Environment Canada
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Service de la protection de l'environnement

A Catalogue of Oil Skimmers

Canada

Economic and Technical Review
Report EPS 3-EP-83-1

ental Protection Programs Directorate
er 1983

ENVIRONMENTAL PROTECTION SERVICE REPORT SERIES

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A CATALOGUE OF OIL SKIMMERS

prepared by

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for the

Technical Services Branch
Environmental Protection Programs Directorate
Environmental Protection Service
Environment Canada
Ottawa, Ontario
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EPS 3-EP-83-1
September 1983

Cat No En 48-3/83-1E
ISBN 0-662-12800-1
BEAUREGARD PRESS LIMITED

ABSTRACT

This report provides information concerning various types of mechanical oil recovery devices for the purpose of spill cleanup. These are listed in alphabetical order according to the manufacturer, distributor and/or developer to facilitate use of the document as a guide.

RÉSUMÉ

Ce catalogue donne des renseignements sur les divers types d'équipements de récupération utilisés pour nettoyer les déversements accidentels d'hydrocarbures. Ces dispositifs sont énumérés en ordre alphabétique par nom de fabricant, de distributeur ou de concepteur pour faciliter la consultation du présent document.

FOREWORD

The information contained in this report was compiled by Mr. L.B. Solsberg of S.L. Ross Environmental Research Limited under contract to the Environmental Protection Service. Any opinions expressed reflect those of the author as well as of the operators and test personnel who have worked with skimming equipment. These more subjective views are included specifically with regard to the modes of operation of the skimmers, their merits and shortcomings, and their optimum application.

ACKNOWLEDGEMENTS

The manufacturers and distributors of oil skimmers are acknowledged for their provision of technical data on which the descriptions of operating characteristics and specifications of the devices are based. The evaluation information was compiled from: file literature, reports and technical papers made available by Environment Canada; documentation and discussion freely given by personnel at the U.S. Environmental Protection Agency's Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT); and reports forwarded by the Norwegian Oil Pollution Control-Research and Development Program (PFO). In particular, Mr. M.F. Fingas and Mr. K.M. Meikle of Environment Canada, Mr. H.W. Lichte of Mason & Hanger-Silas Mason Co. at OHMSETT, and Mr. J.N. Langfeldt of PFO in Norway are thanked for their assistance.

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INTRODUCTION

This catalogue summarizes the physical specifications, operating characteristics, and performance of mechanical oil recovery devices. It is directed not only to the purchasers and users of countermeasures equipment but also to the manufacturers. The main purpose of the document is to improve the former group's ability to make rational decisions regarding oil recovery units best suited to particular needs. At the same time, the manufacturing sector should also benefit from the opportunity of reviewing an impartial account of the advantages and disadvantages reported for various generic concepts and machine configurations. It is believed that a compilation of the wide variety of oil collection principles should be of more general interest to both parties because of their involvement and concern with oil spills.

Machines that either are or have been commercially available, or that have been developed to the prototype stage, are examined. In several instances, collection principles that exist at the conceptual level are briefly dealt with. Comments on performance are included as documented by test personnel in technical reports and papers. These are occasionally supplemented by observations provided by users of the equipment. Formal references are cited for each entry where appropriate, and the reader is directed to what are for the most part impartial sources for further information. In cases where no independent test data are known, analogies have been drawn where possible according to evaluation results of similar oil collection approaches. The qualification PREDICTED is then applied to the description of both PERFORMANCE and OPTIMUM APPLICATION for such devices.

The catalogue is comprised of two sections, namely MAIN ENTRIES, in which two pages are devoted to each skimmer, and ABBREVIATED ENTRIES, which are comprised of one or more paragraphs. With several exceptions, a decision for insertion in one or the other of the sections was based on the information available and the current status of the concept. Thus, machines included as main entries have been developed to or beyond the prototype level; they have been or are being marketed commercially so that sales literature was consulted; test data have been recorded; and/or comprehensive machine specifications particularly concerning the oil recovery principle are otherwise available.

In the case of the shorter entries, sufficient detail was usually not available to allow for an account of performance. In some instances, time limitations also precluded

an expansion upon the information obtained. Several commercial products fall into this category; where market availability has been determined, an appropriate indication is given. The section, however, generally includes lesser known devices. These were located in the literature which contains many descriptions of generic types of oil skimmers or approaches which have either not advanced beyond the "drawing board" stage or have only been fabricated as scale models to test out various theories. Where it is not clear whether progress beyond these initial efforts has been made, either no assessment of machine status has been attempted or verification of availability is suggested. (Prototypes are, however, reported as such for both sections.) Several companies which are known to distribute the equipment of manufacturers either in Canada or internationally are also included as abbreviated entries; clarification in this regard is provided.

A third category of skimmers should also be noted. These are additional oil recovery approaches that have been made known to Environment Canada but which do not appear in the catalogue. The originators of such ideas are usually individuals who have sought to solve the problem of removing a floating layer of oil on the water's surface using intuitive methods usually associated with their mechanical machinery-related experience. While several of the approaches are quite interesting, the budget and time constraints of this study did not permit compilation, analysis and recording of many unsolicited submissions forwarded to the Department for review; an arbitrary cutoff point had to be established. This grouping of skimmers includes devices that have been constructed in several instances as working models. The single most common drawback apparent in these skimmer designs is failure to accommodate potential interferences resulting from waves and flow patterns. Test personnel at the U.S. Environmental Protection Agency's Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) also report a similar experience of receiving numerous descriptions of oil collection hardware for evaluation. This situation accounts in part for programs developed at OHMSETT geared specifically to the examination of promising skimming equipment developed by the small business community. Generally, the entries that have been selected for inclusion in the catalogue cover most of the different collection component types made known to Environment Canada (and to OHMSETT to some extent); the odd exception does, however, occur.

The two sets of entries for the catalogue have each been arranged in alphabetical order according to company or developer (if no manufacturing or distribution firm is known to exist). Where the same basic oil collection component has been

incorporated in several models, these are usually grouped together as a single listing. In several situations, differentiation between such groupings has been predicated on machine size, a variation of the application of the concept, or the availability of test results.

Insofar as the evaluation results are concerned, the viscosities of test media used in such programs are usually indicated. These data have been further projected for optimum applications; specific reference was made to the oil types to which the individual device is most applicable. Generally, light or low viscosity oils imply a kinematic viscosity at ambient conditions of zero to several cm^2/s; medium viscosity products range to about 10 cm^2/s; and heavy petroleum derivatives are more than 10 cm^2/s. More specifically, diesel, kerosene or fresh crude would be considered light oils; some lubricating stocks and slightly weathered crude oils would be medium viscosity products; and Bunker C and emulsified and/or aged crude would be heavy oils.

The INDEX consists of two reference lists, one containing the names of companies and developers, and one which is based on the names or model designations of the skimmers. The list of companies includes manufacturers as well as a number of firms specializing in product marketing or distribution only. In the skimmer list, common alternative names or labels are given, often associated with the skimming principle, developer/inventor, or other sponsoring or contributing party.

Even as the catalogue was being prepared, numerous changes in product-related data were evident including pricing information, the availability of optional materials, the selection of component hardware (such as pumps), and the introduction of new models or variations on existing ones. When informed of such circumstances (excluding price which is indicated in accordance with the date of its original transmittal), the additional information was recorded. Contact with the manufacturer is suggested, in any case, to validate machine specifications and prices. Questions can, of course, be directed at the same time to clarify points raised with regard to either machine performance or modifications made subsequent to test programs.

Mechanical oil skimming is a field of spill technology that obviously continues to advance. During the course of this study, it became apparent that a much greater engineering effort is now being directed at equipment development including increased consideration of oil properties and hydrodynamics. While physical recovery methods do not represent a universal panacea to the problem of oil spills, selection of appropriate skimmers followed by their practical utilization should go a long way towards providing a practical solution to many cleanup situations.

NOMENCLATURE

A	ampere
API	American Petroleum Institute
@	at
cm	centimetre
cm/s	centimetre per second
cm^2/s	square centimetre per second
DC	direct current
DKR	Danish Krona
dwt	dead weight tonne
(effective 21-8-21)	date of price setting, day-month-year
HP	horsepower (continuous)
h	hour
Hz	Hertz (cycles per second)
kg	kilogram
kg/m	kilogram per metre
kPa	kilopascal
kn	knot
kW	kilowatt
L	litre
L/min	litre per minute
lube	lubricating oil
m	metre
m^2	square metre
m^3	cubic metre
m^3/h	cubic metre per hour
Mk	Mark (or model series)
min	minute
mm	millimetre
m/min	metre per minute
m/s	metre per second
mPa•s	millipascal per second
NA	not applicable

n.m.	nautical mile
m^3/h (STP)	cubic metre per hour at normal (standard) temperature and pressure
No.	number
NOK	Norwegian Krona
OHMSETT	Oil and Hazardous Materials Simulated Environmental Test Tank (operated by the U.S. Environmental Protection Agency in Leonardo, New Jersey)
p.	page number
pp.	page numbers
PVC	polyvinyl chloride
rpm	revolutions per minute
rps	revolutions per second
s	second
s^{-1}	per second
SEK	Swedish Krona
S.G.	specific gravity
SSU	Saybolt seconds universal
telephone (201) 625-0002	(area code) local number - Canadian and U.S. telephone numbers
telephone (47)(02)143590	(country code) (routing code) local number - UK and European telephone numbers
tonne	metric ton
V	volt
V AC	volt, alternating cycle
°	degree
°C	degree Celsius
%	percent

INDEX

By Company

Names of companies that are capitalized appear in the catalogue as main entries. Listings printed in upper and lower case letters are included either as abbreviated entries or are referred to in the text of both sections of entries.

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By Device

MAIN ENTRIES

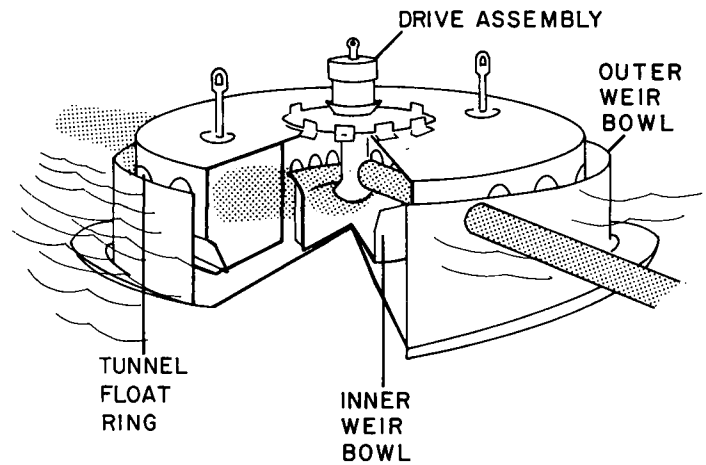
ACME PRODUCTS, CO.
P.O. Box 51388
Tulsa, OK 74151
USA

telephone (918) 836-7184

FS 400SKL-51T
(Tunnel Skimmer, Floating Saucer)
Price: $2 617 to $3 055 (U.S.)
(effective 31-1-81)

COLLECTION PRINCIPLE

An engine incorporated into the skimmer directly drives an impeller within an inner weir to remove product pulled through the tunnels of an outer float ring and over an outer weir arrangement.



PHYSICAL SPECIFICATIONS

First Weir Diameter (cm)	160
Second Weir Diameter (cm)	44
Draught (cm)	35
Discharge Hose Diameter (cm)	10.2
Weight (kg)	117-130, depending on engine type
Power Unit	internal gasoline, electric and pneumatic drives available in various sizes (1.7-4 HP)
Materials of Construction	fibreglass float ring, cast aluminum body (epoxy coated), stainless steel impeller

MODE OF OPERATION

Self-contained if gasoline engine selected; air or electricity required for pneumatic and electric models. Deployed from vessel, wharf or shoreline into stationary pool of oil concentrated by boom, with discharge directed to available storage/separation facilities. Launching may require a small crane or other lifting equipment depending on the height of the working platform above water.

PERFORMANCE

The Acme FS 400SKL-51T was designed to collect light and foamy materials as well as oil. In situ testing conducted by Environment Canada and the Petroleum Association for Conservation of the Canadian Environment bore out the manufacturer's claim that the skimmer best applies to light products. Best performance was achieved for diesel oil thicknesses exceeding 1 cm in calm, debris-free conditions. Some difficulty was experienced in attaining an optimum functioning of the inner weir so that continuous oil flow

would occur, particularly for very thin slicks of several millimetres. Highest oil content was 5.9%, necessitating a settling procedure to treat the liquid retrieved. This skimmer should show much improved performance in greater thicknesses of oil.

Optimum Test Results

Air Temp. (°C)	Water Temp. (°C)	Sea State	Test Medium	Oil Thickness (mm)	Oil Recovery Rate (m^3/h)	Oil Content (%)
15	11	calm	crude	6	0.28	2.3
6	11	calm	crude	11	0.88	5.8
12	12	calm	diesel	2	0.26	1.6
13	12	calm	diesel	9	0.94	5.9

Diesel: kinematic viscosity 1.90 SSU @ 37.8°C; API Gravity 40°; S.G. 0.8251

Crude: Iranian, kinematic viscosity 58 SSU @ 37.8°C; API Gravity 30°; S.G. 0.8708

Four eyebolts in the top cover allow for easy adjustment of the exterior weir level; these can also be used for crane launching. However, the unit's weight, bulk and lack of handles make manual deployment more cumbersome. A 10 cm diameter soft plastic hose clamps directly to the skimmer and is awkward to handle; a hard rubber flexible hose would be preferable. Evaluation personnel recommended an explosion-proof engine over the spark ignition drive for skimming light oils.

OPTIMUM APPLICATION

In stationary pools of concentrated, very light oils several centimetres in thickness contained by boom; in debris-free water; with storage/separation facilities.

ADDITIONAL PERFORMANCE INFORMATION

Abdelnour, R. et al., Field Evaluation of Eight Small Stationary Skimmers, Technology Development Report EPS 4-EC-78-5, Environment Canada, Ottawa, Ontario, (May, 1978).

OTHER DATA

See also Acme Products, Co. SK-39T for performance of this skimmer type in thicker slicks.

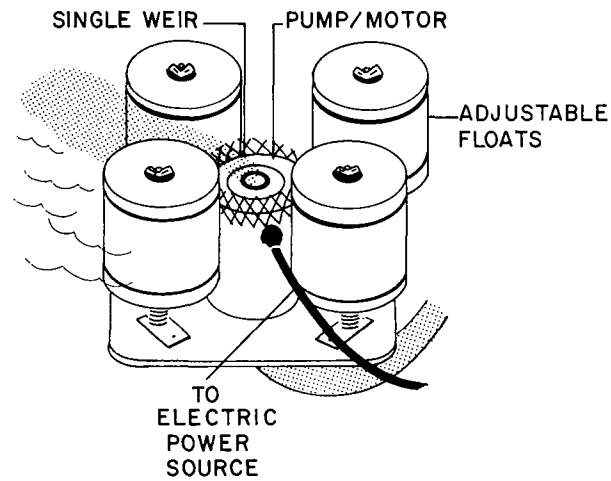
ACME PRODUCTS, CO.
P.O. Box 51388
Tulsa, OK 74151
USA

telephone (918) 836-7184

FS 50SKL-17E
(Mini Floating Saucer
Skimmer, FSV-5, FSW-5)
Price: $360 to $485 (U.S.)
(effective 31-1-81)

COLLECTION PRINCIPLE

This device is a simple weir consisting of a central, circular oil collection plate supported by four adjustable floats. Recovered liquid flows by gravity to the centre where it is drawn into a suction pipe by a submersible pump driven by a sealed electric motor (or by a remote pump or vacuum truck in passive, lower priced models). Large particles are excluded by an intake screen.



PHYSICAL SPECIFICATIONS

Length, Width (cm)	45
Height (cm)	39
Draught (cm)	24
Discharge Hose Diameter (cm)	1.3
Weight (kg)	11
Power Unit	1/20 HP, 115 V, 3.2 A submersible electric motor; optional 230 V, 50/60 Hz motor
Materials of Construction	fibreglass body, nylon impeller and casing, urethane floats
Debris	screen provided

MODE OF OPERATION

Designed for low-volume skimming where space or handling is limited. Plugs into 115 or 220 V power source. Also available as a passive model for connection via 3.8 cm tube to vacuum truck or pump (Models FSV-5 and FSW-5). The unit can be carried by a single person.

PERFORMANCE

The Mini Floating Saucer is very small and light in comparison with most other skimming devices and is therefore easy to clean and highly portable. It is supported by four external floats which provide good stability and precise adjustment of the weir. The electric centrifugal pump does not generate significant emulsification during the recovery process. During tests conducted by Environment Canada and the Petroleum Association for Conservation of the Canadian Environment at Quebec City, recovery rates were found to range from 2.4 L/min for crude oil to 6.4 L/min for diesel. Oil content was a maximum of 17.6% and 21%, respectively.

Should the vacuum model be selected, a smooth flowing pumping system is required since slug flow otherwise results and optimum weir levels are difficult to set. A debris screen surrounding the weir was removed for the Canadian crude oil tests because of the impedance it presented to oil flow. The evaluation crew recommended a lighter, more flexible discharge hose to further improve the ease of operation of this device.

Optimum Test Results

Air Temp. (°C)	Water Temp. (°C)	Sea State	Test Medium	Oil Thickness (mm)	Oil Recovery Rate (m^3/h)	Oil Content (%)
9	12	calm	Crude	6	0.14	17.6
10	14	waves 0-5 cm		8	0.10	9.3
12	13	calm	Diesel	9	0.38	21.0
12	13	calm		8	0.21	13.4

Diesel: kinematic viscosity 1.90 SSU @ 37.8°C; API Gravity 40°; S.G. 0.8251

Crude: Iranian, kinematic viscosity 58 SSU @ 37.8°C; API Gravity 30°; S.G. 0.8708

OPTIMUM APPLICATION

For minor amounts of very light oil where space for direct access is limited; in debris-free conditions.

ADDITIONAL PERFORMANCE INFORMATION

Abdelnour, R. et al., Field Evaluation of Eight Small Stationary Skimmers, Technology Development Report EPS 4-EC-78-5, Environment Canada, Ottawa, Ontario, (May, 1978).

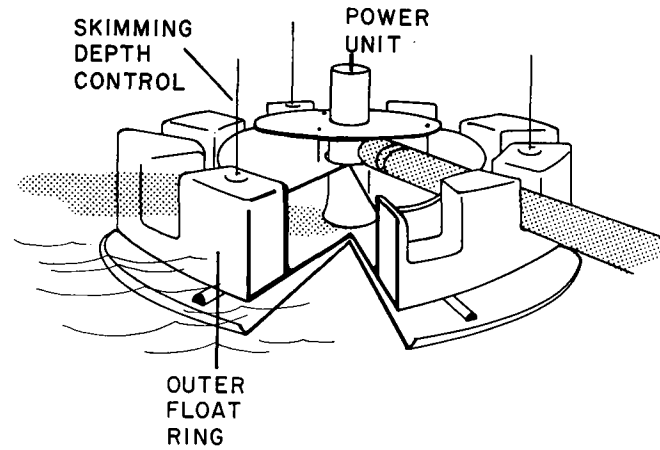
ACME PRODUCTS, CO.
P.O. Box 51388
Tulsa, OK 74151
USA

telephone (918) 836-7184

SK-39T
(Tunnel Skimmer,
Floating Saucer)
Price: $1 617 to
$2 055 (U.S.)
(effective 31-1-81)

COLLECTION PRINCIPLE

A double weir system identical to that of the Acme SKL-51T (see preceeding entry) effects the oil recovery process. An impeller driven by an engine within the skimmer head initiates the flow of fluid over the weirs.



PHYSICAL SPECIFICATIONS

Overall Diameter (cm)	117
Height (cm)	61
Discharge Hose Diameter (cm)	10.2
Weight (kg)	63 (with gasoline motor)
Power Unit	optional air, electric or gasoline drives (1.7-4 HP)
Materials of Construction	fibreglass float ring, epoxy-coated aluminum body, stainless steel impeller (replaces bronze impeller in earlier models)

MODE OF OPERATION

Placed in boomed-off area alongside vessel or dock or near shoreline. Self-contained when gas powered, otherwise compressor or source of electricity required (115/230 or 230/460 V AC). Launching by two persons is possible.

PERFORMANCE

The test data below reflect work carried out at OHMSETT using lube oil. Like its 51T counterpart, the 39T tends to pick up a significant volume of water. The U.S. program determined the dependence of oil recovery capacity on the diameter and length of the connection hose although no clear correlation of skimmer performance and wave conditions was observed. The U.S. evaluations were conducted in a slick thickness of about 2.5 cm; this resulted in substantially higher oil recovery rates and oil content in the collected product versus the results obtained using the 51T in thin slicks (1 cm or less). The evaluation work clearly indicates the importance of applying the Acme Skimmers to oil that has been contained and concentrated in order to maximize their effectiveness.

U.S. Test Results

Air Temp. (°C)	Oil Viscosity (cm^2/s @ 20 °C)	Oil Temp. (°C)	Wave Height (m)	Wave Length (m)	Wave Period (s)	Oil recovery Rate (m^3/h)	Oil Content (%)
11	16.97	14	0	0	--	4.3	27.3
18	2.82	25	0	0	--	1.4	57.1
16	3.03	19	0.6	9.1	3.0	2.9	41.6
18	3.43	19	0.3	13.7	4.0	3.7	56.7

OPTIMUM APPLICATION

In concentrated, light oils several centimetres in thickness contained by a spill barrier in calm, debris-free water; storage/separation capacity required.

ADDITIONAL PERFORMANCE INFORMATION

McCracken, W.E., Performance Testing of Selected Inland Oil Spill Control Equipment, EPA 600/2-77-150, U.S. Environmental Protection Agency, Cincinnati, OH, (1977).

