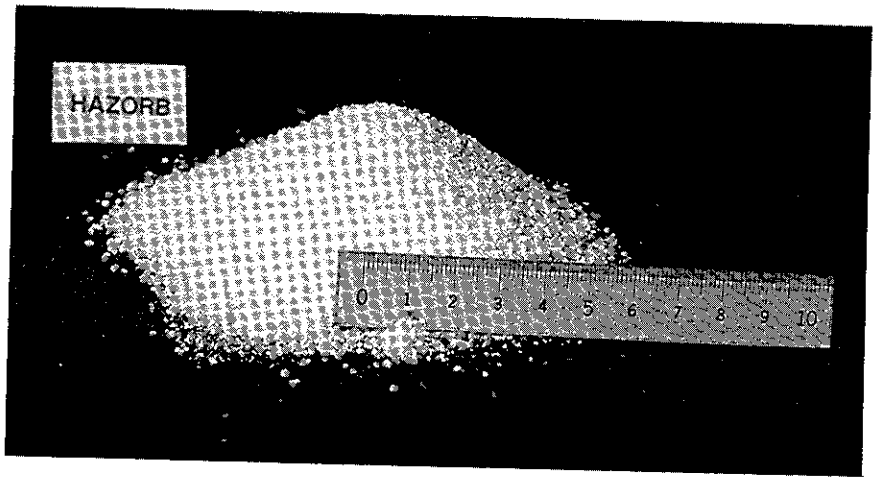
Oil Pickup Ratio:	Up to 40:1
Reusability:	Reusable

Application

Type of Spill:	Light to heavy oil on water and land
Recommended Dosage:	
Equipment Required:	Manual labour, air deployable; wringers and carrying pans desirable for reuse (available from manufacturer)
Reaction Time:	Immediate to slow depending on viscosity; faster on second and subsequent uses
Retrieval Method:	Manual labour
Disposal:	Incineration, landfill
Toxicity:	Nontoxic



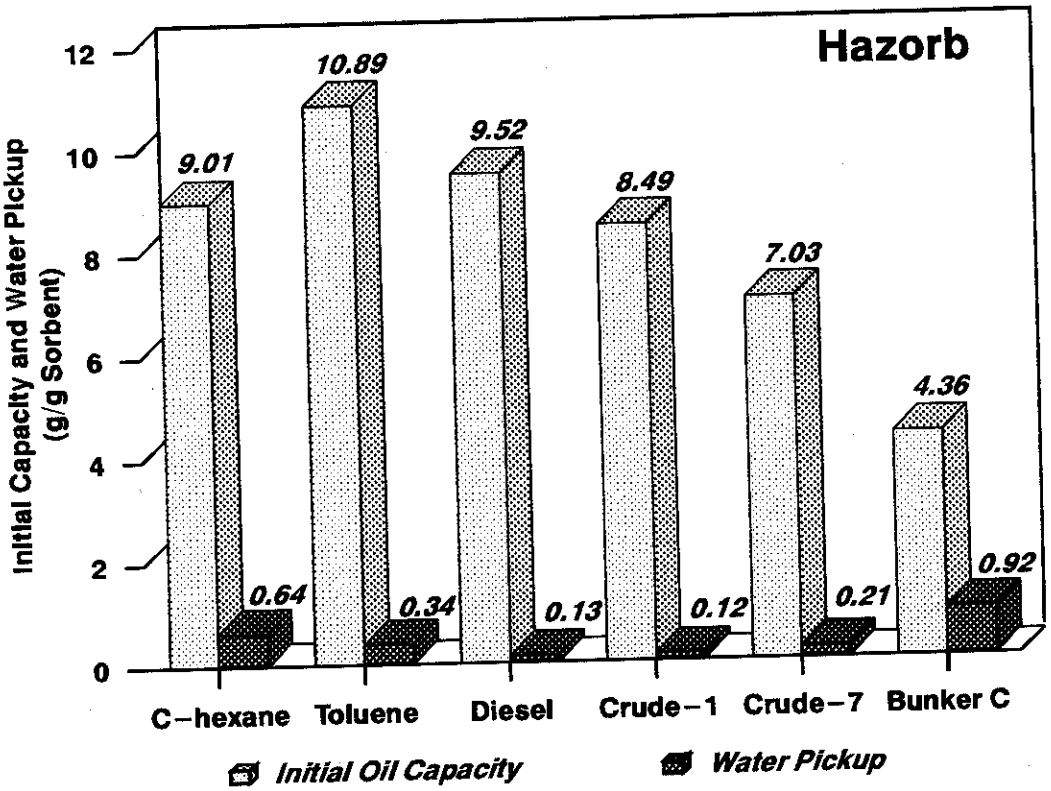
13. Trade Name: ***HAZORB Oil-Off-Water***