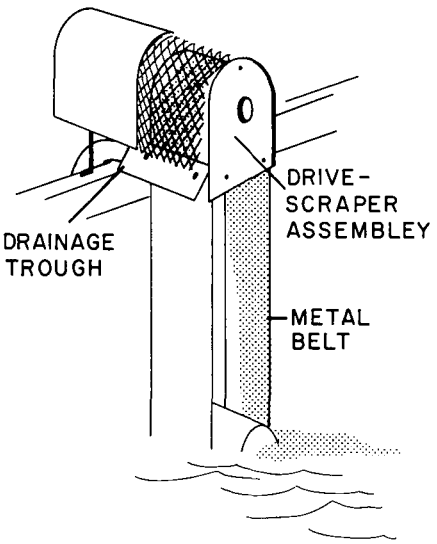
AERODYNE DEVELOPMENT CORP.
1905 Solon Road
Cleveland, OH 44139
USA

telephone (216) 248-8212

AERODYNE OIL SKIMMER
(Price: $990 to $1 150 (U.S.)
(effective 4-9-81)

COLLECTION PRINCIPLE

An endless metal belt is held vertically and passed through the oil to be collected. Doctor blades associated with the drive assembly remove product which drains from a trough to a collection point. Machines with one to five belts can be purchased.



PHYSICAL SPECIFICATIONS (single belt unit)

Overall Dimensions (cm)	Width	32.4
	Length	70.5
	Height	3.8
Belt Width (cm)	22.4	
Belt Length	as necessary in 0.3 m (1-foot) increments	
Discharge Hose Diameter (cm)	1.6	
Weight (kg)	227	
Materials of Construction	carbon steel body and belt (other materials for alkaline or acidic solutions also available)	
Power Unit	standard TEFC fractional (1/4-1/3 HP) gear motor 230-460 V AC, 3-phase, 60 Hz; optional fractional HP, 115 V AC single-phase and explosion-proof motors	
Additional Features	thermostatically controlled heater optional	

MODE OF OPERATION

The Aerodyne skimmer has been designed for the removal of oily wastes from sumps, settling tanks, etc. The electric drive assembly is supported above the liquid and the continuous belt passed through to a submerged, free-riding tail pulley. The appropriate belt length can be selected, source of power secured, and set-up engineered for this permanent oil-removal device.

PREDICTED PERFORMANCE

No evaluation data available. Refer to performance information provided for Frank Mohn A/S Framo ACW-400 skimmer which employs metal discs for oil pickup.

The manufacturer claims an oil recovery rate of 0.12 m^3/h for a single belt unit based on SAE 30 oil. This value is well within the recovery rates to be expected for oil adhering to both sides of a 20 cm wide moving metal surface. Waves should not be a factor for most settling basins; since the belt travels in a vertical attitude, most forms of debris will not interfere with its operation. A wide range of oils will cling to the metal belt, and the heating unit should allow the stripping of more viscous products.

PREDICTED OPTIMUM APPLICATION

In a settling basin or tank as a permanent installation for the removal of light to heavy oils directed towards the unit.

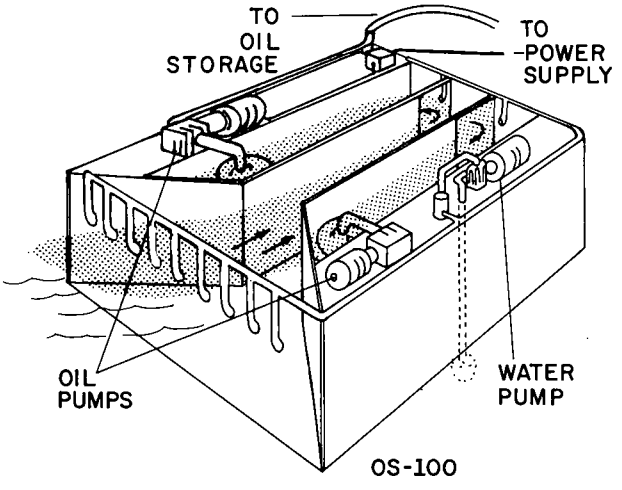
AGAR CORPORATION
2215 Bauer Drive
Houston, TX 77080
USA

telephone (713) 464-4451
telex 790094

OS-100 STATIC OIL SKIMMER
OS-200 Dynamic Oil Skimmer
Price: $5 000 to $50 000 (U.S.)
(effective 1-11-81)

COLLECTION PRINCIPLE

A system of water jets draws a surface layer of oil into a series of narrow channels where gravity separation of product from water occurs. Two pumps then transfer the collected oil to storage while water is returned through the bottom of the skimmer.



PHYSICAL SPECIFICATIONS

	OS-100 Static Skimmer	OS-200 Dynamic Skimmer
Length (m)	3	6.4
Beam (m)	2.5	2.5
Height (m)	0.76	1.2
Draught (m)	0.4	0.6
Discharge Hose Diameter (mm)	75	75
Weight (kg)	204	2 000
Materials of Construction	fibreglass body	marine steel, PVC
Power Requirements	5.5 kW, 208/220V, 60 Hz 3-phase or pneumatic at 540 kPa	4-cylinder, 50 HP diesel
Vessel Speed (kt)	--	0 to 5
Oil Pump	gear type	positive displacement
Water Pump	centrifugal, self-priming	engine-driven rubber impeller
Storage Capacity (L)	680	680
Debris	grill provided	

MODE OF OPERATION

The Static Skimmer requires an external source of power, either electricity or air, to function while the OS-200 is self-contained. Both models can be operated within a contained slick using the water enhancement system to draw in product. The Dynamic Skimmer also accomplishes this by being advanced through oil. Due to limited on-board storage, additional capacity would be required should the size of the spill warrant it.

PREDICTED PERFORMANCE

No evaluation data are known.

The skimmer is set up in a fashion similar to some ballast treatment facilities. Since oil/water separation is achieved by gravity, it can be reasonably expected that calm conditions would allow the more thorough separation of product (i.e. a minimum of mixing energy is present). Adequate residence time within the baffled section and a minimum disturbance to the incoming oil layer are other factors which would result in improved performance.

The main oil loss mechanisms, particularly for the advancing system, would be the entrainment and carryunder of product, and the turbulence or other hydraulic effects of the hulls at higher speeds and in greater wave heights.

Overall, the simplicity of the system is appealing; efficient oil collection should be possible while the skimmer is stationary or operating at speeds approximating 1 kn or less in the self-propelled model.

PREDICTED OPTIMUM APPLICATION

In light to heavy oils; in calm conditions; at speeds less than 1 kn; in debris-free conditions; will likely concentrate product present as a layer of several millimetres or more.

ALSTHOM ATLANTIQUE
P.O. Box 61 X
38041 Grenoble Cedex
France

telephone (33)(76) 98 81 98
telex 320 547 F

In the U.S. contact:

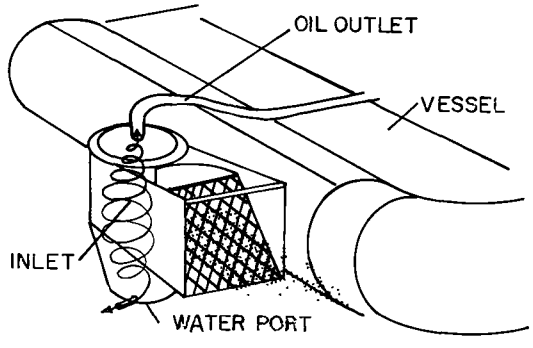
Alsthom Atlantic, Inc.
Pollution Control Department
600 Carondelet Street - Suite 604
New Orleans, LA 70130 USA

telephone (504) 529-1695
telex 266073 ALSTH UR

CYCLONET 050
(Cajun Skim System)
Price upon request

COLLECTION PRINCIPLE

A layer of oil and water enters the device through an inlet located below the water's surface. A tangential velocity imparted to the contents causes a rotation of the liquid so that the lighter oil tends to collect centrally. It is then pumped from the outlet of the chamber located at its upper end. Water flows downward and discharges through a port in the bottom.



PHYSICAL SPECIFICATIONS

Overflow Diameter (m)	0.5
Cyclone Diameter (m)	0.35
Overall Length (m)	1.5 - 1.8
Height (m)	0.8 - 1.0
Discharge Hose Diameter (cm)	5.1
Average Draught (m)	0.7 - 0.85
Weight (kg)	60 - 80 (one-cyclonic chamber) 700 (skimming package)
Material of Construction	steel
Pump	self-priming positive displacement, driven by 4.5 HP air-cooled, explosion-proof diesel, hand started (available from manufacturer)
Debris	grill provided

MODE OF OPERATION

The Cyclonet 050 can be mounted so that one vortex chamber is fastened on either side of an inflatable Zodiac or similar size craft, or positioned as a single twin-chamber system at the bow of a vessel. The operator controls the flow rate by adjusting the valves of a common pump manifold and/or speed of the diesel prime mover. Submergence depth is selected by simple hand winch operation. The Cyclonet system has been designed to recover oil where a relative velocity exists between the collection device and the spilled product.

PERFORMANCE

Optimum Test Results

Air Temp. (°C)	Water Temp. (°C)	Wave Height (cm)	Test Medium	Vessel Speed (kn)	Slick Thickness (mm)	Oil Recovered vs Oil Encountered (%)	Oil Recovery Rate (m^3/h)	Oil Content (%)
(1) Québec City, October 1976								
4	8.5	10-15	diesel	3	2	24.1	0.22	28.4
(2) Québec City, May 1977								
22	11	0	crude	2.1	2	40	1.56	10
20	11	10-15	crude	1.9	2	28	0.79	34

Crude Oil: API Gravity 32.5°; S.G. 0.8575

In Canadian tests, the 050 system has been evaluated with the chambers mounted on either side of a Zodiac and when positioned at the bow of a self-propelled barge. In the latter case, trials have been undertaken of the chambers welded together as well as separated by a divergence piece. Maximum oil recovered versus oil encountered and oil content of the recovered liquid were 40% and 34%, respectively, achieved for the barge-mounted, welded system at a speed of about 2 kn, with lower and larger chamber entrances than in the equipment as originally received. Factors adversely affecting oil recovery included surging in the skimmer mouth, vessel roll and pitch, and carry-through of product via the exit ports. Hull interference with the Zodiac was experienced.

At OHMSETT, two oil loss mechanisms were determined to place an upper limit on performance, namely vortex shedding of oil out the bottom of the convergent side wall near its point of attachment to the hydrocyclone, and losses underneath the Zodiac hull at all speeds. With modifications, speed range limits were determined to be 1.5-3 kn in calm water, with the percentage of light oil recovered versus that encountered falling below 10% in a 0.15 m harbour chop at a tow speed of 1.5 kn.

Overall, the "no moving parts" aspect of the Cyclonet system is appealing.

OPTIMUM APPLICATION

In calm conditions, in concentrations of medium to heavy oil several centimetres in thickness, at relative velocities of 1.5-3 kn; free from vessel interference.

ADDITIONAL PERFORMANCE INFORMATION

(1) Getman, J.H., Performance Tests of Three Fast Current Oil Recovery Devices, 1977 Oil Spill Conference, New Orleans, LA, (1977).

(2) Solsberg, L.B., W.C. Wallace and M.A. Dunne, Field Evaluation of Oil Spill Recovery Devices: Phase Two, Technology Development Report EPS 4-EC-77-14, Environment Canada, Ottawa, Ontario, (December, 1977).

(3) Urban, R.W. and D.J. Graham, Performance Tests of Four Selected Oil Spill Skimmers, EPA 600/2-78-204, U.S. Environmental Protection Agency, Cincinnati, OH, (1978).

OTHER DATA

The Cajun Skim System is now available as a self-contained package that includes a 6 m aluminum boat, 100 HP motor, two 050 skimmers, one stationary skimmer, pump, diesel engine, oil/water separator, flexible tanks, and trailer (total weight 1 550 kg). A smaller 040 Cyclonet system is also now sold.

ALSTHOM ATLANTIQUE
P.O. Box 61 X
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telex 320 547 F

In the U.S. contact:

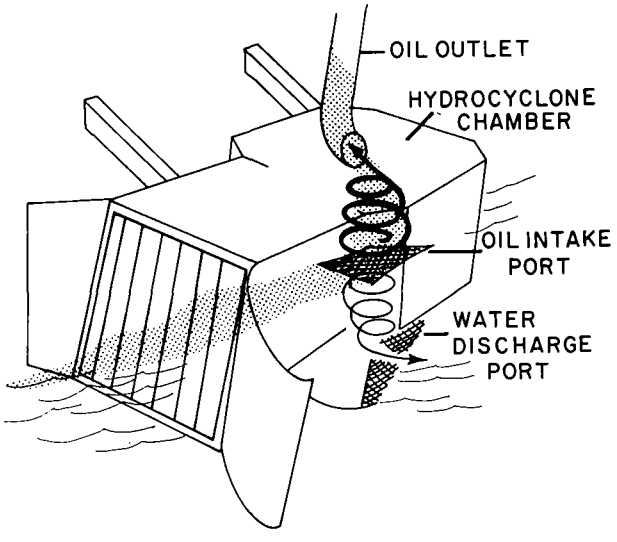
Alsthom Atlantic, Inc.
Pollution Control Department
600 Carondelet Street - Suite 604
New Orleans, LA 70130 USA

telephone (504) 529-1695
telex 266073 ALSTH UR

CYCLONET 100
(Also information for series 070, 120, 150 and 200)
Price upon request

COLLECTION PRINCIPLE

(See also Alsthom Atlantique Cyclonet 050.) Oil and water enter a circular chamber through a small trap door in the side and flow in a circular pattern. Oil rising to the top of the chamber is pumped to storage while water exits from the bottom.



PHYSICAL SPECIFICATIONS

Because of the similarity in Cyclonet models 070 through 200, specifications for all units are presented (a model 040 has also recently been introduced).

	070	100	120	150	200
Diameter (m)	0.7	1.0	1.2	1.5	2.0
Length (m)	2.1	3.0	3.6	4.5	6.0
Height (m)	1.4	3.0	3.6	4.5	6.0
Width (m)	1.1	1.5	1.8	2.25	3.0
Average Draught (m)	1.21	1.8	2.2	2.5	3.6
Discharge Hose Diameter (cm)	5.1	5.1	10.2	10.2	00
Weight with Support (kg)	200	2 000	4 000	9 000	18 000
Pump	various models available; self-priming, positive displacement units with diesel drives				
Debris	grill provided				

MODE OF OPERATION

Two units are affixed to a vessel, one on either side at some point astern of midships and held there by a simple support or hydraulically operated jack. A hydraulic unit coupled to a diesel motor is used to drive pumping units housed directly on the cyclone chambers. The vessel thus outfitted can be manoeuvered through slicks to chase down uncontained oil. Storage capacity is required.

PERFORMANCE (Cyclonet 100 only)

Optimum Test Data - Calm Water Trials

Tow Speed (kn)	Oil Type	Oil Recovered vs Oil Encountered (%)	Oil Recovery Rate (m^3/h)	Oil Content (%)
2	Medium	56.8	7.1	19.4
3	Medium	54.2	9.0	20.3
4	Medium	24.1	7.1	20.0
5	Medium	19.5	5.5	7.6
6	Medium	15.9	1.3	1.5
1	Heavy	64.4	3.0	15.2
2	Heavy	83.2	9.7	33.3
3	Heavy	78.5	15.4	31.0
3.5	Heavy	60.2	12.5	20.8
4	Heavy	36.7	8.4	15.5
5	Heavy	1.3	0.5	0.7
6	Heavy	2.3	0.1	0.1

Medium Oil: 200 cm^2/s at 28.8°C; S.G. 0.927

Heavy Oil: 7.00 cm^2/s at 28.8°C; S.G. 0.936

Evaluation at OHMSETT in 3 mm slicks demonstrated the oil recovery rate of the Cyclonet 100 to peak at approximately 3 kn in calm water; test runs were generally more successful at the mid-range of tow speeds and in heavy oil rather than in medium viscosity oil. Performance was found to be affected by regular wave and confused sea simulations and by variations greater than 16 cm from the optimum immersion depth. Ratios of pump discharge rate to oil presentation rate did not significantly affect efficiency. As deployed at OHMSETT, pump seals and other system components did not require replacement or repair during the 6-week program. Further investigations were recommended into factors which may have hampered recovery, including the channel iron framework around the inlet, vortex formation in the mouth, elimination of the debris grill, hydroejector performance, high speed pump settings, relative position of the device in waves, the cyclone's processing capacity, and its sensitivity to oil properties.

OPTIMUM APPLICATION

In medium to heavy oils; in calm seas; operated at about 3 kn relative to the oil at optimum immersion depth; in concentrations of oil several centimetres in thickness.

ADDITIONAL PERFORMANCE INFORMATION

Lichte, H.W. and M.K. Breslin, Performance Testing of Three Offshore Skimming Devices, EPA-600/7-78-082, U.S. Environmental Protection Agency, Cincinnati, OH, (1978).

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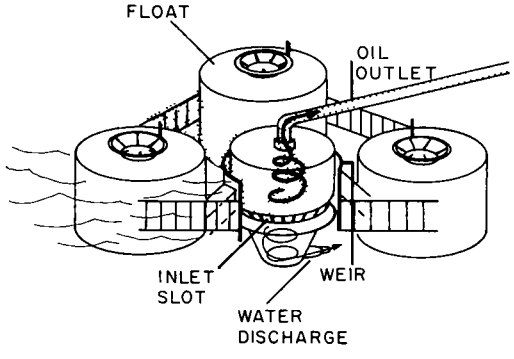
telex 266073 ALSTH UR

CYCLONET S
(Stationary Cyclonet,
S050, S100)
Price upon request

COLLECTION PRINCIPLE

Two components comprise the recovery apparatus, namely a circular surface weir and a hydrocyclone. Liquid spills over the weir and enters the body of the hydrocyclone tangentially through a series of inlet slots equipped with guide vanes. Rotation of fluid is produced in the chamber to effect separation of the lighter oil from the heavier water. Oil is removed by a pump connected by hose to the upper portion of the unit while water is taken away by a second pump connected tangentially to the lower part of the cyclone.



PHYSICAL SPECIFICATIONS

	S050	S100
Weir Diameter (m)	0.5	0.9
Height (m)	0.7	1.0
Average Draught (m)	0.6	0.9
Discharge Hose Diameter (cm)	5.1	5.1
Weight (kg)	30	80
Materials of Construction	steel, polypropylene floats	
Pump Units	wide range of pumps applicable, 4.5 HP diesel drive	
Debris	screen provided	

MODE OF OPERATION

Connection to two remote pumps is required followed by two-person launching of the skimmer into a stationary, contained slick. Water discharge should be directed away from the recovery area and the oil phase transferred for subsequent settling, depending on slick thickness.

PERFORMANCE (S050)

Optimum Test Results

Oil Thickness (mm)	Test Medium	Liquid Recovery Rate (L/min)	Oil Recovery Rate (m^3/h)	Oil Content (%)	Emulsification in Recovered Oil Phase (%)
2	crude	140.4	0.32	3.8	26
9	crude	136.2	1.13	13.9	17
1	diesel	138.7	0.84	1.0	7
8	diesel	58.1	0.56	16.0	0
10	diesel	84.7	0.70	13.8	1

Crude: Iranian, kinematic viscosity 58 SSU @ 37.8°C; API Gravity 30°; S.G. 0.8708

Diesel: kinematic viscosity 1.90 SSU @ 37.8°C; API Gravity 40°; S.G. 0.8251

In situ evaluation conducted on behalf of Environment Canada and the Petroleum Association for Conservation of the Canadian Environment determined the S050 to be a stable device due to the well-designed arrangement of outriggers and floats. The skimmer also comes equipped with good tether points, lifting eyes and spare parts, and is generally well constructed. Two pumps are required for its operation: one for oil transfer and the other to form a vortex in the cyclonic chamber. The latter was determined in the test program to be an important control variable. Evaluation of the S050 produced maximum recovery rates of 1.13 m^3/h of crude and 0.7 m^3/h of diesel; oil content was a maximum of 13.9% and 16%, respectively. Nonstandard (in North America) hose fittings were supplied, with attachment of the hose possible only when the skimmer was turned on its end. The test team recommended the development of an operation manual for this device indicating optimum pumping rates, although no in-water adjustment of the skimmer proper is required.

OPTIMUM APPLICATON

In calm, debris-free water; in significant concentrations of light to medium viscosity oils contained by a boom; with oil/water separation facilities.

ADDITIONAL PERFORMANCE INFORMATION

Abdelnour, R. et al., Field Evaluation of Eight Small Stationary Skimmers, Technology Development Report EPS 4-EC-78-5, Environment Canada, Ottawa, Ontario, (May, 1978).

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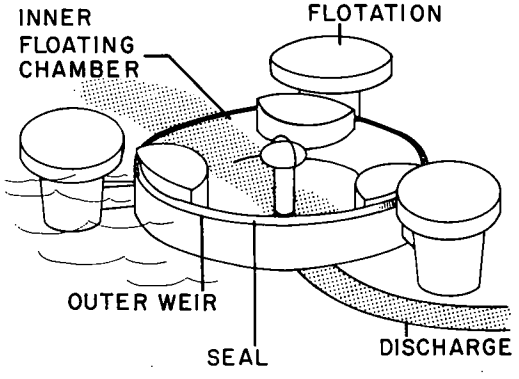
NENUFAR SKIMMER
Price upon request

COLLECTION PRINCIPLE

Oil and water overflow a self-adjusting circular weir into a small floating chamber that moves independently of the weir lip. Product is withdrawn by a remotely operated pump and separated, if necessary, in a settling tank that comprises part of the recovery package.



PHYSICAL SPECIFICATIONS (Two models of skimmers are manufactured)

	N050	N100
Weir Diameter (m)	0.5	0.9
Draught (m)	0.7-1.0	0.9-1.5
Surface Area (m^2)	1.05	2.1
Discharge Hose Diameter (cm)	3.2 or 5.1	6.4 or 7.6
Approximate Weight (kg)	12 or 30	50
Settler Capacity (m^3)	5	15
Materials of Construction	stainless or plain steel with polymeric linings	
Settler Configuration	either open top box shape or closed circular design	
Pump	positive displacement, self-priming; driven by electric motor or combustion engine, sealed or explosion-proof	

MODE OF OPERATION

The Nenufar system is being marketed primarily as a unit for incorporation into existing pollution control systems where stationary concentrations of floating products are to be removed. It is also intended for application from suitable working platforms to similarly contained accidental spillages. Inclusion of the oil/water separation component renders the package less portable than a single, small skimmer but is judged to be a realistic and integral part of this weir skimming concept.

PREDICTED PERFORMANCE

No data available.

Consult Industrial & Municipal Engineering Oela-III performance summary.