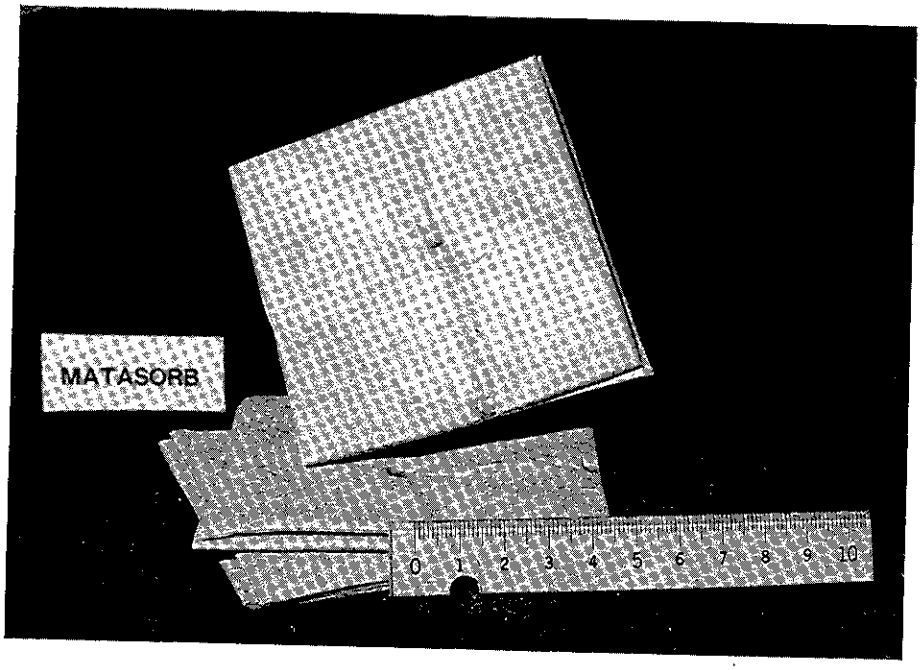
Type:	Mixture of sodium/calcium, borosilicate glass with silicone emulsion
Available Geometry:	Boom 96 × 5.5 in (244 × 14 cm) Industrial 26 × 17 × 2 in (66 × 43 × 5 cm) Laboratory 17 × 8 × 2 in (43 × 20 × 5 cm)
Distributor:	Mr. Ronald Smith Pigmalion Environmental Services 1600 Aimco Blvd. Unit 9 Mississauga, Ontario L4W 1V1 (416) 629-9577
Cost:	
Manufacturer:	Lightweight Environmental
Physical Properties	
Bulk Density:	2.75 lb/ft^3 (44 kg/m^3)
Shelf Life:	Indefinite
Storage Requirements:	None
Performance	
Oil Pickup Ratio:	Up to 1:10 times by weight sorbent:oil
Reusability:	Not reusable but oil may be recovered

Application

Type of Spill:	Emergency spills of oil on open water or in waste streams or holding tanks
Recommended Dosage:	Sorbent:oil, 1:8 by volume
Equipment Required:	Manual labour
Reaction Time:	Immediate
Retrieval Method:	Manual labour
Disposal:	Chemical fixation neutralization, incineration and landfill
Toxicity:	Low