Recovery rates should exceed most other hydro-adjustable weir skimming systems because of the provision for settling. Collection throughput will depend on pump capacity, oil type, and residence time of the collected fluid in the separator tank. Matching up these considerations and engineering a system for a truck, working vessel or barge should provide good spill control capability. Like other weir skimmers, performance will be adversely affected by debris and waves although the outrigger float assembly should provide relatively good stability.

PREDICTED OPTIMUM APPLICATION

In light to medium viscosity oils; as a permanent installation or engineered mobile system; in debris-free, calm conditions.

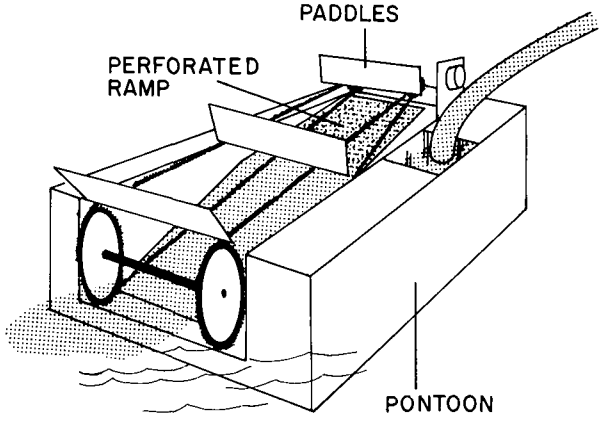
ANTI-POLLUTION, INC.
P.O. Box 885
1319-1325 Front Street
Morgan City, LA 70380
USA

telephone (504) 384-9517

PADDLE-WHEEL SKIMMER
(Clowsor Skimmer)
Price: $27 500 (U.S.)
for Model B-11
(effective 27-8-81)

COLLECTION PRINCIPLE

Four rotating paddles draw oil and water up a perforated inclined plane. The heavier water settles downward and passes through a series of holes that diminish in size progressively up the ramp. The oil-rich mixture finally falls through a grouping of large perforations located in the upper portion of the ramp and, as well, passes over the end into a sump. Off-loading is achieved by either on-board pumps or shore-based vacuum/suction systems. Flapper valves on the machine's underside permit the exit of water but prevent its surging inward.



PHYSICAL SPECIFICATIONS (Model B-11)

Overall Dimensions (cm)		Hull Dimensions (cm)
Length	132	Length 122
Width	81	Width 46
Average Draught (cm)	10	
Discharge Hose Diameter (cm)	5.1	
Weight (kg)	80	
Materials of Construction	welded aluminum marine grade 5086 hull, cast steel chain, steel/aluminum sprockets, Vicon wipers	
Power Unit & Pumps	US Motors, 3-phase, 5 HP explosion-proof motor and starting switch, 220/440 V with 5 cm Peabody Barnes centrifugal or Viking gear pump (51 kg)	
	Optional 5 HP Lombardini diesel engine and 5 cm Tait centrifugal pump (80 kg)	
	orbitrol hydraulic pump (14.4 L/min)	
Debris	collection basket available	

MODE OF OPERATION

The Paddle-Wheel Skimmer has been designed in a variety of sizes for use in shallow or deep water primarily as a stationary oil recovery device. The package includes an air flotation boom mounted on a hydraulically operated recovery reel on the starboard side. The boom can be deployed around the slick, secured to the skimmer's opposite side, and gradually retrieved to concentrate the oil.

PERFORMANCE

During the period 6 to 16 September 1977 at OHMSETT, 32 oil collection performance data tests were conducted with the skimmer. A total of 21 tests were undertaken with high viscosity oil; 11 tests were conducted with low viscosity oil. Highest average values are reported for three performance parameters for tests in each oil type. All were obtained in calm water at zero tow speed with the exception of the 61% recovery figure for light oil which occurred at a speed of 1.5 kn.

	Heavy Oil	Light Oil
Oil Recovered vs Oil Encountered (%)	96	61
Water Content (%)	91	65
Oil Recovery Rate (m^3/h)	21.6	12.2

A maximum oil recovery rate of 23 m^3/h was noted for a 30 cm thick slick of 19.00 cm^2/s product (heavy oil) corresponding to the maximum flow rate of the off-loading pumps supplied. Higher capacity pumps would have yielded a higher figure. For the same oil, recovery efficiencies of 85-95% were achieved for a wide variation of oil presentation rates and thicknesses in the stationary mode. Although a slight decrease in oil content of recovered product occurred in light oil, increasing trends in oil content were recorded for regular and harbour chop wave conditions.

The predominant oil loss mechanism was determined to be the entrainment of oil generated from the action of the rotating paddles contacting the water's surface. Overall, performance was limited by currents in excess of 0.5 kn, waves exceeding a 0.3 m harbour chop, paddle speeds greater than 2.5 rpm, and oil viscosity less than 0.20 cm^2/s.

Debris collection and removal would be possible with appropriate off-loading capability.

OPTIMUM APPLICATION

In stationary mode, using supplied boom where applicable; in medium to heavy viscosity oil (excluding Bunker C) that has been highly concentrated; at paddle speeds less than 2.5 rpm.

ADDITIONAL PERFORMANCE INFORMATION

Urban, R.W. and D.J. Graham, Performance Tests of Four Selected Oil Spill Skimmers, EPA 600/2-78-204, U.S. Environmental Protection Agency, Cincinnati, OH, (1978).

OTHER DATA

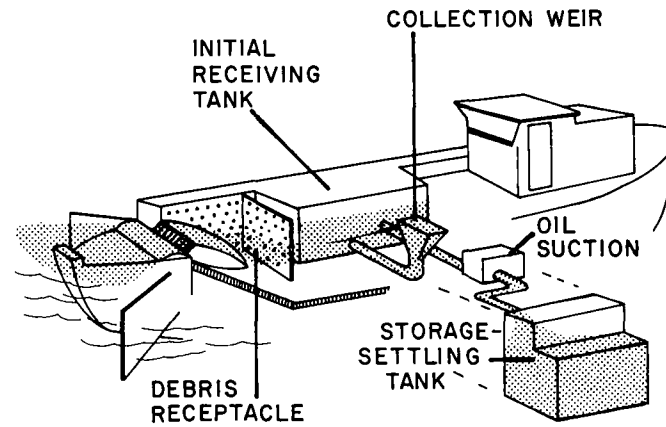
A custom-built larger unit is available as model D-11; an additional skimmer, model S-23, is sold for clarification applications.

BLACK SEA CENTRAL
PLANNING AND DESIGNING BUREAU
15-A Lostochkin Street
Odessa
USSR

SOVIET HARBOR OIL/DEBRIS SKIMMER
Model 2550/4
Price: about 200 000 rubles

COLLECTION PRINCIPLE

Oil and water flow over a broad-crested weir into a large basin incorporated in the forward portion of the vessel, largely drawn by the main ducted propeller. The water portion is passed through a large coke filter, through adjustable sluice gates, over rectangular weirs, through adjustable valves and out the main propulsion duct. Oil enters an adjustable basket strainer and overflow weir before being drawn by vacuum first into a starboard tank and then into a port tank, with both tanks serving as oil storage areas.



PHYSICAL SPECIFICATIONS

Length (m)	17.7
Height (m)	2.4
Beam (m)	4.3
Draught (m)	1.6
Weight (tonne)	39
Material of Construction	steel
Power Unit	150 HP diesel power pack
Transfer System	centrifugal pump rated at 1 893 L/min
Debris	processing system included

MODE OF OPERATION

The skimmer is capable of operation in both the advancing and stationary modes. The ducted propeller system draws floating oil into the vessel in either case. The machine is completely self-contained, includes debris removal apparatus, and can be efficiently operated by three persons.

PERFORMANCE

A total of 132 trials were conducted at OHMSETT; the Soviet Skimmer was operated for 20 days without significant breakdown. Oil recovery rates of 8.64 and 12.4 m^3/h were realized for light and heavy oils, respectively. Optimum performances were noted as follows:

	Oil Content (%)	Velocity (kn)	Wave Conditions	Oil Recovered vs Oil Encountered (%)	Velocity (kn)	Wave Conditions (height and length)
Advancing Mode						
Light Oil	59	2.0	calm	89	1.0	calm
Heavy Oil	85	1.5	calm	90	1.0	calm
				80	2.0	calm
				77	2.0	0.36 m x 6.95 m
				15	2.0	0.7 m (harbour chop)
Stationary Mode						
Light Oil	51	0	calm	74	0	0.4 m x 1.52 m
Heavy Oil	94	0	calm	86	0	calm

Light Oil: 0.24 cm^2/s at 28.8°C; S.G. 0.907
Heavy Oil: 7.00 cm^2/s at 28.8°C; S.G. 0.936

An average of 3.8 tonnes/h was recovered in a variety of oil and sea conditions using a two-man crew for both stationary and advancing tests. Oil collection was better in heavier oil due to entrainment of the lighter product. Although a centrifugal pump in the gravity separation system was effective, a second unit, a vortex fire/ballast system, was judged to have significantly less capacity. Recommendations made included the use of a positive displacement pump in the recovery circuit, a third crew while skimming when underway, and the further testing of the efficiency of the coke filter system, gill door, and port-side storage characteristics at higher oil throughput. Overall, the skimmer was favourably reviewed for high efficiencies in both operating modes: "The unique application of various weirs into one system, mobility, the efficient use of energy, the incorporation of series oil/water separation, the propulsion system, and using high oil/water flow conditions suggest the skimmer best of its class in harbour operations."

OPTIMUM APPLICATION

In heavier oils (excluding non-flowing products); in clear or debris-laden waters at velocities of 1-2 kn (or as operated in the stationary mode); in calm conditions.

ADDITIONAL PERFORMANCE INFORMATION

Lichte, H.W., Performance Testing of the Soviet Oil/Debris Skimmer, U.S. Environmental Protection Agency, Cincinnati, OH, (1980).

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Also contact:
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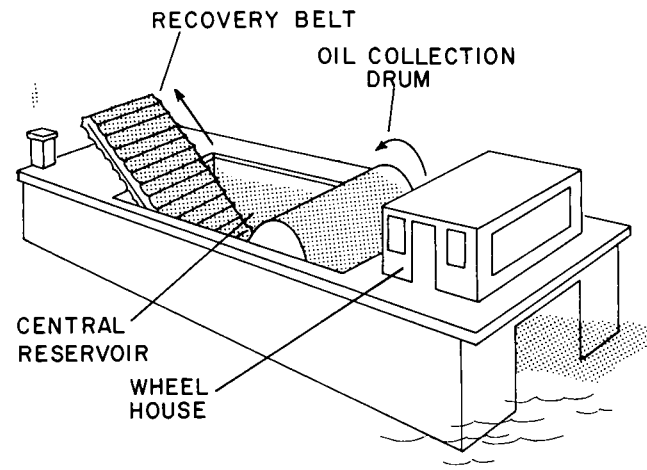
D 4000 Dusseldorf
West Germany

telephone 0211-4576-1
telex 858 34-0 ksd d

BODAN OIL SKIMMER
(Catamaran 3 SOG)
Price upon request

COLLECTION PRINCIPLE

Sweep arms concentrate and direct product into a quiescent area midships in this catamaran-type craft where a rotating drum recovers oil. Scrapers then remove the oil which is transferred to storage. A continuous rotating belt can also be employed to remove product in the vessel's central reservoir. Oil and debris collected by the belt are deposited in on-deck containers.



PHYSICAL SPECIFICATIONS

Length (m)	15
Beam (m)	5.3
Depth (m)	1.9
Sweep Width (m)	8.0
Draught (m)	1.1 (with 14 tonnes of stored product)
Weight (tonne)	27 (fully equipped)
Material of Construction	steel
Power and Pump Units	two MWM type D226-6 diesel engines each rated at 112 HP at 2 500 rpm, Schottel rudder propeller
	diaphragm transfer pump, water pump, belts and crane are hydraulically operated, driven by MWM type D226-4 diesel rated at 74 HP at 2 500 rpm
Maximum Vessel Speed	16-17 km/h (8.6-9.2 kn)

MODE OF OPERATION

Oil collection is dependent upon a relative velocity existing between the vessel and the oil to be recovered. The 15 m catamaran has been designed as a self-contained unit suitable for operation in harbours, rivers and lakes. Prior containment of the spilled oil is therefore not a prerequisite for application of the skimmer.

PREDICTED PERFORMANCE

Evaluation data for the Bodan-Werft oil skimmer are not available.

Refer to information provided for Versatech's Bennett Mark 4 Skimmer and Clear Seas Atlantic Ltd.'s OSCAR.

The drum should be capable of processing medium to heavy viscosity oils best while the belt system would be used to recover a mixture of oil and debris. Specific oil removal apparatus for both belt and drum were not detailed in the literature provided yet are critical to machine performance. An upper oil viscosity limit likely exists beyond which the transfer of oil from drum to storage tanks as well as the subsequent off-loading of the tanks cannot take place. Overall, the working platform coupled with the choice and positioning of collection gear appear to offer an effective skimming machine. The mechanical recovery components will require the implementation of a continuous and thorough maintenance program.

PREDICTED OPTIMUM APPLICATION

In medium and high viscosity oils; at relative velocities of 2-3 kn and less; in concentrations of oil several centimetres in thickness; will process most forms of debris.

OTHER DATA

A larger 29.5 m vessel is also marketed that houses fire-fighting equipment in addition to two rotating oil conveying drums positioned in series in the central collection area (with no belt system).

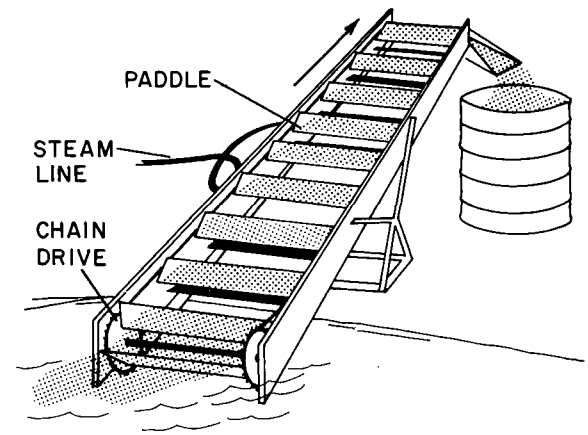
CANADIAN COAST GUARD
Prescott Base
P.O. Box 1000
Prescott, Ontario K0E 1T0
Canada

telephone (613) 925-2865

LITTLE GIANT
(Oil Harvester)
Price upon request

COLLECTION PRINCIPLE

A series of vanes each fastened on either side to two endless rotating chains carry oil up to the top of an inclined tray where it drops off into a collection tank or other container placed at the working platform level. A preheat unit consisting of steam pipes and shroud is located beneath the inclined surface.



PHYSICAL SPECIFICATIONS

Overall Dimensions	
Length (m)	4.9
Width (m)	1.3
Height (m)	1.2
Vanes	
Width (cm)	54
Height (cm)	9
Distance Between Vanes (cm)	61
Power Unit	hydraulic motor with appropriate drive (see Vikoma International Ltd. Komara Miniskimmer)
Materials of Construction	steel with aluminum intake and discharge chutes and preheat chamber, copper steam pipes

MODE OF OPERATION

Designed to be operated from a floating platform or dock, the lower end of the ramp can be positioned in contained oil by pivoting the device about its stand. An external power source is necessary to drive the hydraulic motor; an independent supply of steam is also required (e.g. a Steam Jenny). Launching is accomplished by forklift, small crane or equivalent.

PERFORMANCE

At air temperatures of between 1 and 3°C, highest recovery rate of Bunker C was measured at 5.44 m^3/h for 10 tests conducted on behalf of Environment Canada, in Newfoundland, in a boomed-off area within a refinery settling pond. Initial set-up of the skimmer was judged important to eliminate the necessity of manual feeding. If the bottom roller is set too high, the vanes do not load oil; if too low, a paddling action by the

vanes drives away oil. Shrouding for the upper, discharge end of the ramp and shortening of the inlet chute were recommended.

A modified second prototype of this mechanically uncomplex device was scheduled for testing in the autumn of 1981.

Optimum Test Results

Oil Thickness (mm)	Oil Temp. (°C)	Belt Speed (m/s)	Skimmer Slope (°)	Oil Recovery Rate (m^3/h)	Oil Content (%)
20	11	0.20	27	2.12	80
25	14	0.21	27	2.84	80
27	10	0.21	30	2.63	60
32	11	0.21	27	2.33	60
38	11	0.20	27	5.44	95

OPTIMUM APPLICATION

Highly viscous oils, contained in calm water, with some debris infestation; must be operated from 0.5 m or less above water's surface at an angle of 25-30°.

FURTHER PERFORMANCE INFORMATION

A Winter Evaluation of Oil Skimmers and Booms, Environmental Emergency Branch, Environment Canada, Ottawa, Ontario, (in preparation) (1981).

OTHER DATA

The Canadian Coast Guard has continued to develop, upgrade and test the Oil Harvester. Machines in various sizes have been investigated including one with a 91 cm wide collection vane track. Sealed steam trays are also being considered for (steam) recycling purposes. The Oil Harvester was originally fabricated from a hay bale elevator manufactured by the Portable Elevator Division of Dynamics Corp. of America, Bloomington, Illinois, USA (distributed in Canada by Allied Farm Equipment of St. Mary's, Ontario).

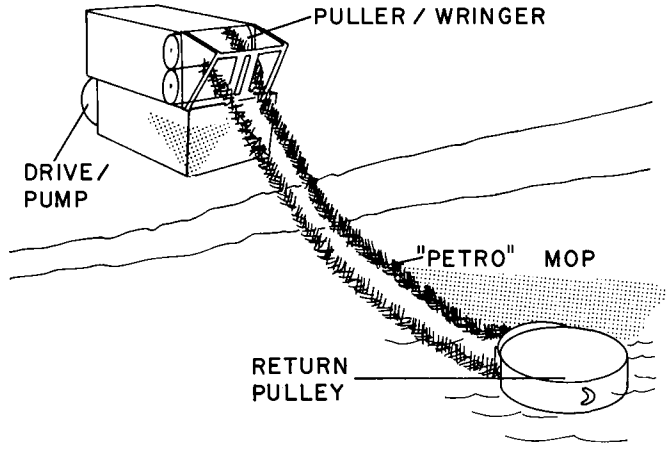
CENTRIFUGAL SYSTEMS, INC.
8319 Bauman Road
Houston, TX 77022
USA

telephone (713) 692-7722
telex 791 238

PULLER-WRINGER
(CSI Models 14, 24, 26, 29 and 212)
Price upon request

COLLECTION PRINCIPLE

An endless woven polymeric mop pulled by a drive/wringer assembly is passed through a slick. Product is squeezed from the mop, deposited in a sump integral to the wringer, and transferred by pump to ultimate storage. An idler pulley anchors the floating end of the mop.



PHYSICAL SPECIFICATIONS (typical values given; various models in each group marketed)

	14	24	26	29
Length (cm)	55.9	104	183	236
Width (cm)	37.5	81	91	117
Height (cm)	5 917	127	112	137
Mop Diameter (cm)	10.2	10.2	15.2	22.9
Materials of Construction	steel wringer/drive assembly, polypropylene fibre mop			
Weight (kg)	16	200	454	907
	varies with choice of drive and pump			
Pump	centrifugal, progressing cavity and lobe units are available in sizes 1.9 to 10.2 cm			
Drive Units	electric 115/230 V single-phase and 230/460 V 3-phase motors, 1/3 to 15 HP; air-cooled diesel engines also sold with models 26 and 29 rated at 7 to 18 HP			

MODE OF OPERATION

All models outfitted with a pump require mechanical lifting assistance; electric units need various power sources according to voltage, phase, etc. The wringer/power assembly is positioned on a working platform or on shore and the woven mop extended into stationary, contained oil. The return idler, through which the far end of the mop passes, is secured by anchoring or tying off to an appropriate point. Facilities for product storage are required to complete the recovery process. Advancing skimmers that are self-contained are also available.

PREDICTED PERFORMANCE

No evalution data are known for Centrifugal Systems, Inc. equipment.

See also Oil Mop Inc. entry.

The polymeric endless rope concept has been comprehensively evaluated in Canada, the United States, the United Kingdom and in other countries. It has also been widely applied to spills. Performance is generally reported to be very good over a wide range of oil viscosities, excluding highly viscous products such as Bunker C particularly at lower temperatures. The configuration of the recovery component permits its operation in moderate wave conditions and in many forms of debris. As Centrifugal Systems, Inc. has done, machines are available in several forms including an advancing skimming concept (see Oil Mop Inc. Dynamic Skimmer entry).

Recovery efficiencies should vary with mop speed, oil type and environmental conditions; however, generally slightly higher recovery rates should be expected for light to medium viscosity oils than for more viscous products. Higher oil content is more likely with the heavier oils. Prior concentration of the oil to be collected within a boomed-off area would ensure maximum saturation of the mop and optimum performance. The company's wide choice of pumps and drive units should satisfy any conceivable engineering requirement of the devices offered. The twisting configuration of the mop is not likely to affect its ability to contact oil; however, its flattened webbing core should reduce the likelihood of either jamming or slippage.

PREDICTED OPTIMUM APPLICATION

In light to heavy oils, excluding non-flowing products contained in thicknesses of several millimetres and more; in a variety of debris forms; in calm to moderate wave conditions.

ADDITIONAL PERFORMANCE INFORMATION

For appropriate references, see Oil Mop, Inc. entries.

OTHER DATA

Centrifugal Systems, Inc. has also constructed self-propelled catamaran vessels incorporating multiple mops between the hulls as a zero relative velocity oil collection system. One craft is 29 m long with a 12 m beam and a displacement of 272 tonnes, while another is about 15 m in length with a 5 m beam and weighs 25 tonnes. The former utilizes multiple 46 cm mops while the latter sweeps with 30 cm mops.

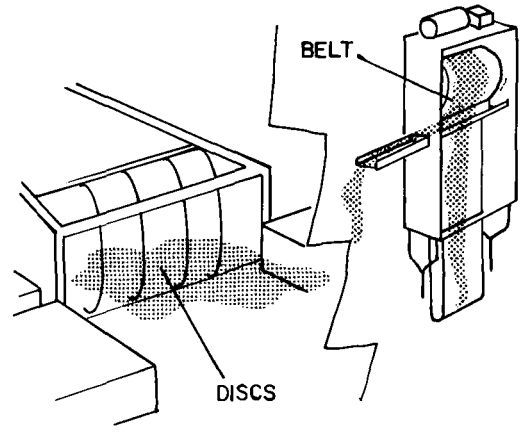
CENTRI-SPRAY CORPORATION
39001 Schoolcraft Road
Livonia, MI 48150
USA

telephone (313) 534-7000

CENTRI-CLERE OIL RECOVERY UNITS
Price upon request

COLLECTION PRINCIPLE

The company has marketed both a belt type and a rotating disc skimmer. Both employ sorbent surfaces to which the oil adheres. It is then removed by scrapers and transferred to storage.