14. Trade Name: ***Matasorb***



Type:	Melt-blown polypropylene
Available Geometry:	Booms, pillows, pads, grind and rolls in a variety of sizes
Distributor:	Mr. Harry Hildebrand Can-Ross Environmental Services Ltd. 441 Wyecroft Road Oakville, Ontario L6K 2H2 (416) 849-4566
	Mr. Ray Stewart Pesco Sales Ltd. 48 Colonnade Road Nepean, Ontario K2E 7S6 (613) 727-9492
Cost:	

Physical Properties

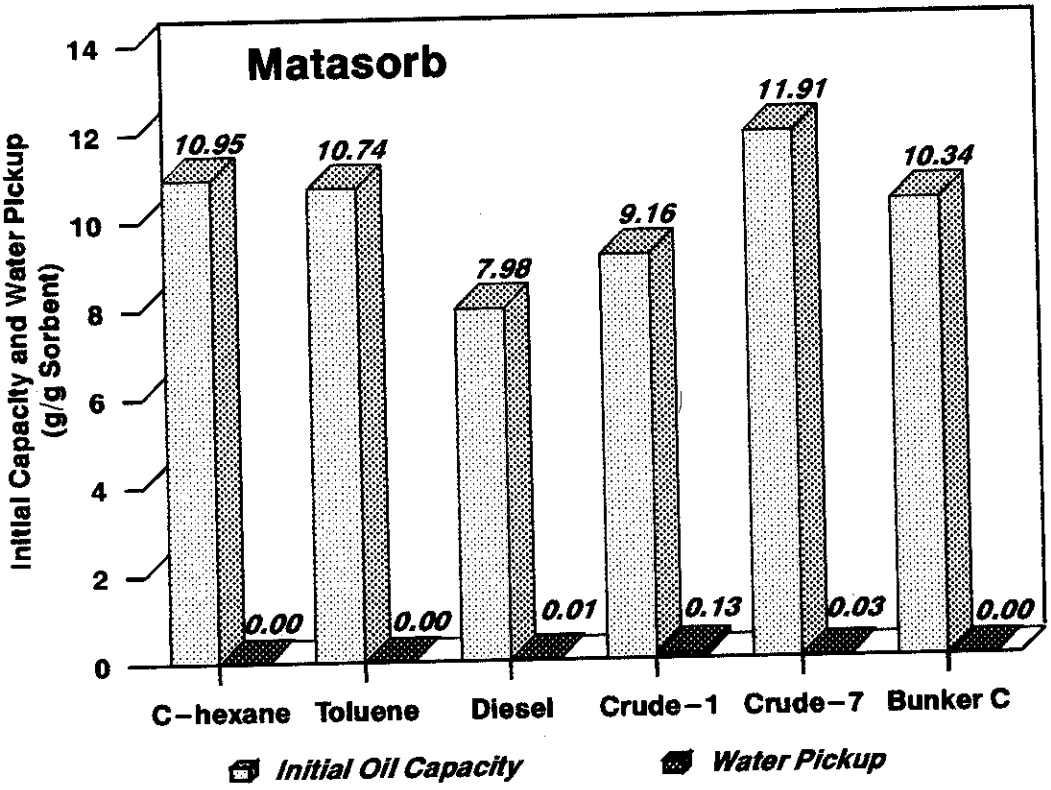
Bulk Density:	N/A
Shelf Life:	
Storage Requirements:	None

Performance

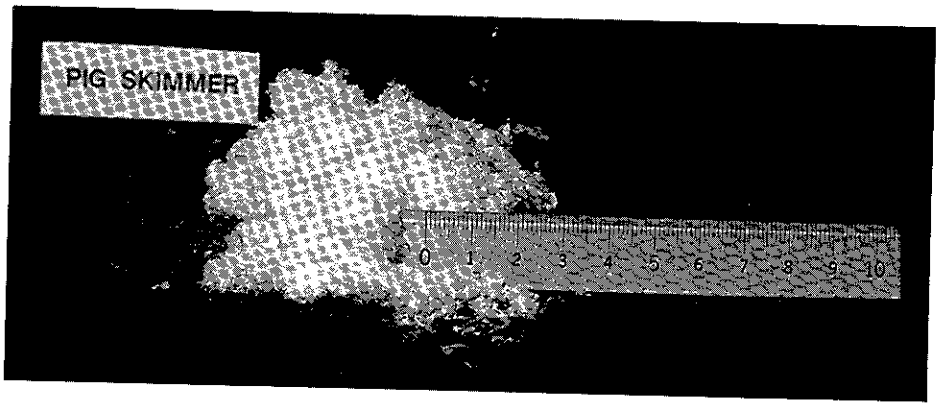
Oil Pickup Ratio:	Up to 1:20 by weight, sorbent:oil
Reusability:	Reusable

Application

Type of Spill:	Most oil- and hydrocarbon-based spills, either on land or water
Recommended Dosage:	Sorbent:oil, 1:20 depending on viscosity of oil
Equipment Required:	Manual labour
Reaction Time:	Fast acting
Retrieval Method:	Manual labour (rakes, shovels or pitchforks)
Disposal:	Incineration, landfill
Toxicity:	Nontoxic



15. Trade Name: ***Pig Skimmer***



Type:	Flash-spun polyethylene, polymer fillers by DuPont
Available Geometry:	Socks, pillows, pulp spill control kits available
Manufacturer:	New Pig Corporation Pig Place, 1 Pork Avenue Tipton, Pennsylvania 16684 (814) 684-0101
Cost:	Pig Skimmer Socks 10 lb box (4.5 kg) = $109.00 Booms 5 × 10 in (12.7 × 25.4 cm), 20 lb box (9 kg) = $139.00 Booms 8 × 10 in (20 × 25.4 cm), 39 lb box (18 kg) = $269.00 Pulp 5 lb bag (2.27 kg) = $49.00

Physical Properties

Bulk Density:	16 to 21 lb/ft^3 (packed) (256 to 336 kg/m^3)
Shelf Life:	Indefinite
Storage Requirements:	None