PHYSICAL SPECIFICATIONS

	Belt Unit	Disc Unit
Length (m)	2.4	3.0
Width (m)	1.0	2.7
Height (m)	0.66	1.2
Draught (cm)	68.6	35.6
Weight (kg)	907	1 397
Power Requirements	1 HP	5.6 A motor, 460 V, 3-phase
Discharge	trough	5.1 cm hose
Storage Capacity (L)	0	91
Additional Data	the belts are sold in widths ranging from 30.5 to 61 cm. Disc skimmers are available in a range of sizes. Both the number of discs and their diameter vary depending upon the model selected	

MODE OF OPERATION

Both skimming systems were designed as stationary oil removal devices. The belt model is applied as a permanent installation whereas the disc system can be used as a floating oil collection unit in large separators, sumps or otherwise in protected water.

PREDICTED PERFORMANCE

No performance data are available for the Centri-Spray products. Refer also to entries for Thune-Eureka Euroskimmer regarding the disc skimmer and Aerodyne Development Corporation for the belt skimmer.

The Centri-Clere disc system probably best applies to medium and heavier oils with the exception of non-flowing products. The manufacturer's claim appears to be accurate of utilization of the skimming unit in sheltered waterways and plant facilities such as treatment ponds and basins. The collection of oil should be possible where it has accumulated in contact with the disc as a result of either surface drift or flow at relative velocities of 0-0.5 kn.

The vertical belt skimmer should be similarly useful in settling facilities. Again, a wide range of oil viscosities is likely within the processing capability of the machine. An available heating option should further enhance the potential to recover oils of higher viscosity. Whereas the disc skimmer has the potential to be deployed in a lake or bay, the belt unit has been designed as a permanently installed oil removal device. Debris, if present in minor amounts, should not pose a problem for either skimmer.

PREDICTED OPTIMUM APPLICATION

In medium to high viscosity oils available in thicknesses of several millimetres or more; in calm, non-flowing conditions; will process most forms of debris.

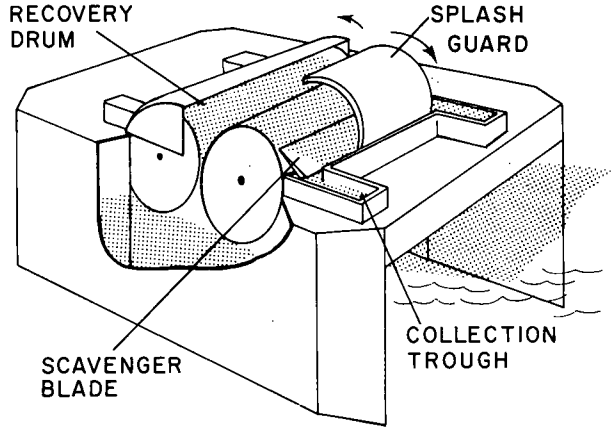
CLEAR SEAS ATLANTIC LTD.
P.O. Box 1272
Fredericton, New Brunswick
E3B 5C8
Canada

telephone (506) 455-9973

OSCAR
(Oil Spill Containment and Recovery Seagoing Vessel)
Price upon request

COLLECTION PRINCIPLE

Two steel drums mounted horizontally between the hulls of a catamaran contra-rotate. Oil preferentially adheres to the drums and is scraped by scavenger blades, with the removed product flowing through a trough into the hulls' storage tanks. Further oil/water separation takes place there with water exiting the bottom of each side hull through seacocks.



PHYSICAL SPECIFICATIONS

Overall Length (m)	12.19
Beam (m)	7.92
Hull Depth (m)	3.05
Recovery Drums	3.05 m long x 2.44 m in diameter
Hull Width (m)	3.05
Operating Draught (m)	1.52
Gross Weight (tonne)	37
Materials of Construction	steel hulls and drums, plastic/teflon or aluminum scrapers
Power Units	twin 35 HP, 3-cylinder air-cooled diesel engines; each provides hydraulic drive for one drum; the catamaran is not self-propelled

MODE OF OPERATION

The OSCAR is marketed as a vessel capable of oil collection in either the advancing or stationary modes. Towing or pushing is required to advance the skimmer through slicks. It is self-contained, includes product separation/storage facilities, and has been conceived for harbour and coastal applications. Launching by suitable cane is required.

PERFORMANCE

The OSCAR concept has been investigated in two separate programs by Environment Canada. In June 1975, a prototype was briefly field-tested using crude oil, while in 1978/1979 a comprehensive engineering evaluation of a full-scale model of the recovery component was undertaken in a series of flume tests. The main findings of the experimental work are reported.

The contra-rotating steel drums collect oil when it adheres to the drum surfaces and not through a pumping action of the drums. Pickup rate is determined by slick thickness, oil properties and the rotational speed of the drums. When used in the advancing mode, oil is recovered primarily by the forward drum; when held stationary, however, both drums pick oil up at equal rates. Gap width between the drum is not a critical factor if there is no contact between oil/water layers on each drum. Generally, high drum speeds and/or deep submergence lead to emulsification of product beneath the drums and a reduced recoverable oil layer.

It has also been shown that submergence depth of the 2.44 m diameter drums should be set at a minimum to reduce the effects of wave action. A drum speed of 5 rpm and submergence depth of 30 cm produce optimum performance in thin slicks while thicker slicks of 1 cm and greater can be optimally collected at 30 rpm and 4 cm of drum submergence. Entrainment is minimized and recovery rates are maximized at these settings. When advanced through a slick, a vessel speed which maximizes an oil layer buildup next to the forward drum should be selected.

Further studies have been recommended to evaluate optimum drum size and improve oil recovery performance.

Optimum Test Results

Test Medium	Gap Width (cm)	Vessel Speed (kn)	Oil Thickness (mm)	Drum Speed (rpm)	Oil Collection Rate (m^3/h)	Oil Content (%)	Oil Recovered vs Oil Presented (%)
Diesel	1.6	0.33	3	15	1.66	67	70
Oil Mix 54	1.2	0.33	2	5	1.02	96	82

Diesel: API Gravity 38.0°; kinematic viscosity 0.74 cm^2/s @ 15°C

Oil Mix 54: API Gravity 22.8°; kinematic viscosity 8.07 cm^2/s @ 15°C

OPTIMUM APPLICATION

In slick thickness 1 cm and greater; will process all forms of debris; in medium to heavy oils including Bunker fuels; at preselected drum speed, drum submergence depth, and advancing speeds (of less than 1 kn).

ADDITIONAL PERFORMANCE INFORMATION

(1) Solsberg, L.B. et al., Field Evaluation of Seven Oil Spill Recovery Devices, Technology Development Report EPS 4-EC-76-3, Environment Canada, Ontario, (October, 1976).

(2) Western Canada Hydraulic Laboratories Ltd., Investigation of the Operating Parameters of the Oil Containment and Recovery (OSCAR) Vessel, Technology Development Report EPS 4-EC-81-5, Environment Canada, Ottawa, Ontario, (December, 1981).

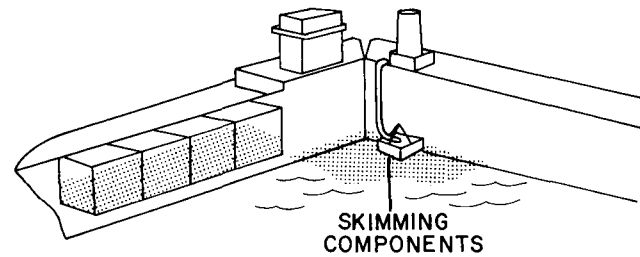
C. LUHRING SCHIFFSWERFT GmbH & CO. KG
2880 Brake
Unterweser
West Germany

telephone (49)(04)401/7351
telex 025217

OIL RECOVERY VESSEL
Price upon request

COLLECTION PRINCIPLE

Two separate hull sections which comprise a single vessel are joined together at the stern. A retractable rudder/screw propeller located at the bow of each hull is used to drive the sections apart creating a triangular area in which oil collects. Skimmers both integral to the hull and independent of it are then used to recover the oil thus contained.



PHYSICAL SPECIFICATIONS

Length (m)	85.6
Sweep Width (m)	80
Beam (m)	20
Depth (m)	7
Draught (m)	6
Deadweight (tonne)	5 000
Cargo Tank Capacity (m^3)	5 500

Power Units main propulsion: two diesel engines rated at approximately 1 700 kW each;
auxiliary propulsion: two engines rated at approximately 485 kW each

MODE OF OPERATION

This self-contained recovery vessel encompasses the entire scope of cleanup operations ranging from containment to oil/water separation of the collected product and storage. The ship can be manoeuvered with the hulls in the skimming mode to accept moving or stationary slicks in water depths greater than 6 m. The size of the coastal tanker model suggests offshore applications while a smaller version has been designed for more sheltered waterways.

PREDICTED PERFORMANCE

No test data are known to exist.

See also Offshore Devices Inc. High Seas Skimming Barrier and Hydrovac Systems (Holland) BV Sweeper Arm.

The appealing aspects of this concept relate to the rigid, integral structures of the propelled hulls which provide a manoeuverable containment/skimming/storage/separation operation in a single vessel. Thus, oil removal could be attempted downstream from a continuous, single-point oil discharge; changes in direction of the slick drift could be accommodated by relatively uncomplicated repositioning of the hulls. Less applicability is foreseen for the concept in chasing down uncontained oil at sea.

The unknown performance factors lie in the role that vessel interference may play in the oil collection process as well as the effectiveness of the skimming components. Thin slicks, shorter period waves or other wave forms that would result in gross vessel movement (pitch, roll, etc.) might be expected to adversely affect oil collection efficiency. Reflected wave activity as a result of the hulls might occur. Debris handling capability and the possibility of oil entrainment (under the hulls) should also be examined.

PREDICTED OPTIMUM APPLICATION

In concentrated slicks of light to heavy oil; downwind from a discrete oil release; in calm seas; at relative velocities to the oil of about 1 kn or less.

OTHER DATA

A smaller 33 m twin-hull vessel is also marketed with a sweep width of about 30 m.

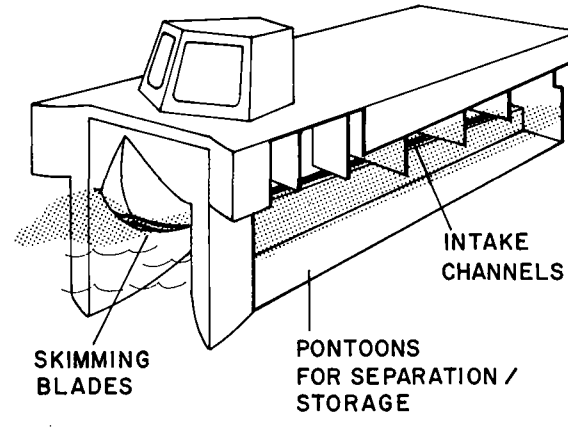
COSTRUZIONE BATELLI DISINQUINANTI S.p.A
(CO. BA. DI.)
Via Verda, 281
550949 Viareggio
Italy

telephone (39)(0584) 45165-46297
telex 590624

GAIMA
Price upon request

COLLECTION PRINCIPLE

Oil flows under the central portion of the vessel where it is confined by side hulls. A series of skimming blades then direct it toward intakes or inverted channels incorporated between the central and side hulls where a system of baffles and fins act to separate and contain the incoming oil. The oily liquid is suctioned off into collection tanks where further separation of the oil and water occurs. The water can then be discharged overboard.



PHYSICAL SPECIFICATIONS

Three models of the Gaima, designated by vessel length, are sold which incorporate the same collection principle.

Overall Length (m)	8.5	12.45	50
Overall Beam (m)	2.50	5.30	17
Construction Height (m)	1.69	3.50	8.20
Operational Draught (m)	1.15	2.55	6.70
Displacement - Fully Equipped (tonne)	6.2	42.50	950
Storage Capacity (tonne)	5.6	40	1 250
Materials of Construction			
Hull	aluminium	steel	steel
Superstructure	aluminum	aluminum	aluminum
Required Number of Operators	1	2	7
Crew Accommodation	--	2	24
Propulsion/Power Unit	VM688-HT/9 100 HP @ 3 000 rpm	two GM500M 164 HP @ 2 800 rpm/ CM 3/53N 100 HP	two 1 500 HP diesels/two GM 8V71 230 HP at 1 800 rpm
Cruising Speed (kn)	6	8	15
Operating Range	120 n.m.	450 n.m.	25 days
Discharge Pump (rating in m^3/h)	150	400	two @ 800
Debris	processing included in all models		

MODE OF OPERATION

The vessels are designed for chasing down oil slicks or operating when a relative velocity exists between the oil to be collected and the skimmer. On-board oil/water separation is possible, but for the smallest model (or when otherwise required for the larger units) attendant storage vessels must be used. The range in size of the skimmers reflects their intended application from sheltered waters to coastal regimes to offshore conditions. All vessels are designed for multi-purpose use including fire fighting.

PREDICTED PERFORMANCE

See also JBF Scientific Corp. DIP entry.

The recovery capability of the Gaima 12.45 was tested in May 1979 in situ on behalf of the Ministry of the Italian Merchant Marine. Of 2 tonnes presented to the device, 72.5% was recovered as a contained but thin (thickness not specified) slick. The collection efficiency would be directly dependent upon the action of the buoyant oil to rise up in significant volume into the collection troughs. Disruption to a continuous incoming layer of oil, e.g. higher sea states, would likely adversely affect performance. The mechanical simplicity of the recovery principle, vessel stability and on-board oil/water separation are three appealing aspects of the skimmer.

More specifically, the main oil loss mechanism is anticipated to be the bypass of product underneath the vessel as it fails to contact the skimming blades and does not enter the intake channels. Vessel response to waves will be the main factor influencing this aspect of oil recovery. A maximum relative velocity between the skimmer and the oil also likely exists beyond which collection efficiency drops dramatically. Thus, in order to maximize utilization of the skimmer and its "no moving parts" collection component, vessel speed and sea state together with oil properties should all be taken into account.

PREDICTED OPTIMUM APPLICATION

In light to medium viscosity oils; in relatively calm sea states or ocean swells; in significant concentrations of oil (several centimetres); at speeds of 1 kn and less.

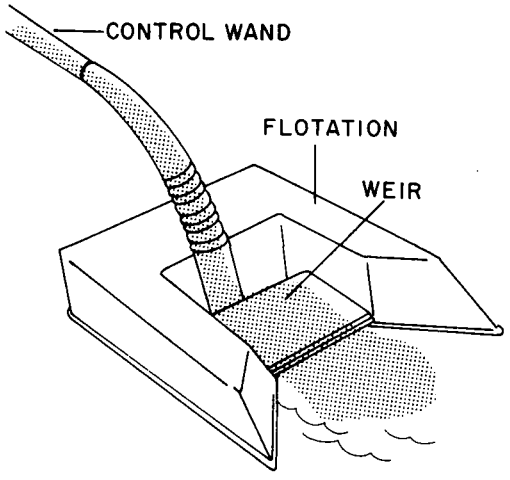
DOUGLAS ENGINEERING
5168 Brookside Lane
Concord, CA 94521
USA

telephone (415) 827-9040

SKIM-PAK
Price: $685 to $1 450 (U.S.)
Skimmer head only
(effective 29-9-81)

COLLECTION PRINCIPLE

A weir mechanism self-adjusts with flow and wave conditions to result in product being suctioned off through a hollow wand via an external pump to storage.



PHYSICAL SPECIFICATIONS (two sizes are sold)

	2000 Series	4000 Series
Length (cm)	53	71
Width (cm)	53	71
Height (cm)	15	20
Draught (cm)	7.5	10
Weight (kg)	7	9
Materials of Construction	fibreglass body, polymer hinge aluminum wand (4000 series also fabricated in stainless steel)	
Debris	screen optional	

MODE OF OPERATION

The Skim-Pak is connected to a pump or vacuum truck and placed in a concentrated slick. Skimming depth and rate are controlled by pump speed and a butterfly valve on the control wand. Two rigging arrangements allow both direct manoeuvering by one person and unattended skimming. The skimmer's small size provides for ease of handling and portability.

PERFORMANCE

Environment Canada directed evaluation of the Skim-Pak 2000 series in conjunction with a 7.6 cm Spate pump at a refinery settling pond in air temperatures of 0 to 2 °C and a water temperature of 10 °C using Venezuelan crude (API Gravity 24 °).

Slick Thickness (mm)	Valve Opening	Oil Recovery Rate (m^3/h)	Oil Content (%)
6	1/2	0.41	5
15	1/2	1.35	20
16	1/4	0.70	43
18	1	1.46	21

Oil content of the recovered liquid was found to increase with lower pumping rates (2 m^3/h), smaller valve opening (1/4 turn) and thicker slicks. For higher removal rates in thinner slicks, a settling tank was recommended by the test team. The skimmer was judged to be light, easy to use, and readily controlled by the wand/valve/pump and self-adjusting weir arrangement. The wand provides a practical means to optimally position the unit. Higher oil recovery rates could be expected in greater slick thicknesses depending upon the pump selected. For example, in U.S. tests, a maximum of 5.9 m^3/h of oil was collected in calm conditions using a Wilden pump and the Skim-Pak.

OPTIMUM APPLICATION

In light to medium viscosity oils; in significant thicknesses (greater than 1 cm) concentrated by boom in calm or small wave, debris-free conditions; can be used from vessel or dock or where direct access may be space-limited.

FURTHER PERFORMANCE INFORMATION

(1) A Winter Evaluation of Oil Skimmers and Booms, Environmental Emergency Branch, Environment Canada, Ottawa, Ontario, (in preparation) (1981).

(2) Breslin, M.K. and H.W. Lichte, Performance Testing of Selected Skimmers Developed by Small Businesses, U.S. Environmental Protection Agency, Cincinnati, OH, (in preparation) (1980).

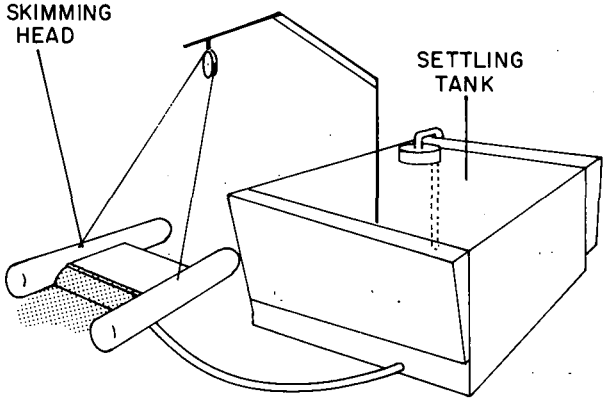
ENTREPRISE SANITAIRE
ET DE CANALISATION
Le Panorama
13693 Martiques
France

telephone (33) (42) 071035

ESCA THRESHOLD SKIMMER
(and Floating Settling Barge)
Price: 280 000 French francs
(effective 1-3-81)
pump, boom additional

COLLECTION PRINCIPLE

A floating suction head consisting of a simple weir initially collects product concentrated by an advancing boom. The mixture is conveyed to a trailing storage/separation tank where water settles out by gravity and is periodically pumped out.



PHYSICAL SPECIFICATIONS

Length (m)	8.5
Beam (m)	2.5
Height (m)	1.5
Draught	variable
Storage Capacity (m^3)	20
Weight (kg)	8 000
Power Requirements	5 HP
Pumps	Spate induced-flow; air screw unit

MODE OF OPERATION

A single length of boom is towed by two vessels to form a catenary. The skimming head is held at the apex with the separation barge trailing behind the boom. The complete system is then advanced through an uncontained slick and the separated product transferred to attendant storage facilities. Launching of the boom can be accomplished from the ESCA barge by two persons. The size and configuration of the equipment suggest applications in harbours and other sheltered waterways.

PREDICTED PERFORMANCE

No independent evaluation data are known.

See also Environment Protection Machines Ltd. EPM Skimmer and Offshore Devices, Inc. Scoop.

Performance of the ESCA skimmer/barge system will likely relate strongly to two factors, namely the relative velocity selected between the oil and the skimmer/boom assembly as well as sea state. The speed of advance

will have to be limited to velocities that allow a significant buildup of product in the apex of the catenary while allowing the simple weir system to accept the floating layer. At excessive speeds (probably of the order of 1 kn and greater), losses might occur through the entrainment of oil both under the boom and also in front of the skimming head. In other than moderate sea conditions, reflected wave activity at the boom and splash and washover of the weir lip might be expected to limit collection efficiency.

The ESCA System will likely function best in calm conditions and at slower speeds. Flow of product from the skimming head to the settling barge is a factor critical to performance even at lower relative velocities; however, the exact nature of this phase of the collection process is unknown. In the case of a very similar concept developed in Canada and tested at OHMSETT (the results remain confidential), collection efficiency was limited by the action of the free-floating weir inlet and subsequent oil pathway. Concentration of debris may also be a concern.

The company has taken into account the substantial water pickup that can be expected of a simple advancing weir system. The inclusion of the oil/water separations barge is therefore a practical choice and should provide the means to accumulate a concentrated product.

PREDICTED OPTIMUM APPLICATION

In light to medium oils present as slicks several millimetres and greater in thickness in debris-free water; in calm conditions and at speeds of 0.75 kn and less so that substantial product buildup results.

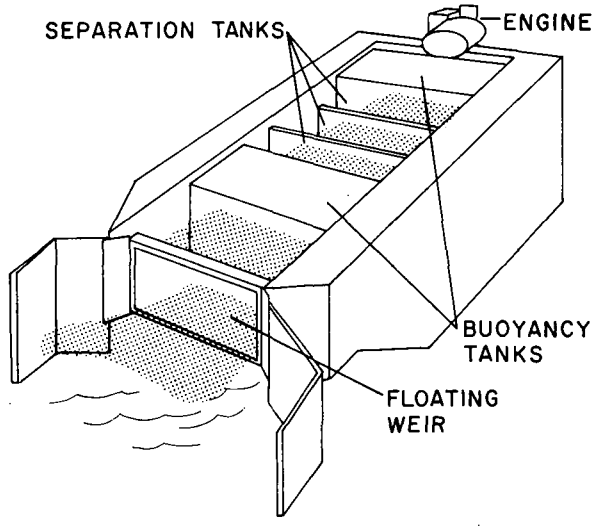
ENVIRONMENT PROTECTION MACHINES LTD.
Route 2, Box 97
Estacada, OR 97023
USA

telephone (503) 630-6644

EPM SKIMMER
(Oil/Debris Skimmer)
Price upon request

COLLECTION PRINCIPLE

An articulated floating weir accepts product which overflows the self-adjusting weir lip. Further oil/water separation occurs in a series of staged compartments.