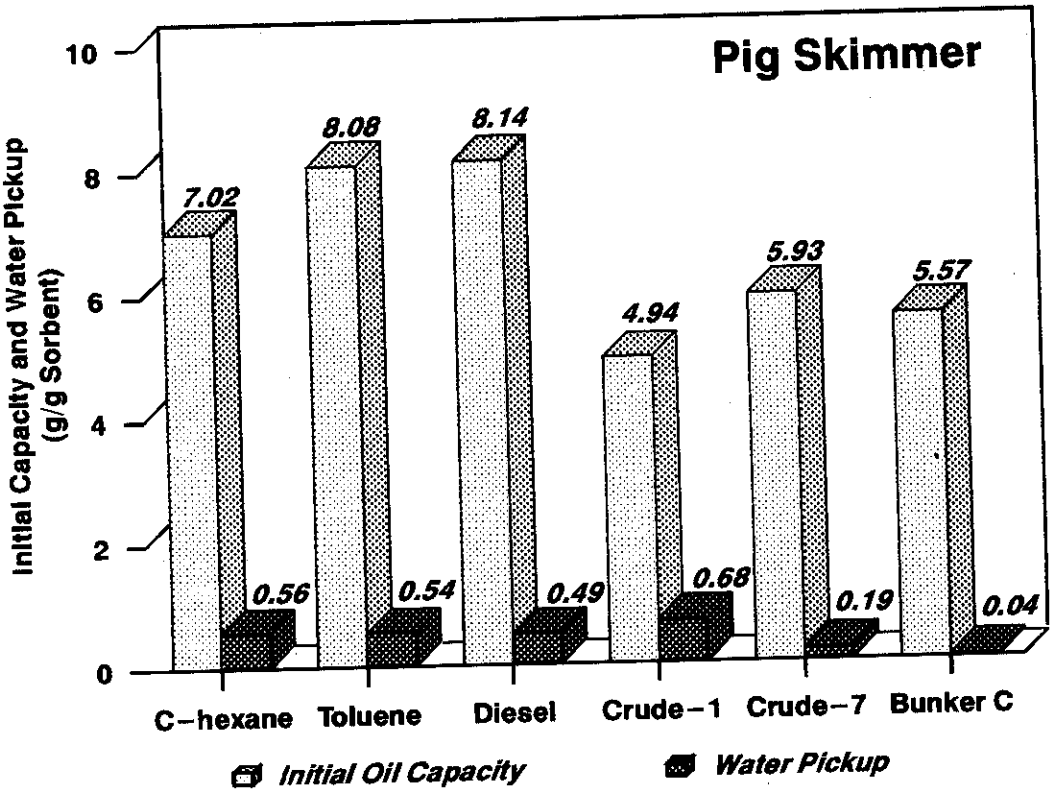
Performance

Oil Pickup Ratio:	5 lb (2.27 kg) of solvent:4 gal (15 L) of oil
Reusability:	Not reusable

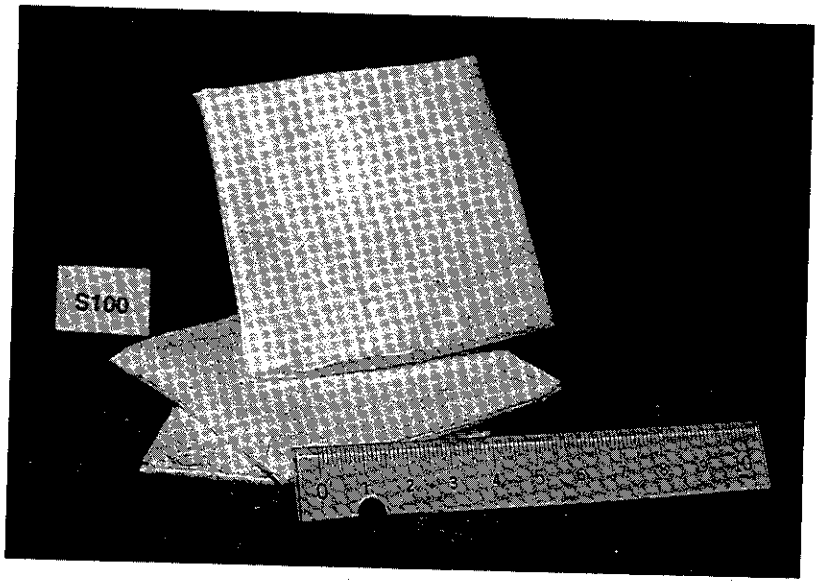
Application

Type of Spill:	Light to heavy oil
Recommended Dosage:	N/A

Equipment Required:	Manual labour
Reaction Time:	Immediate to fast
Retrieval Method:	Manual labour
Disposal:	Incineration or landfill
Toxicity:	Nontoxic