PHYSICAL SPECIFICATIONS

Various size skimmers ranging from 4.6 to 14.4 m in length have been constructed in passive and propelled modes. Specifications are given for the "standard" model.

Length (m)	12.9
Width (m)	5.5
Height (m)	2.1
Draught (m)	1.2
Weight (tonne)	10.9
Storage Capacity (m^3)	about 75
Pump	Crisafulli, powered by diesel engine (unspecified) on larger units
Propulsion	unspecified on self-propelled models

MODE OF OPERATION

The skimmer must be advanced through the product to be recovered or held in a stream of product flowing toward it so that oil enters the device and is transferred and concentrated in a series of retention areas. The standard model is not self-propelled and so must be pushed or towed, or the oil otherwise directed to it. A separate off-loading pump is required.

PERFORMANCE

Tow Speed (kn)	Wave Form	Oil Recovered vs Oil Encountered (%) Before Modifications	After Modifications
Heavy Oil			
2	calm	86	93
3	calm	31	85
4	calm	NA	62
2	regular wave*	40	61
2	harbour chop	47	61
Light Oil			
2	calm	57	63
3	calm	31	63
4	calm	NA	51
2	regular wave*	20	50
1.5	harbour chop	47	56

* regular wave form 18 cm high x 5.5 m long

Evaluation was conducted of the EPM at OHMSETT in 1978; an initial series of tests was followed by modifications and subsequent examination. The test data indicate the machine performs optimally with heavier oil in calm seas at relative velocities of 2 kn or less. Oil content in calm water testing exceeded 90%. The absence of mechanical failure has been reported by users of the equipment.

OPTIMIUM APPLICATION

In medium to heavy oil (excluding cold Bunker fuels) at relative velocities of about 1 kn in calm water; the machine will process some debris.

ADDITIONAL PERFORMANCE DATA

Breslin, M.K. and H.W. Lichte, Performance Testing of Selected Oil Skimmers Developed by Small Businesses, U.S. Environmental Protection Agency, Cincinnati, OH, (1980).

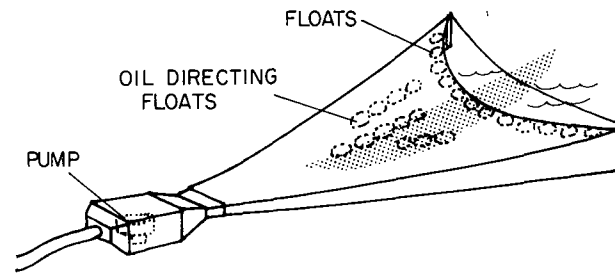
FISKEREDSKAP A/S
Contact:
Oil Pollution Control R & D Program
NTNF
PO Box 70 Taasen
N. Oslo 8, Norway

telephone (47) (02) 143590

OILTRAWL
Price upon request

COLLECTION PRINCIPLE

A unitized boom and trailing skimming compartment, which utilizes a net to maintain its configuration, concentrates oil entering the system. Water exits the open bottom while a pump housed in a semi-enclosed rear chamber removes collected oil. Buoyancy is provided by multiple floats.



PHYSICAL SPECIFICATIONS (prototype)

Length (m)	40
Width of Leading Edge (m)	17
Width of Skimming Compartment (m)	1
Skirt Depth (m)	0.9
Net	100 mm mesh size
Pumping Compartment	3.2 m x 2 m x 1.7 m
Pump	Frank Mohn Fusa A/S TK6 centrifugal pump
Other Data	ballast 0.6 kg/m along either outer length of skimming compartment

MODE OF OPERATION

The Fiskeredskap Oiltrawl is taken in tow by two vessels with lengths of boom attached to either side of the skimmer to augment the swath width. A trailing vessel accepts the collected liquid with oil/water separation provided by on-board tankage. Although bulky, deployent of the prototype was achieved at sea through the use of conventional fishing net reel and lifting equipment once the mother ship had arrived on station. The Oiltrawl has been designed for offshore use.

PERFORMANCE

In situ evaluation of the prototype Oiltrawl was conducted in the North Sea offshore of Alesund, Norway, in June 1980. Using an emulsion made from an SAE lube oil, the first test series was conducted in a swell with a significant wave height of 2.2 m and average period of 8.1 seconds. Towing speed ranged from 1 to 1.6 kn. About 80% of an 11 000 mPa•s emulsion released as a 49% water-in-oil mixture was recovered. (About 12 m^3 of oil was collected of 15.4 m^3 of oil discharged.) About 50% of the liquid pumped to the storage vessel was determined to be free water with the remainder measured to have a water content of 71%.

The second test was run at towing speeds to approximately 1.2 kn in a significant wave height of 1.2 m and a wind speed of 5.6 m/s (11 kn). About 30 m^3 of a 25 000 mPa•s emulsion was released which was contained by the Oiltrawl. Inability to pump the heavy emulsion prevented the recording of any collection efficiency data.

Overall, the capability of the trawl to accept and contain oil was observed to be very good with minor amounts of leakage mainly attributed to the secondary boom. The major drawback was concluded to be the low capacity of the pump which proved to be insufficient to deal with the 20 000 mPa•s emulsion.

OPTIMUM APPLICATION

In light to medium viscosity oils present as free-floating slicks; in wave heights to several metres, operated at a wide range of tow speeds (0-2 kn and beyond); may clog with some debris forms.

ADDITIONAL PERFORMANCE INFORMATION

Langfeldt, J.N. and M. Wold, Full Scale Tests with Oil Recovery Systems Offshore Norway, June 1980, Oil Pollution Control Research and Development Program, Oslo, Norway, (June, 1981).

OTHER DATA

A hybrid device incorporating the design specifications of both the Fiskeredskap and Romsdals Fiskevegnsfabrikk Oil Trawls (see latter entry for performance information) has been overseen through the Norwegian Oil Pollution Control Research and Development Program, with testing scheduled for 1982.

FRAMNAES MEK. VAERKSTED
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Oil Pollution Control R & D Program
NTNF
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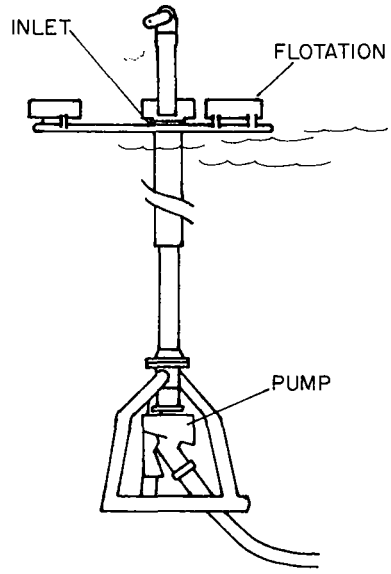
N. Oslo 8, Norway

telephone (47) (02) 143590

FRAMNAES SKIMMER
Price upon request

COLLECTION PRINCIPLE

Three buoyancy chambers support a sliding vertical weir tube which in turn feeds product overflowing the weir lip into elongated openings in a centre tube. The liquid then flows down into a pump, located at the bottom end of the skimmer, for off-loading. The flotation elements, weir assembly and pump are constructed around the central support tube which in the prototype has a lifting lug at its top end for deployment.



PHYSICAL SPECIFICATIONS

Centre Tube	Length	3.77	m
	Diameter	22	cm
Weir Tube	Length	2.11	m
	Diameter	25.5	cm
Buoyancy Chambers	Number	3	
	Height	25	cm
	Diameter	37	cm
Float Support	Diameter	1.365	m
Weight	unspecified		
Materials of Construction	sliding PVC weir tube; stainless steel centre tube, floats and sub-assembly		
Pump	Frank Mohn Fusa A/S TK6 centrifugal pump		

MODE OF OPERATION

The prototype tested was deployed with the use of the ship's crane to which the skimmer remained tethered for the duration of its evaluation. It could thus be quickly launched and retrieved. The manufacturer foresees

the skimmer also being permanently affixed to a ship with a pump internal to the vessel initiating the oil collection process. It would insert into a slot in the ship's side when not in use. A boom held out at an angle from the vessel directs oil to the skimmer so that the main use of the system is in chasing down slicks at sea or intercepting oil downstream from a single release point.

PERFORMANCE

In situ evaluations of a prototype Framnaes skimmer were conducted during June 1980 offshore Alesund, Norway, in the North Sea; the prime purpose was the assessment of the skimming principle. Towing speed in one test series ranged from 0.7 to 1.6 kn in a significant wave height of 2.8 m and an average wave period of 8.5 seconds. Of 20 m^3 of an 11 000 mPa•s emulsion (47% water-in-oil) released to the skimmer, about 70% was recovered as a 71.5% water-in-oil mixture. In terms of oil alone, 7.4 m^3 was collected of 10.6 m^3 discharged.

A second trial run took place in a significant wave height of 1.6 m and an average period of 4.9 seconds at tow speeds from 0.7 to 1.3 kn. Wind speed was 9.6 m/s (19 kn). About 30 m^3 of a 25 000 mPa•s, 66% water-in-oil emulsion (10.2 m^3 oil) was released and 60%, or 6.1 m^3, of oil was recovered as a 70% water-in-oil mixture (total volume 20.5 m^3).

Performance was affected by the rolling motion of the ship. This caused the sliding weir tube to constantly strike the top and bottom, i.e. the limits of its movement, so that some turbulence was created. Otherwise, wave conformity was judged to be very good. Towards the end of the second test, the support plate for the flotation chambers was damaged due to the excessive motion.

Overall, emulsion entered the skimming system very readily with no apparent adverse effects due to wave action. Little difference in pumping capability was discernible between the 11 000 mPa•s and 25 000 mPa•s emulsion tests.

OPTIMUM APPLICATION

In light to heavy oils present as uncontained slicks; used in conjunction with deflector boom; in wave heights likely to about 1 m; may clog with some forms of debris; at speeds of advance to about 1.5 kn.

ADDITIONAL PERFORMANCE INFORMATION

Langfeldt, J.N. and M. Wold, Full Scale Tests with Oil Recovery Systems Offshore Norway, June 1980, Oil Pollution Control Research and Development Program, Oslo, Norway, (June, 1981).

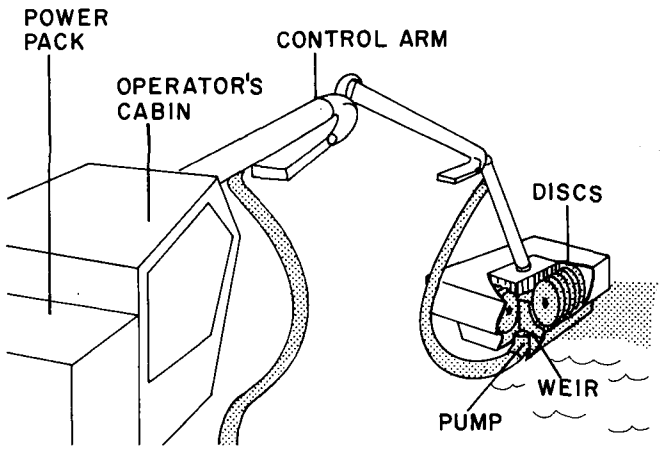
FRANK MOHN FUSA A/S
PO Box 10
N-5670 Fusa
Norway

telephone (47)(055) 82100
telex 40417 FRAFU N

FRAMO SKIMMER
(ACW-400, 402; Arctic Skimmer)
Price: 1 780 000 (NOK)
for ACW-400;
3 690 000 (NOK)
for Arctic Skimmer
(effective 28-9-81)

COLLECTION PRINCIPLE

Four banks of discs to which oil adheres rotate within a floating frame attached to a hydraulic arm. The oil is removed by scrapers to a central sump from which point a transfer pump off-loads it. The entire skimming head can be lowered to act as a weir so that oil flows by gravity to the pumpwell.



PHYSICAL SPECIFICATIONS

Two models are available, complete with operator cabin, power pack, extension and skimming head.

Overall Dimensions	ACW-400	Arctic Skimmer
Length (m)	6.8	12.4
Width (m)	2.5	3.7
Height (m)	3.4	3.7
Discharge Hose Diameter (cm)	15.2	15.2
Total Weight (tonnes)	7	13
Number of Discs	168	200
Disc Diameter (mm)	500	500
Maximum Extension of Arm (m)	10.5	18
Materials of Construction	aluminum A57 (NS17210) skimming head and discs	
Power Unit	GM Cylinder V53 rated at 175 HP @ 2 500 rpm	Mercedes OM-402 rated at 224 HP @ 2 300 rpm
Pump	TK6 centrifugal pump in both models	
Heating Unit (Arctic Skimmer only)	Shell terminal oil heated by 440 V, 60 Hz, 3 A system rated at 24 kW in double wall of pumpwell	

MODE OF OPERATION

The ACW-400 series is sold as a self-contained package that includes prime mover, operator cabin with controls, extension arm and skimming pumping head. It is designed to be mounted on an offshore supply vessel or similar platform (it requires deck space 2.7 m x 7.4 m). Oil that has been contained and concentrated by a boom can be removed by the system and transferred to on-board storage.

PERFORMANCE

Of 74 oil collection efficiency tests performed at OHMSETT during October 23 to Nobember 3, 1978, the following optimum data were determined for the ACW-400. All were achieved in calm conditions.

	Test Medium	Average Slick Thickness (mm)	Weir Height (cm)	Disc Speed (rpm)
Oil Content = 96%	Heavy Oil	73	0	4
Oil Recovery Rate = 97.2 m^3/h	"	79	-2	20
Oil Content = 92%	Medium Oil	73	0	10
Oil Recovery Rate = 93.6 m^3/h	"	43	-5	20
Oil Recovery Rate = 190.8 m^3/h	"	138	-5	20

Heavy Oil: kinematic viscosity 19.00 cm^2/s; S.G. 0.936

Medium Oil: kinematic viscosity 4.80 cm^2/s; S.G. 0.927

Highest oil recovery rates were measured with the overflow weir positioned below the water's surface in calm conditions while highest oil content was analyzed for oil collection with the weir held above the water. Thus the Framo can be operated in either of the two skimming modes depending primarily upon the storage/separation facilities available and taking into account such factors as slick thickness, oil viscosity, wave conditions and available operational time. Moving the skimming head within the contained slick was determined to maximize performance regardless of weir position, wave form and slick thickness.

Maximum pummping rate for water only was 526 m^3/h obtained against a 5 m head. This value would reduce with increasing oil viscosity and (discharge hose) head and frictional losses as well as for disc-only recovery operations under any circumstances. The skimmer has been designed to function in waves with a period of 6 seconds and greater.

Subsequent to the U.S. test program, the manufacturer developed the Arctic Skimmer which incorporates the following recommendations made by OHMSETT personnel:

(1) improved oil scraping capability (heated system)
(2) improved shorter-period wave response including an active hydraulic feedback system that is computer controlled
(3) longer, 17-18 m control arm

OPTIMUM APPLICATION

In medium to heavy oils, contained and concentrated by a barrier, in significant thickness (1 cm or more); in moderate sea conditions including ocean swells and, generally, longer period waves.

ADDITIONAL PERFORMANCE INFORMATION

(1) Gill, S.D. and W. Ryan, Assessment of the ACW-400 Oil Skimmer by the Canadian Coast Guard for Oil Spill Countermeasure Operations, Proceedings, 1979 Oil Spill Conference, Los Angeles, CA, (1979).

(2) Graham, D.J., R.W. Urban, M.K. Breslin and M.C. Johnson, OHMSETT Evaluation Tests: Three Oil Skimmers and a Water Jet Herder, EPA 600/7-80-020, U.S. Environmental Protection Agency, Cincinnati, OH, (1980).

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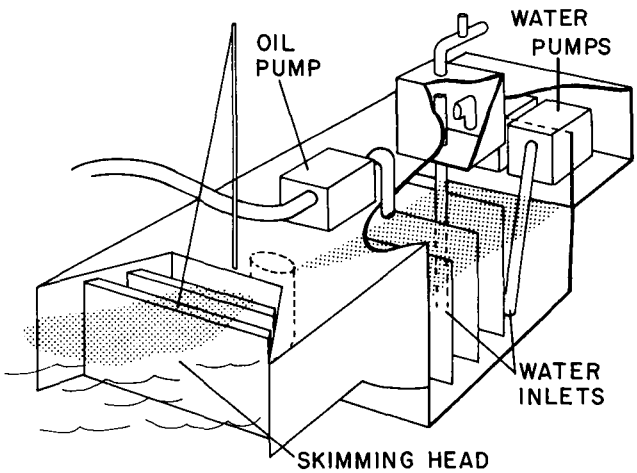
USA

telephone (201) 341-3600

DIPERNA SWEEPER
(GORS No. 1)
Price upon request

COLLECTION PRINCIPLE

A partial vacuum results in nonturbulent recovery of oil and water in a sealed gravity separator. The inlet is a floating weir. Oil is drawn off the top of the separator and transferred to storage while the heavier water is off-loaded from the bottom.



PHYSICAL SPECIFICATIONS

Length (m)	5.5
Beam (m)	2.9
Draught (m)	1.7
Weight (kg)	3 000
Pumps	single diaphragm, make not specified

MODE OF OPERATION

Self-contained, the skimmer can be operated in either stationary or advancing modes. A series of pumps maintain an equilibrium amongst the partial vacuum of the separator chamber, incoming flow of liquid, withdrawl of oil from the upper layer of collected product and removal of water from the bottom layer. Crane launching is required. The DiPerna Sweeper was designed as a self-propelled vessel for use in harbour and other more sheltered waterways.

PERFORMANCE

Evaluation was conducted at OHMSETT during May 1979. Nine tests of light oil and 34 of heavy oil showed the DiPerna Sweeper to be generally effective at speeds to 2.0 kn. The following best performance data were recorded (oil recovery rate is corrected to a 12 mm slick) for the two speeds and conditions indicated:

	0.5 kn		1.0 kn		1.5 kn		2.0 kn		2.5 kn	
	OR vs OE	ORR	OR vs OE	ORR	OR vs OE	ORR	OR vs OE	ORR	OR vs OE	ORR
A	95.0	12.7*	96.2	26.3*	95.1	38.0*	75.3	40.2	33.2	22.1
B	44.1	5.3	72.8	19.4	46.4	18.5	27.3	14.6		
C			38.3	10.0	23.5	9.4	21.1	11.3	21.0	14.0

OR vs OE: Oil Recovered versus Oil Encountered (%)
ORR: Oil Recovery Rate (m^3/h)
A: Calm Water
B: 0.3 m Harbour Chop
C: 0.4 m x 11.6 m Wave
*: One water discharge pump (70 m^3/h) was used; all other tests involved four pumps (125 m^3/h).

Oil content in discrete samples taken at the oil pump outlet was 95.5% at 1 kn in calm water and 88% at 0.5 kn in the 0.3 m harbour chop. The skimmer functioned optimally in heavy oil in calm water and with the greater number of pumps operating to maximize oil intake.

Regular wave head seas resulted in poorest performance since the skimming head and its attachment to the main body of the device through a large stiff hose did not promote maximum wave conformity. The main portion of the skimmer was stable and generally unresponsive to waves due to the deep, water-filled keel and the flotation chambers on both sides of the vessel.

Testing of a newly designed skimming head and inlet hose to improve wave response performed in 1980 proved disappointing.

OPTIMUM APPLICATION

In medium to heavy oil (excluding Bunker C fuel) at speeds to 2 kn; in calm water using a water discharge pump with a capacity of 125 m^3/h.

ADDITIONAL PERFORMANCE INFORMATION

Breslin, M.K., Performance Test of a Vacuum-driven Skimmer, U.S. Environmental Protection Agency, Cincinnati, OH, (in preparation) (1980).

OTHER DATA

One DiPerna Sweeper, renamed GORS No. 1, was evaluated at OHMSETT. The existence of additional units is not known.

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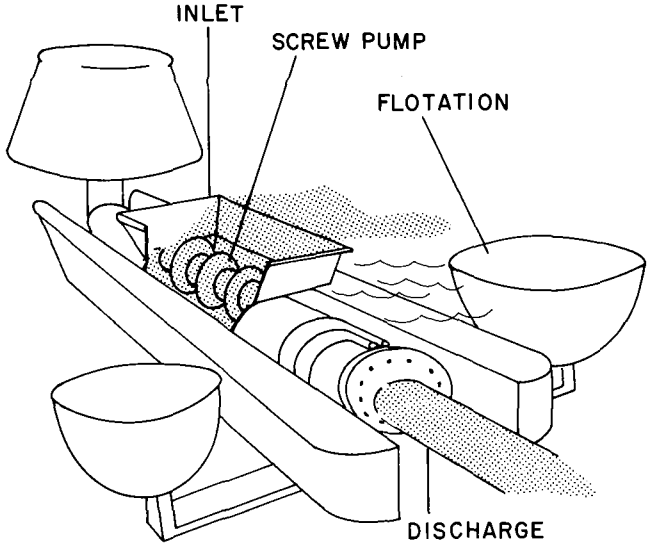
DESTROIL
Price upon request

COLLECTION PRINCIPLE

Oil overflows a simple weir arrangement or hopper to feed an Archimedes screw pump positioned towards the bottom of the suction inlet. Product is then transferred directly upon its removal from the water's surface to storage or disposal facilities.



PHYSICAL SPECIFICATIONS

Three sizes of skimmer are available which incorporate the same collection principle.

	DS150	DS210	DS310
Skimming Head			
Length (cm)	203	254	356
Width (cm)	122	170	221
Discharge Hose Diameter (cm)	10.2	12.7	15.2-20.3
Weight (kg)	125-150	185-280	430
Materials of Construction	steel housing, aluminum suction inlet and floats (polyurethane-filled), bronze bearings		
Power Pack			
Length (cm)	122	160	200
Width (cm)	100	100	100
Height (cm)	110	110	110
Weight (kg)	600	800	1 000
Diesel Engine (kW)	10	20	30
	Deutz, air-cooled, four-stroke engine		
Hydraulic Pump	Cessna pressure/flow compensated axial pump		

MODE OF OPERATION

The skimming head is placed in a boomed-off area of concentrated oil and operated via its power pack and controls from a remote platform. Weir position can be adjusted by air feed into a flotation chamber on the skimmer from a compressor in the drive package. The Destroil and Troilboom (of Trelleborg AB, Sweden)

have been marketed as an advancing oil recovery system although both are also sold as separate items for more general application.

PERFORMANCE

Evaluation was undertaken in Canada in March 1980 and at OHMSETT in August 1979. The latter program included testing of the Destroil/Trailboom System and resulted in the following peak performance figures at a tow speed of 0.75 kn and maximum preload of 3.785 m^3 of oil:

For heavy oil (maximum viscosity 8.50 cm^2/s) in waves 0.26 m high x 4.2 m long:

Oil Content = 93%

Oil Recovery Rate = 20.9 m^3/h

For light oil, in calm conditions:

Oil Content = 91%

Oil Recovery Rate = 23.8 m^3

Maximum pumping rate was measured at 37.4 m^3/h and an upper tow speed limit determined to be 1 kn for oil retention without significant loss. The independent towing bridle allowed the boom to maintain a relatively constant waterline in waves while the total boom/skimmer system displayed good conformity in waves up to a 0.5 m irregular harbour chop.

Oil losses were approximately 227 m^3/h at 1 kn and 2 268 m^3/h at 1.2 kn; they were observed to be the result of vortex shedding near the side walls of the skimmer collection pocket. The processing of most forms of debris by the pump was possible.

In the Canadian tests, Bunker C was transferred by the Destroil at air temperatures of -5 to 0°C. Flow of the high viscosity oil to the pump was hampered by blockage due to the floats and difficulty was encountered in positioning the weir. If the weir was positioned too high, overflow of product did not occur; if too low, inflow of water flooded the intake. It was concluded, however, that oil that flowed and was present in sufficient thickness would not have presented these problems.

OPTIMUM APPLICATION

In light to very heavy oils (including Bunker fuels) contained in substantial thicknesses and in calm water; in all forms of debris (excluding rope); towed at 0.75 kn or less when used with Trailboom.

ADDITIONAL PERFORMANCE INFORMATION

(1) A Winter Evaluation of Oil Skimmers and Booms, Environmental Emergency Branch, Environment Canada, Ottawa, Ontario, (in preparation) (1981).

(2) Lichte, H.W., M.K. Breslin, G.F. Smith, D.J. Graham and R.W. Urban, Performance Testing of Four Skimming Systems, U.S. Environmental Protection Agency, Cincinnati, OH, (in preparation) (1980).

OTHER DATA

New lightweight skimmers have replaced older models. See Gustaf Terling AB GT-185 Oil Recovery System for details.

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Sweden

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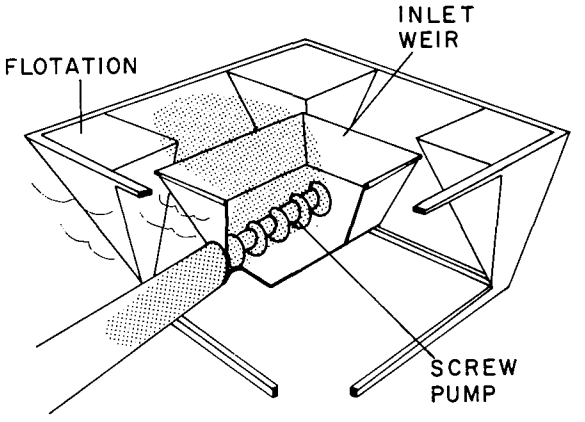
GT-185
(Oil Recovery System)
Price upon request

COLLECTION PRINCIPLE

A simple overflow weir accepts product which is transferred directly by an Archimedes screw pump located in the bottom of the suction inlet.



PHYSICAL SPECIFICATIONS

Approximate Dimensions

Length (cm)	125
Width (cm)	170
Discharge Hose Diameter	10.2 cm and 15.2 cm are standard
Weight (kg)	100
Materials of Construction	aluminum frame, stainless steel screw with fibreglass-reinforced discs, aluminum or iron pump casing
Drive Unit	TRW type MAE hydraulic motor driven by 20 kW diesel powerpack
Other Data	several configurations of flotation units are available

MODE OF OPERATION

The skimming head is deployed in either a moving or stationary contained slick and operated remotely from the powerpack. The weir lip is positioned hydraulically relative to the floats for optimum skimming depth. The pump can also be used as a separate submersible unit in other applications.

PREDICTED PERFORMANCE

See also Gustaf Terling AB Destroil.

Based on past Canadian and U.S. evaluations and in view of recent technical innovations, the GT-185 skimmer should offer improved skimming capability over previous Destroil skimmer models. The suction inlet can be positioned more precisely relative to the surface layer of oil. Additionally, the different flotation configuration should result in a more stable skimming operation.

Limitations will likely be encountered should attempts be made to recover oil at a temperature below its pour point. The availability of the screw pump as a separate device in the same package, however, adds significantly to its versatility.

The main oil loss mechanisms are likely to be similar to those experienced with other weir-type skimmers. These are usually attributable to limited wave response and an overflow of water into the weir as it shears with the oil flow in spite of the weir lip. The GT-185, as with most weir devices, is best applied to slicks concentrated by a boom. It is, however, unique in that it should be capable of processing Bunker C.

PREDICTED OPTIMUM APPLICATION

In light to very heavy oils contained in significant thicknesses in calm water; in various forms of debris; when towed at 0.75 kn or less when used with Troilboom.

ADDITIONAL PERFORMANCE DATA

See Gustaf Terling AB Destroil.

OTHER DATA

The company continues to investigate various float configurations and has actively engaged in engineering programs on a continuous basis to upgrade the skimming system.

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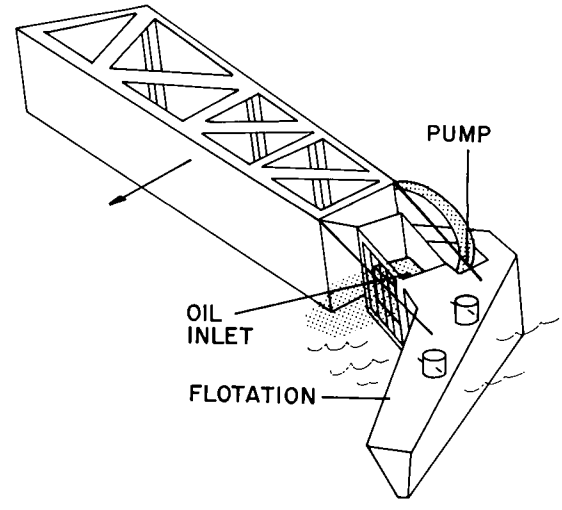
SWEEPER ARM
(Veegarm, IHC Slicktrail)
Price upon request

COLLECTION PRINCIPLE

Sweeping arms incorporate a weir-type skimmer in a chamber (near the mother ship's hull) which includes a wave-compensation mechanism. Two submersible pumps behind the weir remove collected product to an on-board open-top hopper where oil/water separation takes place.



PHYSICAL SPECIFICATIONS

Sweeper Arm Length (m)	20
Total Sweep Width (two arms) (m)	50

Vessel Dimensions (Cosmos Dredger)

Length (m)	113.6
Beam (m)	20.0
Draught (m)	7.28 - 8.35
Hopper Capacity (m^3)	5.375
Propulsion	two 5 200 HP engines
Pump Drive	two 1 450 HP motors
Bow Propeller	750 HP
Debris	grate provided

MODE OF OPERATION

A sweeper arm is connected on either side of a vessel (a trailing suction hopper dredger has been utilized) by means of a tubular structure containing discharge pipes and hydraulic feed lines. In this mode, uncontained oil can be chased down. When not in use, the arms are stowed on deck; they are deployed overboard with the aid of gantries. Application in coastal and offshore waters is foreseen.

PERFORMANCE

Testing was conducted at OHMSETT in various wave conditions at tow speeds to 3 kn and in slick thicknesses of 1, 2 and 5 mm using both heavy and light oils. The unit recovered 100% of the heavy oil encountered in calm water at 1 kn and 50% for the 2 and 5 mm slicks at about 2.5 kn. Oil content reached a maximum of 40% for the thickest slick; otherwise, it remained relatively constant above 0.5 kn. The highest value of oil recovery rate was about 35 m^3/h, again with the 5 mm slick, dropping to a distinct minimum at 1.5 kn for all thicknesses tested. In the harbour chop conditions, best results in terms of recovery rates and efficiencies were recorded for heavy oil and the lowest speeds.

When headed directly into a regular wave pattern 1.9 m high, oil was prevented from entering the skimmer by an interference pattern which set up between the vessel hull and rigid boom face.

OPTIMUM APPLICATION

In calm water, debris-free; in medium to heavy oil (but not Bunker C) 5 mm or more in thickness; at speeds to 1 kn; avoid direct heading into waves.

ADDITIONAL PERFORMANCE INFORMATION

Farlow, J.S. and R.A. Griffiths, OHMSETT Research Overview 1979-1980, pp. 661-666, Proceedings, 1981 Oil Spill Conference, Atlanta, GA, (March 2-5, 1981).

OTHER DATA

Because a number of groups have been involved with the development of this concept as a total skimming package, various names are associated with it. These include the Research and Development Department of IHC Holland, the Netherlands State Waterways Board (Rijkswaterstaat), Hydrovac Systems (Holland) BV, and Cosmos Dredging v.o.f. (consisting of Holland Dredging Co., Royal Bos Kalis Westminster Group nv and Royal Volker Stevin nv).

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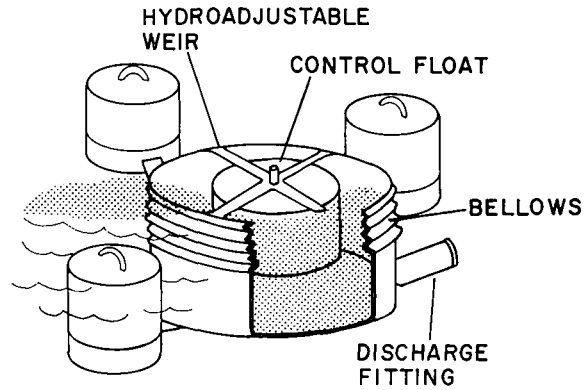
OELA
(Swiss Skimmer,
Kaiser Oela Skimmer)
Price upon request

COLLECTION PRINCIPLE

A central control float is attached through a rubber bellows to a circular weir. The weir lip is thus raised or lowered by buoyant forces to control the depth of skim and regulate the balance between oil intake and the oil withdrawn by an external, separate pump.



PHYSICAL SPECIFICATIONS

Two models which feature the same collection principle are manufactured.

	Oela III	Oela IV
Number of Floats	4	6
Overall Diameter(cm)	130	150
Overall Height (cm)	41	41
Weir Diameter (cm)	43	69
Discharge Hose Diameter (cm)	5.0	7.6
Flotation Chamber		
Diameter (cm)	26	26
Height (cm)	22	22
Weight (cm)	55	91
Total Reduced Size (cm) for Transportation	72 x 66.5	92 x 78
Materials of Construction	stainless steel body, rubber bellows	

MODE OF OPERATION

Must be used in conjunction with a separate pump or vacuum system. The skimmer is deployed in a contained area of oil; product which overflows the weir is withdrawn. In addition to the automatic regulation provided by the control float/bellows arrangement, a valve in the discharge hose can be used to select an appropriate flow rate. The units come with hoses, fittings, valve and instruction booklet and can be deployed by two or three persons.

PERFORMANCE

Field evaluation of the Oela III was conducted in October 1976 under the direction of Environment Canada and yielded maximum recovery rates in L/min (m^3/h) as follows:

	1 mm slick	10 mm slick
Diesel	7 (0.4)	19 (1.1)
Crude	8 (0.5)	50 (3.0)

Crude: Iranian, API Gravity 30° to 43°
Diesel: blend, viscosity 0.024 to 0.043 cm^2/s at 15°C

Oil content in the collected product varied from a maximum of 14% in a 1 mm diesel slick to 50% for the 10 mm crude slick.

The Olea III was deployed in the test site to remove the final traces of oil which other units under study could not recover. It was judged to be of high quality construction, lightweight, rugged and simple in design. Users report deterioration of the rubber bellows upon repeated use; these will therefore require replacement. No trash screen was provided with the skimmer. Oil collection was possible in small to moderate size waves without flooding of the weir.

OPTIMUM APPLICATION

In concentrated, light to medium viscosity oils; in calm conditions; in debris-free water; with smooth-flowing off-loading pump.

ADDITIONAL PERFORMANCE INFORMATION

(1) Smith, F.G. and H.W. Lichte, Summary of US Environmental Protection Agency's OHMSETT Testing, 1974-1979, U.S. Environmental Protection Agency, Cincinnati, OH, (January, 1981).

(2) Solsberg, L.B., W.G. Wallace and M.A. Dunne, Field Evaluation of Oil Spill Recovery Devices: Phase Two, Technology Development Report EPS 4-EC-77-14, pp. 17, 18, 45-48, Environment Canada, Ottawa, Ontario, (December, 1977).

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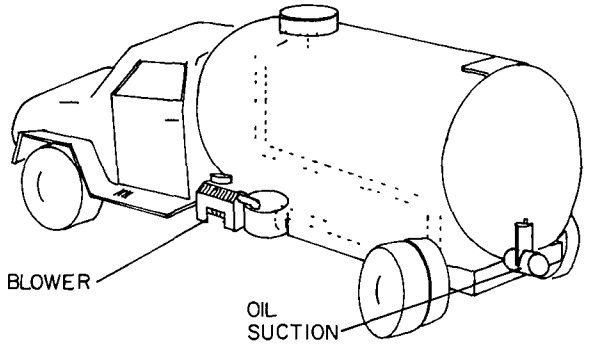
VACUUM TRUCK

COLLECTION PRINCIPLE

A low-volume vacuum pump or blower is used to directly evacuate a truck or skid-mounted tank. A suction hose is then placed in or on the liquid to be recovered which is then drawn into the tank. Skimming heads can also be attached to the end of the hose.



PHYSICAL SPECIFICATIONS

Specifications for vacuum trucks vary widely from company to company. The Industrial and Municipal Engineering equipment has been listed since it is offered in many capacities:

Storage Volume (m^3)	2-23
Tank Diameter (m)	1.21-1.83
Suction Hose Diameter (cm)	7.6 and up
Pump	Pearson Brothers self-lubricating, air- and oil-cooled, two- to four-vane rotor unit; air capacities from 3.8 to 226 m^3/min, vacuum of 9.32 and 10 m water; maximum rotor speed approximately 800-1 000 rpm (optimal gearing available); weight 84-350 kg
Materials of Construction	0.64-0.79 cm sheet steel tank, stainless steel optional, as well as coatings of asphaltum, molded rubber, epoxy or fibreglass
Other Features	tank hatch, tank-end door, secondary shutoffs, hydraulic hoist (for tank elevation and unloading), control panel, etc.

MODE OF OPERATION

The vacuum truck is usually applied as a self-contained package either to skim oil that has concentrated near shore or to transfer collected liquid to ultimate storage/disposal facilities. It has also been used from barges for the recovery of oil where land access does not exist. Vacuum systems are often utilized during spills in harbours, lakes and rivers where their availability is often assured.

PERFORMANCE

In September 1980, a vacuum truck manufactured by Coleman Environmental & Pollution Control Equipment Co., Inc. of East Patchogue, New York, was evaluated at OHMSETT. A total of 11 tests were conducted with an average recovery rate of 13.3 m^3/h of an 18% oil (and water) mixture. The oil recovery rate ranged from

0.5 to 3.9 m^3/h, with oil content varying between 5 and 40%. The oil recovery rate was determined to increase in light test oil (0.07 cm^2/s at 28.8°C) and decrease in heavy oil (7.0 cm^2/s at 28.8°C), with increasing slick thickness also contributing to improved performance. (Slicks of 2 to 25 mm were presented to the device.) Oil content did not significantly change for various hose lengths, oil viscosities or slick thicknesses. The addition of a simple weir skimmer at the inlet, however, doubled the oil content without affecting the oil recovery rate; increased blower speed also raised the oil/water ratio in the collected liquid. Overall, the vacuum truck appeared to the test team to be suited for application to thicker slicks, with the attachment of a skimming head used to accommodate some wave action and raise oil content. It was also concluded that sight gauges in the storage tank would assist in the determination of oil and water phase levels.

OPTIMUM APPLICATION

In light to heavy oils (excluding Bunker C) contained in thicknesses of several centimetres and more; used in conjunction with weir skimming head, at higher blower speeds; will process debris; should function better in lower viscosity oils.

ADDITIONAL PERFORMANCE INFORMATION

(1) Farlow, J.S. and R.A. Griffiths, OHMSETT Research Overview 1979-1980, pp. 661-666, Proceedings, 1981 Oil Spill Conference, Atlanta, GA, (March 2-5, 1981).

(2) Smith, G.F., Vacuum and Air Conveyor System Tests for Oil Spill Recovery, U.S. Environmental Protection Agency, Cincinnati, OH, (in preparation) (1981).

INDUSTRIE MECCANICHE ING. A. SCARDELLATO
31100 Treviso
S. Guiseppe
Italy

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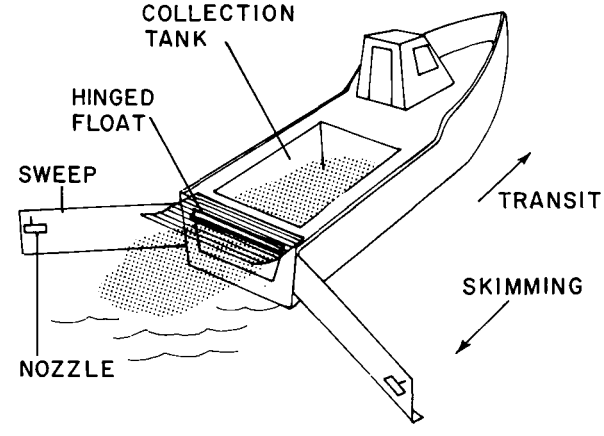
telex IMS TV 41261

GABBIANO SKIMMER
Price upon request

COLLECTION PRINCIPLE

Spray from nozzles directs oil over an adjustable weir and into a settling tank with a hinged float at its entrance preventing the outflow of product. A pump transfers collected oil to storage while water is discharged at the tank bottom through control valves.



PHYSICAL SPECIFICATIONS

Three sizes of vessel are available which incorporate the same oil collection principle.

	Mini	Standard	Super
Vessel Length (m)	5.75	7.25	10.00
Beam (m)	2.30	2.60	3.00
Sweep Width (m)	6.3	6.5	8.5
Overall Length - with Sweeps Extended (m)	8.25	10.75	13.25
Material of Construction	steel in all models		
Propulsion	unspecified, two reversing gears, screws in both stern and bow		
Debris	grill provided plus container		

MODE OF OPERATION

The Gabbiano skimmers have been designed as self-propelled, self-contained oil collection craft. The smaller model was conceived for use in inland waterways and harbours while the larger units were constructed for coastal service. The skimmers travel in one direction when in transit and reverse to advance astern through uncontained slicks. A capability for the collection of solids has been specifically provided. All vessels require crane launching and feature water spray nozzles which assist in directing product into the skimmer mouth.

PREDICTED PERFORMANCE

No evaluation data are known.

See also Environment Protection Machines Ltd. EPM Skimmer.

Because an adjustable weir comprises the initial oil recovery step, it is probable that performance will be sensitive to sea state and relative velocity. More specifically, best results could be expected in calm conditions, likely at speeds of about 1 kn or less. Mixing of oil and water at the skimmer inlet as well as the entrainment of product would be minimized under these conditions. Additionally, the settling tank could optimally function to allow a distinct oil phase to build. The incorporation of the hinged retainer at the tank entrance would also assist in this process.

At higher speeds, anticipated oil loss mechanisms would be the shedding of vortices so that oil passes under the sweeps particularly at their point of attachment to the vessel proper. Excessive vessel pitch in higher sea states could also conceivably result in splash at the inlet and lost product.

Overall, the skimmers appear to be ruggedly designed and should function well under certain operating criteria. The debris-collecting grid is a practical inclusion for harbour applications.

PREDICTED OPTIMUM APPLICATION

In calm sea conditions, at relative velocities of less than 1 kn, in thicknesses of several millimetres and more; will process larger debris forms.

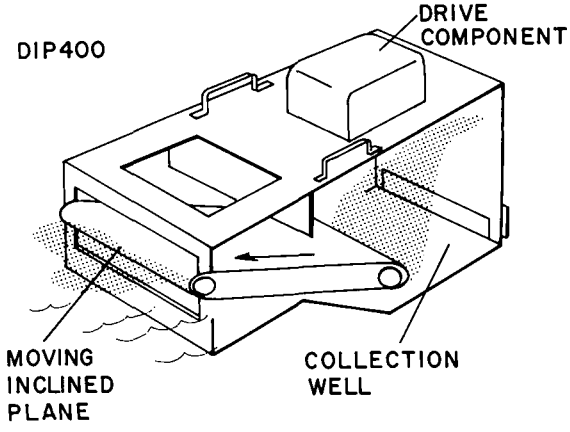
JBF SCIENTIFIC CORPORATION
2 Jewel Drive
Wilmington, MA 01887
USA

telephone (617) 657-4170
telex available

DIP 1001 and 400
Price 1001 upon request
DIP 400: $15 000 (U.S.)
(effective 2-9-81)

COLLECTION PRINCIPLE

The DIP, or dynamic inclined plane, features a rotating endless belt inclined at an angle. Oil presented to the unit is forced downward by the belt, being confined in the horizontal plane by vertical plates. The oil rises into a collection well while water passes through and out the discharge port. Oil adhering to the belt is scraped off and pumped to storage.