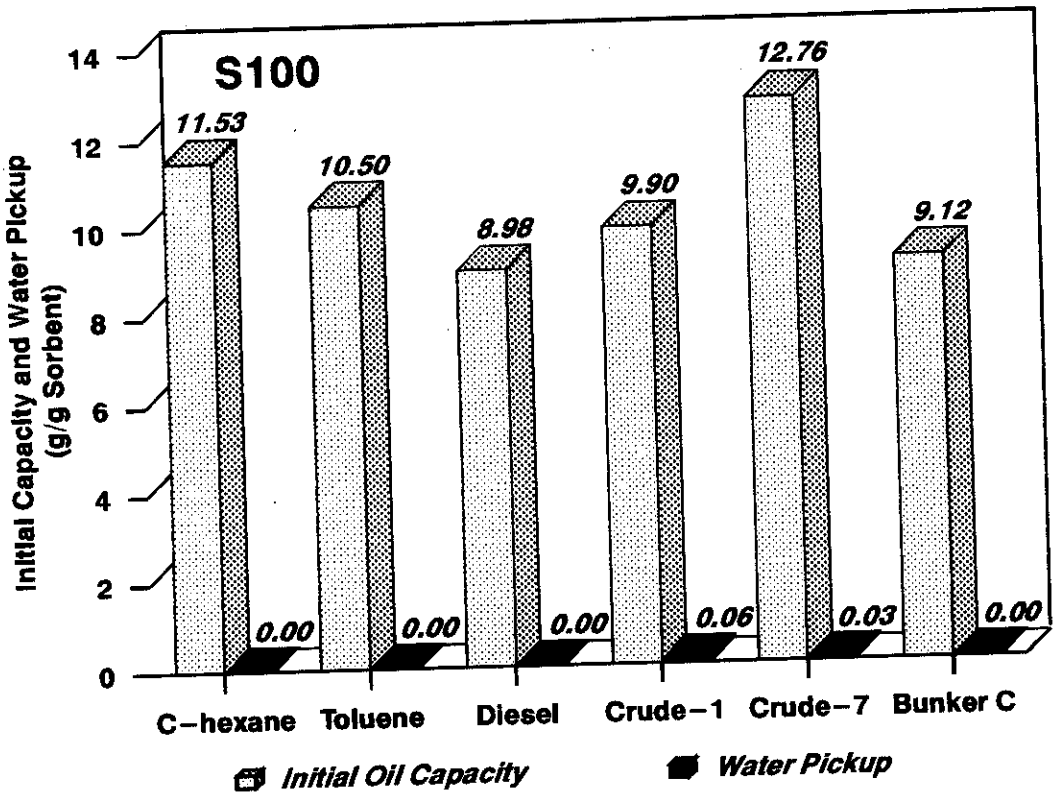
16. Trade Name: ***Slikwik Sorbents***



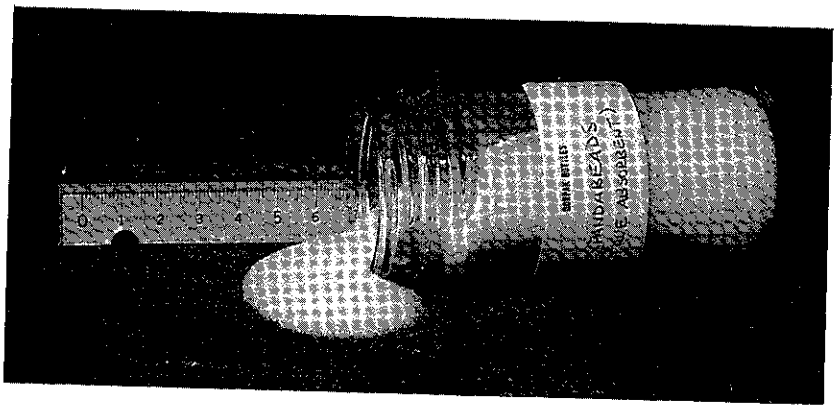
Type:	Melt-blown polypropylene
Available Geometry:	Rolls, pillows, booms, sweeps and loose particulate
Distributor:	Mr. Ronald Smith Pigmalion Environmental Services 1600 Aimco Blvd., Unit 9 Mississauga, Ontario L4W 1V1 (416) 629-9577
Manufacturer:	The Anderson's
Cost:	
Physical Properties	
Bulk Density:	N/A
Shelf Life:	Indefinite
Storage Requirements:	None
Performance	
Oil Pickup Ratio:	Up to 1:20 by weight, sorbent:oil
Reusability:	Reusable
Application	
Type of Spill:	Oil and hydrocarbon based spills on land or water
Recommended Dosage:	Sorbent:oil 1:20 depending on viscosity of oil
Equipment Required:	Manual labour

Application

Type of Spill:	Oil and hydrocarbon based spills on land or water
Recommended Dosage:	Sorbent: oil, 1:20 depending on viscosity of oil
Equipment Required:	Manual labour
Reaction Time:	Fast acting
Retrieval Method:	Manual labour
Disposal:	Incineration, landfill
Toxicity:	Nontoxic