PHYSICAL SPECIFICATIONS

(The 1001 and 400 are the smallest available DIP systems)

	1001	400
Length (cm)	168-183	137
Beam (cm)	107	66
Height (cm)	91-97	74
Draught (cm)	56	41
Weight/Displacement (kg)	273-318	55
Reservoir Capacity (L)	100	23
Belt Width (cm)	53	31
Materials of Construction		
Shell	epoxy coated steel	marine-grade aluminum
Belt	polyurethane/polyethylene	polyethylene
Power Unit	25 HP diesel-driven air compressor rated at 1.70 m^3/min (STP) at 689 kPA	optional electric, hydraulic or pneumatic drives
Pump	Warren Rupp Sandpiper diaphragm pump	screw pump (unspecified)
Discharge Hose Diameter (cm)	3.2	3.8
Propulsion	none	two outboard motor leg units

MODE OF OPERATION

The DIP 1001 and 400 models are designed for use where their operation can be controlled from an adjacent working platform. The 400 skimmer can be deployed by two persons into separating ponds and inner harbours

while the 1001 is intended for use in operating modes that require stationary or manoeuvering capability. A control wand allows direct control of the 1001. Both skimmers recover oil in flowing conditions. Crane launching is required for the larger 1001 unit; an air compressor is also required in pneumatic models.

PERFORMANCE

The DIP 1001 was evaluated under the direction of Environment Canada in October 1976; the following optimum test results were obtained:

Rel. Speed (kn)	Test Medium	Air Temp. (°C)	Water Temp. (°C)	Wave Height (cm)	Slick Thickness (mm)	Oil Recovered vs Oil Presented (%)	Oil Content (%)	Oil Recovery Rate (m^3/h)
0.5	Crude	10	9	5-15	11	99	76	5.6
0.9	Diesel	9	9	0-10	7	86	64	0.8
0	Crude	9	10	4-8	23	--	98	1.8
0	Diesel	10	9	4-8	11	--	56	0.5

Crude: Iranian, API Gravity 30° to 43°

Diesel: blend, 0.02 to 0.043 cm^2/s at 15°C

Overall, oil recovery rates and oil content were highest in slicks of crude oil exceeding 10 mm and lowest in thin slicks of diesel. Although judged mechanically complex by evaluation personnel, the skimmer performed well. Positive commentary was made with regard to the easy-to-operate control box, readily calibrated oil sensor probe, clear instruction manual, well-designed boom attachment points, and practical lifting hardware. The control wand provided was somewhat awkward to use and a water jet enhancement system had little effect. Lower performance figures were attributed to an inoperative sensing probe (which ultimately failed during the tests), carryunder and entrainment of product, and freeze-up of air motors. The skimmer functioned well in waves 15 cm in height and sea response was judged good.

OPTIMUM APPLICATION

In substantial thicknesses (1 cm and greater) of light-to-medium viscosity oils; in smooth flowing conditions; will tolerate some debris.

FURTHER PERFORMANCE INFORMATION

Solsberg, L.B., W.G. Wallace and M.A. Dunne, Field Evaluation of Oil Spill Recovery Devices: Phase Two, Technology Development Report EPS 4-EC-77-14, Environment Canada, Ottawa, Ontario, (December, 1977).

OTHER DATA

The DIP 1001 has been marketed as a complete trailer-mounted recovery package labelled 1002 that includes skimmer, compressor, hoist, boom and trailer. Contact the manufacturer for the current availability of this system.

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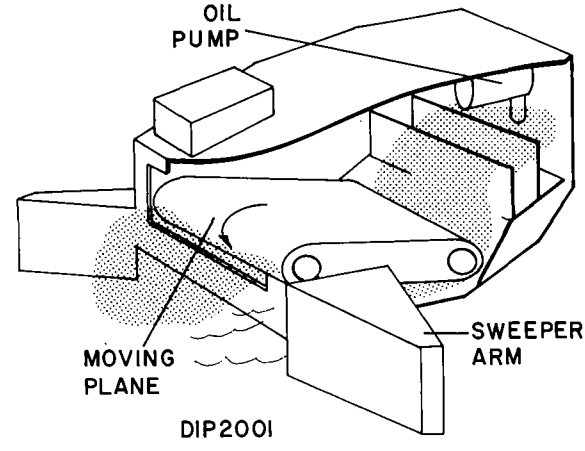
2 Jewel Drive
Wilmington, MA 01887
USA

telephone (617) 657-4170
telex available

DIP 2001
Price: $85 000 (U.S.)
(effedctive 2-9-81)

COLLECTION PRINCIPLE

A moving inclined plane submerges incoming oil which then rises upwards in a collection well. Additional oil is scraped off the belt at the well opening while water exits a discharge port. Oil is transferred to storage by an on-board screw pump.



PHYSICAL SPECIFICATIONS

Hull Dimensions		Belt Characteristics	
Length (cm)	376	Width (cm)	7
Beam (cm)	218	Length (cm)	457
Height (cm)	208	Material	PVC/polyester reinforced
Draught (cm)	89	Drive Motor	1 HP electric
Displacement (kg)	1 814		
Collection Well (L)	568		
Material of Construction	marine-grade aluminum		
Oil Pump	Moyno IEOFSI-CDQ screw pump driven by 7-1/2 HP AC motor at 450 rpm		
Optional Equipment	water jet enhancement system rated at 83 L/min at 276 kPa; diesel/hydraulic drives also available		
Debris	grill included		

MODE OF OPERATION

The 2001 system is either moored in a flowing stream of oil or secured to a support boat and manoeuvered through it. Crane launching is required. Off-loading of product into appropriate storage facilities must be planned using the pump provided. The skimmer is designed for use in harbours and other sheltered waterways.

PERFORMANCE

In situ testing of the DIP 2001 system was conducted by Environment Canada first in a preliminary program during 1973 and then more comprehensively in 1974/5.

Optimum Test Results

Test Medium	Vessel Velocity (kn)	Air Temp. (°C)	Water Temp. (°C)	Wave Height (cm)	Slick Thickness (mm)	Recovered vs Oil Presented (%)	Oil Content (%)	Oil Recovery Rate (m^3/h)
No. 2 Fuel	1.2	32	25	0-10	0.8	98	57	1.0
Crude	1.2	23.5	22	0-10	0.8	91	34	0.9
Crude	0.5	3	2	0	1	94	96	1.1

The evaluation programs revealed the DIP 2001 to collect oil most efficiently at relative velocities up to 1.25 kn. At these speeds, emulsification of recovered oil is slight and entrainment or carry-through of product negligible. Performance was shown to decline with higher velocities, increased wave action and (on a recovery/presentation percentage basis) in thicker slicks. Oil pickup capability was judged to be good up to sea state 2 on the Beaufort wind and wave scale.

Oil losses were apparent between the sweeps and hull as well as underneath the skimmer at higher velocities and in rougher sea conditions. Critical comments were made concerning several hardware items, the lack of push pads, and belt speed control. Overall, however, consistently high efficiency values were obtained for the 2001 under moderate sea conditions.

OPTIMUM PERFORMANCE

In light to medium viscosity oils at relative velocities under 1.25 kn; in wave heights to 10 cm; will tolerate some debris.

ADDITIONAL PERFORMANCE DATA

Solsberg, L.B. et al., Field Evaluation of Seven Oil Spill Recovery Devices, Technology Development Report EPS 4-EC-76-3, Environment Canada, Ottawa, Ontario, (October, 1976).

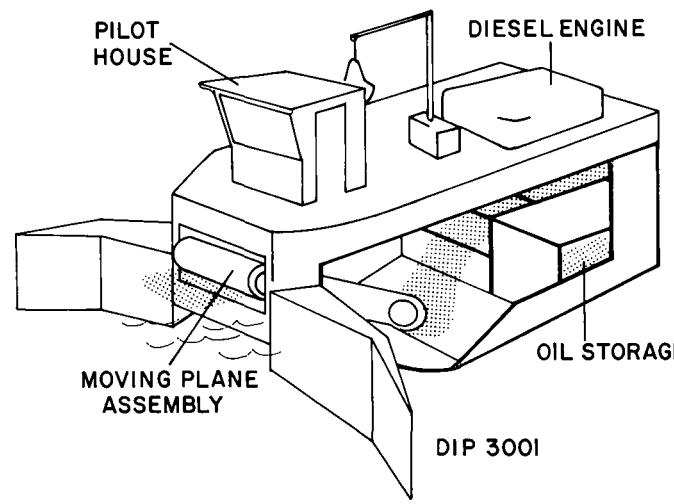
JBF SCIENTIFIC CORPORATION
2 Jewel Drive
Wilmington, MA 01887
USA

telephone (617) 657-4170
telex available

DIP 3000 through 7000
Price: (U.S.)
DIP 3001 $307 000
3003 $490 000
410 subject to quotation
405 $360 000
5001 $1.7 million
6001 subject to quotation
7001 subject to quotation

COLLECTION PRINCIPLE

The larger DIP skimmers incorporate an inclined moving belt which functions identically to analogous equipment in the smaller models. Oil that is encountered is submerged by the belt and subsequently rises into a large collection well. From that point it is transferred to on-board storage.



PHYSICAL SPECIFICATIONS

	3001	3003	405	410	5001	5005	6001	7001
Length (m)	8.2	11.6	9.9	avail.	20.7	15.2	33.5	48.8
Beam (m)	3.0	3.4	2.7	on	5.2	4.3	10.4	11.0
Draught (m)	0.9	1.4	0.8	request	1.5	1.5	2.6	2.7
Displacement/Wt. (tonnes)	1.8	16.3	5.5		102	51	--	--
Storage Capacity (m^3)	5.7	15.1	3.8		37	--	132	265
Construction of Hull	marine-grade aluminum; not specified in models 5001 through 7001							
Belt Material	PVC/polyester reinforced							
Propulsion	91 HP Detroit diesel	117 HP Detroit diesel	twin 120 HP Volvo diesels	--	twin 250 HP diesels	250 HP Detroit diesels	not specified	
Debris	trash grill; clam shovel and macerator also available							

MODE OF OPERATION

The DIP vessels are designed for use in offshore and coastal waters and in harbours. Skimming modes include advancing the DIP into a slick with containment booms attached in a V configuration to either side of the oil inlet; chasing down uncontained slicks using the sweeps alone; and stationing the skimmer downstream from a flowing source of oil.

PERFORMANCE

The DIP 3001 system was evaluated at OHMSETT in June of 1976 and 1977. In the first of these programs, the skimmer was found to operate most efficiently at 1 kn without concentration sweeps. Data trends also indicated improved operation in lower wave heights and at lower relative velocities, although inconsistencies were noted for some runs.

In the 1977 test series, underwater photography contributed substantially to improved results since the source of oil losses could be examined and thereafter minimized. Highest percentage of oil recovered versus oil encountered exceeded 95% at 1 kn and was 80% at 2.5 kn in calm conditions. These figures dropped somewhat as wave action increased.

Critical adjustments were determined for the belt speed, back plate opening and maximum pressure in the water jet enhancement system which together resulted in maximum collection efficiencies. It was recommended that care be exercized with the jets to avoid oil entrainment.

Overall, the larger DIP skimmers should be capable of relatively high oil recovery rates particularly in calm conditions and at speeds of about 1 kn. Efficiencies could be expected to decline in more extreme sea states and at higher relative velocities, i.e. situations in which product carryunder and entrainment would be in evidence.

OPTIMUM APPLICATION

In light to medium viscosity oils; at speeds approximating 1 kn; belt speed adjusted to within 0.5 kn of skimming speed; water jets at 10.3 kPa; will tolerate some debris.

ADDITIONAL PERFORMANCE DATA

Nadeau, P.F., USN DIP 3001 Performance Test Program, U.S. Naval Facilities Engineering Command, Alexandria, VA, (1976).

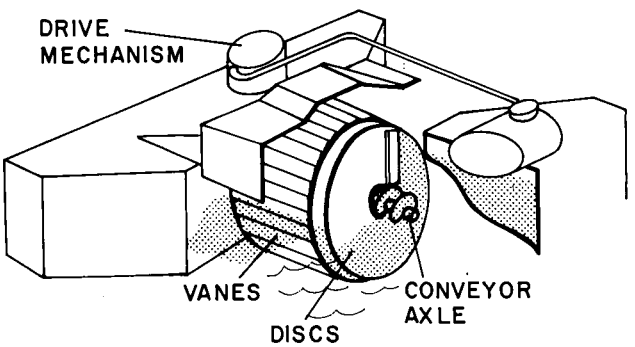
LOCKHEED MISSILES & SPACE COMPANY INC
1111 Lockheed Way
Sunnyvale, CA 94086
USA

telephone (408) 742-8855
telex 346409 LMSC SUVL

CLEAN SWEEP
110, 130, 134, 135, 150
Prices: (effective 30-9-81)
110, 130 upon request
134/135, $14 500 (U.S.) with flotation; $11 250 without flotation.
150, $12 750 (U.S.) with flotation; $9 125 without flotation

COLLECTION PRINCIPLE

A series of overlapping vanes mounted on a drum rotate downward through an oil layer to direct product onto discs rotating within the drum. Wiper blades remove the oil which is deposited into a central hollow axle through which it is pumped to storage.



TYPE 134 / 135

PHYSICAL SPECIFICATIONS (Clean Sweep 100 series)

	110	130	134/135	150
Length (m)	1.2	1.2-1.4	0.8-1.5	0.9-1.3
Width (m)	0.6	1.2-1.3	0.9-1.2	0.9-1.3
Height (m)	0.7	0.9-1.1	0.9	0.77-0.81
Draught (cm)	25	21-34	29	21-23
Discharge Hose Diameter (cm)	2.5	5.1	2.5	2.5
Weight (kg)	70	178-254	150-190	107-173
Materials of Construction	marine-grade aluminum	stainless steel 304, polyethylene wiper blades, polyurethane foam in floats		
Driver System/Motor	3-1/2 HP 4-cycle gasoline engine	1/2 HP three-phase 230/460 V; or single-phase 115/230 V, 60 or 50 Hz		1.27 m^3/min at 6.3 kg/cm^2 air compressor, vane motor
Discharge Pump	flexible nitrile impeller	neoprene diaphragm	lobe type directly coupled to 1-1/2 HP electric motor	Buna-N diaphragm

MODE OF OPERATION

With the exception of model 110 with its gasoline engine, an external power source is required to drive the Clean Sweep 100 series skimmers. Generally, the units are designed for oil removal applications in fixed installations such as tanks, sumps and settling basins where space is limited, electricity is available and storage facilities can be easily established. Launching would otherwise require a lifting capability.

PERFORMANCE

During 1976, evaluations were conducted of the Clean Sweep 150F skimmer at OHMSETT in both stationary and advancing modes. The optimum test results obtained were as follows:

Test Mode	Oil Viscosity (cm^2/s @ 38°C)	Disc Speed (rpm)	Oil Recovery Rate (m^3/h)	Oil Content (%)	Oil Recovered vs Oil Encountered (%)
Stationary	0.10	20.1	0.34	93.3	--
Advancing	0.10	15.1	0.32	85.8	30.4

Maximum values were recorded in calm (no wave) conditions and, in the case of the towed tests, in a 2.4 mm thick slick at about 0.5 kn.

The factors determined to be of importance to better performance included the absence of waves, presentation of product directly to the front of the unit (achieved by hosing the oil), selection of disc speed, and lower relative velocity between oil and skimmer. Although recovery rates increased in the advancing mode with increasing slick thickness, efficiencies dropped proportionately. A wave height of 0.15 m was found to significantly decrease performance in both stationary and advancing tests.

Overall, the smaller Clean Sweep units appear to be ideally suited for the removal of light to medium viscosity oils in situations where they can be installed on a permanent basis and operated when required.

OPTIMUM PERFORMANCE

In light/medium viscosity oils; in quiescent water; where a relative velocity of less than 0.5 kn exists between flowing oil and the skimmer; as a permanent oil removal installation.

ADDITIONAL PERFORMANCE INFORMATION

Wadawsky, A., Performance Tests of Three Skimmers and One Boom at OHMSETT, TM-60P-76-11, U.S. Naval Civil Engineering Laboratory, (1976).

LOCKHEED MISSILES & SPACE COMPANY INC.
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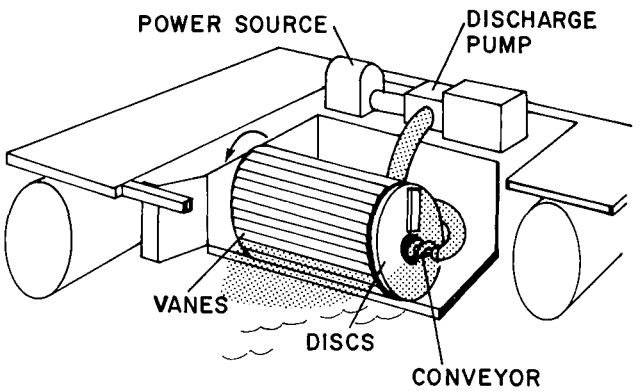
CLEAN SWEEP
R2002, R2003
(Type 2100, 3100, 3200)
Price upon request

COLLECTION PRINCIPLE

Oil adheres to rotating discs housed in a drum composed of overlapping vanes. Scrapers remove product to a central axle from which it is conveyed to storage.



PHYSICAL SPECIFICATIONS (Clean Sweep 2000 and 3000 series)

	R2002			R2003	
	Standard	Type 2100/ Lagoon Boat	Arctic Boat	Type 3100 Bay Model	Type 3200 Harbour Model
Weight (m)	3.1	8.2	4.8	8.9	8.8
Width (m)	3.3	3.1	4.4	5.0	5.3
Height (m)	1.3	2.3	2.9	3.7	3.7
Draught (cm)	33	74	71	66	58
Weight (kg)	800	3 180	6 636	11 350	7 730
Materials of Construction	stainless steel drum; steel frame and floats; polyethylene wipers	aluminum pontoons	steel hulls; aluminum superstructure	steel hulls	steel hulls
Driver System	7.5 HP 60 or 50 Hz or diesel, air systems	29.5 HP diesel	44.3 HP 3-cylinder diesel	86 HP 6-cylinder diesel	44 HP 3-cylinder diesel
Propulsion	no	yes	no	yes	yes
Pump	progressive cavity; or vane, lobe, diaphragm pumps	lobe type	progressive cavity	progressive cavity	vane or progressive cavity
Storage Capacity (L)	0	492	757	1 500	1 500

MODE OF OPERATION

All Clean Sweep R2002 and R2003 systems, except the standard R2002 model, have on-board storage capacity. Tankage is still limited so that additional space for recovered product must be planned. The Clean Sweep series are designed to recover an oil layer that contacts the recovery drum. To accomplish this, the standard 2002 and Arctic Boat must be held stationary in a flowing stream of oil or otherwise manoeuvered through a slick using attendant vessels. The other 2002 and 2003 skimmers are self-contained craft which can propel themselves through spills. Launching of all Clean Sweep systems requires appropriate mechanical lifting capability.

PERFORMANCE

The standard R2002 was evaluated by Environment Canada in 1973 in Burlington Bay, Ontario. These preliminary tests revealed the skimmer to be capable of recovering 46% of No. 2 Fuel Oil presented to it at a relative velocity of 0.85 kn. Oil content was determined to be about 13% for the trials which were conducted in wave heights varying from 0 to 10 cm.

In July 1975, the U.S. Coast Guard sponsored tests of the R2003 skimmer at OHMSETT. In slick thicknesses of 1-1.5 mm, the skimmer displayed substantially higher recovery rates for lube oil than for No. 2 Fuel Oil; peak values of 15 m^3/h of the heavier product were obtained in calm conditions at highest encounter (oil presentation) rates. Performance fell off markedly in wave conditions, particularly in the No. 2 Fuel Oil trial runs and generally at higher tow speeds. Average viscosity of the test oils was 1.08 cm^2/s for the lube oil and 0.091 cm^2/s for the fuel oil.

OPTIMUM APPLICATION

In medium viscosity oils; at relative velocities of 0.25-0.50 kn; in calm conditions; will process some debris; in concentrations of oil 1 cm and greater in thickness.

ADDITIONAL INFORMATION

(1) Chang, W.J., Tests of Coast Guard Developed High Seas Oil Recovery System at OHMSETT, CG-101-75, 44 pp., U.S. Coast Guard, Washington, DC, (1975).

(2) Griffiths, R.A., Performance Tests of Off-the-Shelf Oil Skimmers, Paper OTC 2696, Offshore Technology Conference, Houston, TX, (1976).

(3) Solsberg, L.B. et al., Field Evaluation of Seven Oil Spill Recovery Devices, Technology Development Report EPS 4-EC-76-3, Environment Canada, Ottawa, Ontario, (October, 1976).

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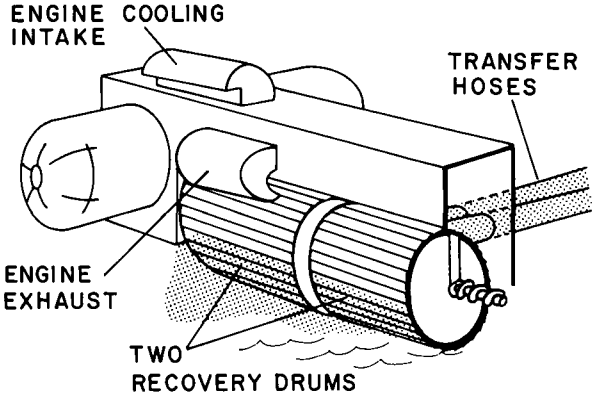
CLEAN SWEEP
Type 4000 & 4122
Price upon request

COLLECTION PRINCIPLE

Rotating discs mounted in a drum pick up oil which is then scraped off and deposited in a central hollow axle. From there it is conveyed to sumps and ultimately to more permanent storage.



TYPE 4000

PHYSICAL SPECIFICATIONS (Type 4122 data preliminary, released March 1981)

	Type 4000 (High Seas Oil Recovery System)	Type 4122 Catamaran
Length (m)	7.9	37.2
Width (m)	8.5	14.3
Height (m)	3.5	4.1
Draught (m)	0.6	2.9
Weight/Displacement (tonne)	8.2	330
Storage Capacity (L)	1 136	270 000
Materials of Construction	aluminum alloy 5083-H321 structure with neoprene-coated nylon inner and outer pontoons	steel hulls
Power Unit	6-cylinder Lister diesel 88.5 HP/hydraulic package	twin 600 HP diesel hydraulic drives
Pump	15.2 cm Tuthill Lobe 600	--
Other Equipment	optional weir	debris net and crane system standard

MODE OF OPERATION

Both the Clean Sweep 4000 and 4122 have been conceived for the removal of oil slicks in offshore conditions. While the 4000 is intended for application within a boomed off area, the 4122 vessel has been designed as a self-contained unit capable of chasing down uncontained oil and collecting debris. The 4000 skimmer can be operated remotely from a support craft which would also accept collected product.