Trade Name: ***Expandabeads****



Type: Cross-linked polymer beads

Available Geometry: Pouches (6 × 6", 15 × 15 cm), pillow (12 × 18", 30 × 46 cm) and bulk

Distributor: Big 'O' Inc.
254 Thames Road E.
Exeter, Ontario
N0M 1S3
(519) 235-0870

Cost:

Physical Properties

Bulk Density: 626 kg/m^3

Shelf Life: Indefinite

Storage Requirements: None

Performance*

Oil Pickup Ratio: Varies with fluid type; gasoline 50:1, No. 2 diesel oil up to 27:1 by weight

Reusability: Can be harvested and recycled depending on the fluid picked up

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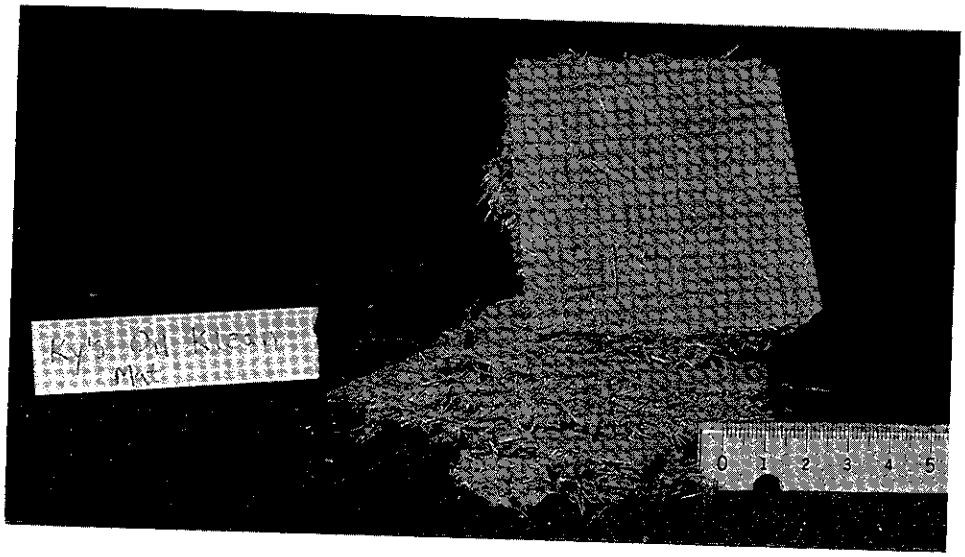
* product not tested - insufficient quantities forwarded

Application

Type of Spill:	Chlorinated and aromatic solvents, polar compounds and light oils
Recommended Dosage:	10-15:1 active beads to oil ratio by weight depending on viscosity
Equipment Required:	Manual labour or mechanical
Reaction Time:	Fast with low viscosity fluids, slower as viscosity increases
Retrieval Method:	Manual or mechanical
Disposal:	Depends on material imbibed
Toxicity:	Nontoxic

Trade Name: ***Ky's Oil-Klean****



Type: Treated wood fibre

Available Geometry: Mats 20 × 24 1/4" (50 × 62 cm), chips, booms (18 ft (5.5 m) and 20 ft (6 m)) and swabs (8 ft (2.4 m))

Distributor: Van Leer Packaging Products
Keyes Fibre Company
3003 Summer Street
Stamford, CT 06905

Total Absorb Inc.
101-11471 Blacksmith Way
Richmond, B.C.
V7A 4T7
(604) 275-5171

Cost:

Physical Properties

Bulk Density: 10 to 12 lb/ft^3 (160 to 192 kg/m^3) 50 to 55 mats per 45 lb (20 kg) carton

Shelf Life: Indefinite

Storage Requirements:

Performance*

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* product not tested - insufficient quantities forwarded

Oil Pickup Ratio:	1:8
Reusability:	Until saturation

Application

Type of Spill:	Absorbs light to medium oils, contains heavier oils
Recommended Dosage:	1:8
Equipment Required:	Manual labour
Reaction Time:	On contact
Retrieval Method:	Manual labour
Disposal:	Incineration and landfill
Toxicity:	Nontoxic