PERFORMANCE

The Lockheed High Seas Oil Recovery System was evaluated at OHMSETT in 1974 with very good results. Oil recovery rate peaked at 112 m^3/h; oil content reached 99% and generally was above 90% in a product with a viscosity of 10.00 cm^2/s at 21°C. Although 91% of the oil presented was recovered during one trial run, most other tests yielded considerably lower results. The disc collection system was determined to be sensitive to viscosity so that, for example, recovery rates for No. 2 Fuel Oil were always below 11.4 m^3/h.

The skimmer performed in wave heights of 0.6 m of either 3 or 6 s periods without significant adverse effects and was judged to be capable of efficient operation over the range 0-2 kn. It was easily deployed and retrieved.

OPTIMUM APPLICATION

In medium viscosity oils (5.00 to 10.00 cm^2/s) in calm conditions or longer period waves. The 4000 system is optimally applied within a containment barrier.

ADDITIONAL PERFORMANCE INFORMATION

Smith, F.G. and H.W. Lichte, Summary of US Environmental Protection Agency's OHMSETT Testing, 1974-1979, EPA 600/9-81-007, U.S. Environmental Protection Agency, Cincinnati, OH, (January, 1981).

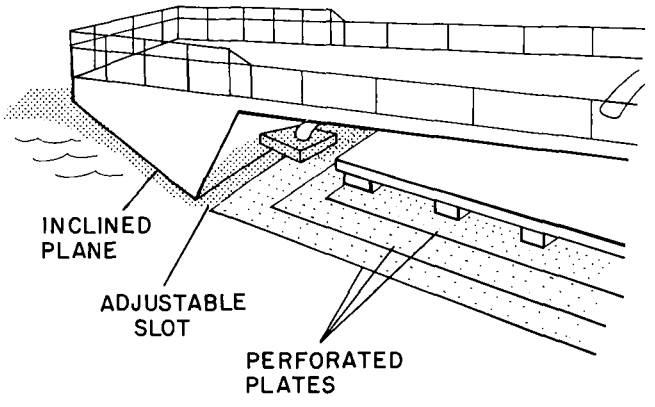
L.P.I. CORPORATION
71 Morris Avenue
Denville, NJ 07834
USA

telephone (201) 625-0002

LPI SKIMMER
Price upon request

COLLECTION PRINCIPLE

An inclined plane is advanced through oil, submerging it and directing it into an inlet slot at the aft end of the plane. Oil then rises through two perforated horizontal plates into a quiescent pool while water exits through perforations in a third bottom deck. Transfer of oil to storage follows.



PHYSICAL SPECIFICATIONS (test model)

Length (m)	4
Beam (m)	1.25
Draught (m)	approximately 0.3
Slot Size (cm)	25 x 115
Oil Reservoir Capacity (L)	400
Weight (kg)	unknown
Materials of Construction	wood, steel
Other Information	a 10 m skimmer (model 33 (feet)) has also been constructed

MODE OF OPERATION

The skimmer is towed or pushed through slicks so that oil collects in its reservoir. A relative velocity must be maintained between the skimmer and the oil so that passage of the latter under the inclined plane is achieved. Transfer of product to storage on an attendant vessel is required. Launching by crane is required for larger models. Application in harbours and other more sheltered water courses is foreseen.

PERFORMANCE

The 4 m test model was evaluated on behalf of Environment Canada in a small freshwater tank in Kanata, Ontario, in January 1979. At tow speeds of 1 kn and less, both the crude and diesel test oils rose into the collection reservoir leaving no observable amount behind the skimmer. At speeds of 1.7 and 2.3 kn, recovery efficiencies were observed to decline. No water was obtained in the samples analyzed as taken from the reservoir following each test run. The evaluation team predicted oil losses in some wave conditions.

Tank trials of the 10 m LPI Skimmer were undertaken at OHMSETT in 1978 with results reported as "significantly consistent and the simplicity of the skimmer design was such that it was used in other test programs during the season as a component of a skimming system". Modifications were made to the skimmer during the program.

The main oil loss mechanisms were attributed to carryunder of product either as the result of excessive relative velocities or vessel pitch in higher sea states. It is interesting to note that the Canadian test team examining a JBF Scientific Corp. skimmer incorporating a rotating submerging belt (see J.B.F Scientific Corp. DIP 1001 entry) envisaged a non-moving inclined plane such as that featured in the LPI skimmer. The unavailability of data renders it impossible to compare evaluations results between the two systems and determine the value of the stationary versus rotating inclined submergence plane.

OPTIMUM APPLICATION

In light and medium viscosity oils; in calm conditions; at tow speeds less than 1.7 kn; will process some forms of debris.

ADDITIONAL INFORMATION

(1) Abdelnour, R. et al., An Evaluation of Oil Skimmers and Pumps, Technology Development Report EPS 4-EC-81-4, Environment Canada, Ottawa, Ontario, (December, 1981).

(2) Breslin, M.K. and H.W. Lichte, Performance Testing of Selected Oil Skimmers Developed by Small Businesses, U.S. Environmental Protection Agency, Cincinnati, OH, (in preparation) (1980).

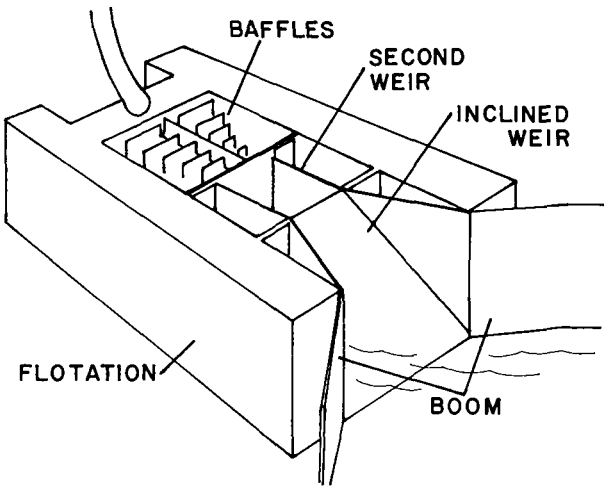
MACMILLAN-BLOEDEL LTD.
1075 West Georgia Street
Vancouver, British Columbia V6E 3R9
Canada

telephone (604) 683-6711

OS-48-W
Price not applicable

COLLECTION PRINCIPLE

Oil and water flow over an inclined plane and pool in a small chamber. A second weir system then accepts product overtopping the chamber. The recovered oil layer then flows through a system of baffles into a trough from which it is pumped to a remote storage location.



PHYSICAL SPECIFICATIONS

Length (cm)	120
Beam (cm)	95
Height (cm)	75
Displacement (kg)	60
Material of Construction	aluminum
Discharge Opening (cm)	8
Debris	grill provided

MODE OF OPERATION

The OS-48-W Skimmer was designed to recover spilled oil while being held stationary in flowing conditions. A containment boom is attached to either side of the inlet and a pump and hose are connected to the discharge port. The float system is adjusted to a suitable height on land and the skimmer then launched manually by two persons. Product is directed to separation /storage facilities.

PERFORMANCE

Eighteen test runs were conducted by Environment Canada on the MacMillan-Bloedel Skimmer in the St. Lawrence River at Quebec City in September and October of 1976. Diesel oil as well as an Iranian crude oil (API Gravity 30° to 43°) were presented to the system. Optimum results were obtained with the thickest slicks (at 10 mm) of crude oil in calm conditions at relative velocities of about 0.5 kn. Oil recovered versus oil presented reached 85%, with an oil content in the collected product peaking at 45%. Diesel oil tests yielded results about 10% lower. The device ceased to function in a short-period wave of about 1 s that exceeded 15 cm in height.

Oil losses were generally attributed to entrainment induced by eddy currents which formed directly in front of the skimmer and from carryunder of product out this open-bottom skimming unit. The test team recommended additional tethering, lifting and holding hardware; they found the baffle and trough arrangement "of dubious value" but judged the skimmer effective in calm, flowing conditions.

OPTIMUM APPLICATION

In medium viscosity oils; in wave-free, flowing conditions at relative velocities of 0.5 kn; with containment booms directly attached.

ADDITIONAL INFORMATION

Solsberg, L.B., W.G. Wallace and M.A. Dunne, Field Evaluation of Oil Spill Recovery Devices: Phase Two, Technology Development Report EPS-4-EC-77-14, Environment Canada, Ottawa, Ontario, (December, 1977).

OTHER DATA

MacMillan-Bloedel Ltd. developed the OS-48-W as part of the company's oil spill control program in British Columbia; they have not indicated the device to be available commercially.

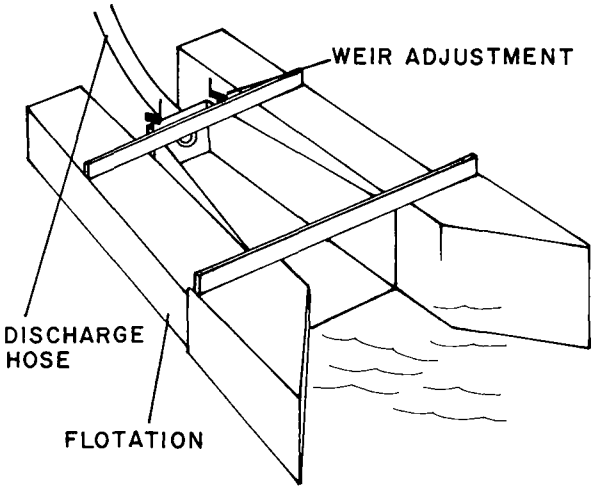
MANNESMANN ITALIANA SPA
Anti-Pollution Department
Via Gabriele D'Annunzio 2-104
16121 Genova
Italy

telephone (39) (010) 581.043
telex 270042 PUDEL GE

M4S
Price upon request

COLLECTION PRINCIPLE

A simple weir can be adjusted in height during operation to accept incoming oil. The oil pools in a small tank from which it is pumped to attendant storage.



PHYSICAL SPECIFICATIONS

The stainless steel M4S skimming system is available as a separate, single unit (dimensions are not given in sales literature). The company also markets vessels with hydrocarbon recovery capability according to the following specifications:

	Scarabeo	Eko-Barge I	Eko-Barge II
Length (m)	10.4	16.9	25.0
Beam (m)	4.5	4.8	6.4
Height (m)	--	2.1	2.8
Draught - Full Cargo (m)	1.25	1.85	1.95
Dead Weight (tonne)	--	--	170
Storage Capacity (m^3)	18	28	120
Power Units	two diesel engines rated at 85 HP at 2 000 rpm	two diesel engines rated at 150 HP at 1 800 rpm	twin 206 HP diesels/one auxiliary 260 HP diesel

MODE OF OPERATION

The M4S Skimmer unit is designed for deployment as a separate device to collect oil contained by a boom. A remotely located pump and storage facilities must be used in conjunction with the skimming head. The recovery vessels are self-contained units that are self-propelled, have on-board storage capacity, and house a weir/collection component at the bow. They are large enough to require crane launching and are designed for harbour and coastal applications.

PREDICTED PERFORMANCE

No evaluation data on the M4S skimmer are known.

It is likely that the weir system functions similarly to other overflow devices. An advantage of the Mannesmann Skimmer is that adjustment of the weir lip can be readily made. Best performance results would probably be achieved by selecting a steady pump-off rate of product that resulted in a close matching of volume of oil entering the device and volume of oil discharged to storage. Relative velocity would also be an operational consideration as hydraulic effects (turbulence, vortex formation, product entrainment, etc.) might become more pronounced at higher speeds. Collection efficiencies can be expected to decline in wave conditions, particularly in short breaking waves that impede the intended action of the weir. Overall, the skimming device's simple design and "no moving parts" concept are appealing.

It is also probable that this advancing weir system will recover a significant volume of water so that the residence time of the collected liquid in the holding tank will be critical. Sufficient storage capacity should be ensured that will allow the settling out of water. This aspect would appear to be taken into account in the vessels now marketed but should be checked against the capacity of on-board pumps.

PREDICTED OPTIMUM APPLICATION

In light and medium viscosity oils; in calm, debris-free condition; at relative velocities less than 1 kn.

ADDITIONAL INFORMATION

See also entries for Environment Protection Machines Ltd. EPM Skimmer and Entreprise Sanitaire et de Canalisation Threshold Skimmer.

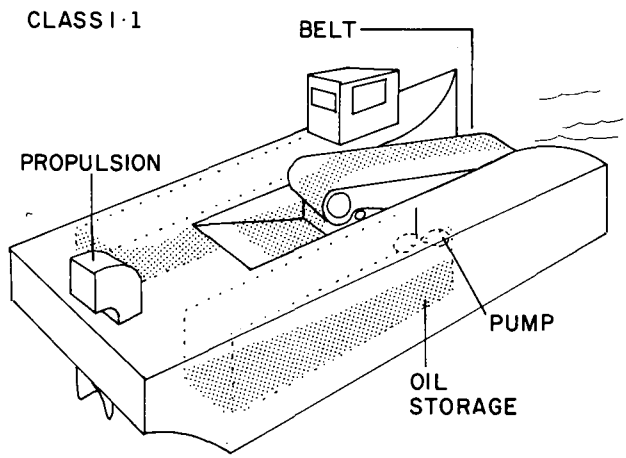
MARCO POLLUTION CONTROL
2300 W. Commodore Way
Seattle, WA 98199
USA

telephone (206) 285-3200
telex 32-0098

CLASS I HARBOR SKIMMER
Price upon request

COLLECTION PRINCIPLE

Oil is entrapped in a rotating porous belt and then conveyed to a squeeze roller and scraper blade. Oil removed from the belt then falls into a sump. An induction pump behind the belt assists in drawing oil to the skimmer.



PHYSICAL SPECIFICATIONS

Three models of the Class I skimmer are available.

	Class I	Class I.1	Class I-D
Length (m)	8.5	10.2	10.9
Beam (m)	2.4	3.2	3.1
Moulded Depth (m)	0.91	0.91	0.99
Displacement (kg)	2 858	3 695	5 216
Belt Width (m)	0.3	0.3	0.3
Materials of Construction	welded aluminum vessel, polyurethane foam belt		
Propulsion	twin 60 HP outboards	twin 60 HP outboards	twin 120 HP diesels
Vessel Speed (kt)	18	16	20
Approximate Storage Capacity (L)	3 250	4 900	5 100
Pump	various pumps are available		

MODE OF OPERATION

The Class I can be transported by trailer; launching is accomplished by a single-point lift. The system is self-contained and can be used to chase down uncontained slicks or applied to boomed oil (using the induction pump in both cases). On-board storage volume is relatively high although, in a spill of significant size, supplementary capacity would be required. The Class I vessels have been designed for application to bays and harbours.

PERFORMANCE

The Class I Skimmer was evaluated at OHMSETT in July 1975 in a U.S. Coast Guard sponsored program. A catamaran platform specially constructed for the tests by OHMSETT personnel was used to support the 0.3 m wide belt system.

Optimum oil recovery rate was 41 L/min for No. 2 Fuel Oil and 79 L/min for lube oil. Maximum oil content was 65-70% with values typically 35-60% in a 1 mm thick slick. Results were consistently higher for the more viscous lube oil tests. As the tow speed was increased, recovery rates also increased, but efficiency dropped off. Belt speed was 1.2 m/s.

Performance was also found to decline in waves. The primary reason for this was attributed to the poor wave response of the vessel on which the device was mounted and the nose diving and splash of a flow-control fairing. Calm conditions allowed optimum collection values.

The ability of the belt to process debris was not examined at OHMSETT although separate trials have been conducted for the system's capability in ice.

OPTIMUM APPLICAITON

In medium viscosity oils; at relative velocities of 1-1.5 kn; in calm conditions; will process most forms of debris when manually attended.

ADDITIONAL PERFORMANCE INFORMATION

Griffiths, R.A., Performance Tests of Off-the-Shelf Oil Skimmers, Paper No. OTC 2696, Offshore Technology Conference, Houston, TX, (May, 1976).

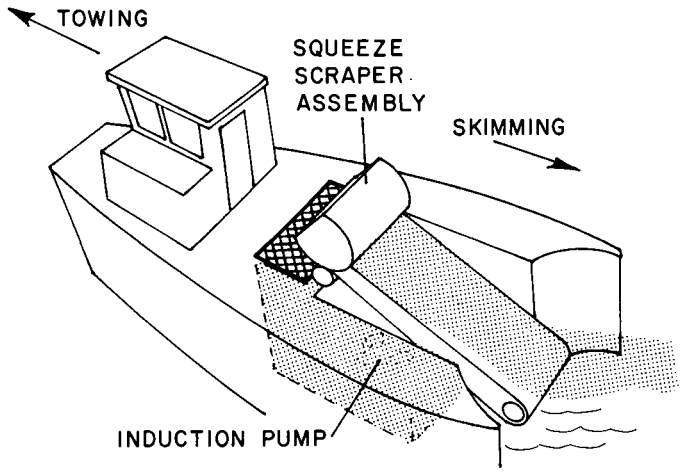
MARCO POLLUTION CONTROL
2300 W. Commodore Way
Seattle, WA 98199
USA

telephone (206) 285-3200
telex 32-0098

CLASS V
(Ocean Skimmer)
Price upon request

COLLECTION PRINCIPLE

A porous rotating belt picks up oil which is then removed by a squeeze roller and scraper blade arrangement. Oil is deposited in an on-board sump. A pump behind the belt assists in drawing in product.



PHYSICAL SPECIFICATIONS

Length (m)	10.97
Beam (m)	3.66
Height (m)	5.18
Draught - Under Load (m)	1.27
Displacement - Full Load (tonne)	17.2
Sump Capacity (L)	6 360
Belt Width (m)	0.91
Materials of Construction	polyurethane belt, aluminum hulls
Main Engine & Drive	Detroit diesel 4-153, 100 HP @ 2 400 rpm rotatable thruster; pneumatic and hydraulic drives
Vessel Speed	5 kn forward, 3 kn astern
Transfer Pumps	12.7 cm Midland progressive cavity unit; 10.2 cm Marco submersible trash pump

MODE OF OPERATION

The Class V Skimmer is designed to be towed to the spill scene. Its direction of advance is reversed when operated in the skimming mode; on-board propulsion is provided. Although equipped with storage capacity, additional tankage associated with support vessels would be required to deal with a major offshore spill. The skimmer is available as three modules which are highway-transportable and which can be assembled on land with the use of a crane.

PERFORMANCE

The Marco Class V was tested in situ on behalf of Environment Canada in August 1977 near Victoria, British Columbia. Tank trials have also been undertaken of the device at OHMSETT in September-October 1976 and in June-July 1977. The extensive data collected, including a very thorough scrutiny of the machine, have allowed many detailed comments to be made. Test programs conducted on other skimmers do not generally offer the same depth of observations.

Maximum performance data were recorded for the 1977 OHMSETT program in which a 3 mm thick slick was set out in calm conditions:

Test Medium	Tow Speed (kn)	Oil Recovery Rate (m^3/h)	Oil Content (%)	Oil Recovered vs Oil Encountered (%)
heavy	0.5	3.0	89.6	74.3
heavy	1	8.0	88.8	94.9
heavy	1.5	8.5	93.4	76.6
heavy	2	12.0	94.3	72.8
heavy	3	8.0	84.6	29.6
medium	1	6.7	75.2	79.2
medium	2	12.5	82.2	58.1

Medium Oil: 2.00 cm^2/s; S.G. 0.927

Heavy Oil: 7.00 cm^2/s; S.G. 0.936 (recorded at 28.8°C)

The matching up of vessel speed to induction pump pressure was determined to prevent oil losses from the impeller (pump setting too high) or headwave formation/oil entrainment at the skimmer mouth (setting too low). Best collection efficiencies were achieved at 1 kn, with operations judged "impractical" at 3 kn. Although performance varied in waves, successful operation was reported in 0.6 m waves and a 1.2 m harbour chop. The skimmer responded better in waves than in calm water for the medium test oil and vice versa with heavy oil.

Oil losses have been attributed to deterioration of the polyurethane belt upon prolonged exposure to sunlight, compression of the belt against rungs on the underside, vortex formation at the prows of the hulls, and operator inexperience. The Environment Canada tests also encountered corrosion problems in the squeezer arm but overall found the vessel stable, well constructed and highly manoeuverable.

OPTIMUM APPLICATION

In medium to heavy oils; at velocities of 1-1.5 kn; operated at best combination of setting for belt speed, forward velocity and induction pump setting; will process most forms of debris with manual assistance.

ADDITIONAL PERFORMANCE INFORMATION

(1) Beak Consultants Ltd. et al., Field Evaluation of the Super Seahawk and Marco Class V Oil Skimmers, Technology Development Report EPS 4-EC-78-2, Environment Canada, Ottawa, Ontario, (May, 1978).

(2) Lichte, H.W. and M.K. Breslin, Performance Testing of Three Offshore Skimming Devices, EPA 600/7-78-082, U.S. Environmental Protection Agency, Cincinnati, OH, (1978).

(3) Smith, G.F. and H.W. Lichte, Summary of US Environmental Protection Agency's OHMSETT Testing, 1974-1979, EPA 600/9-81-007, U.S. Environmental Protection Agency, Cincinnati, OH, (January, 1981).

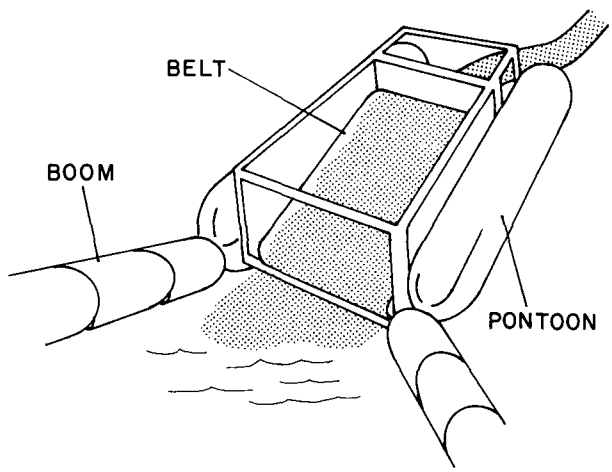
MARCO POLLUTION CONTROL
2300 W. Commodore Way
Seattle, WA 98199
USA

telephone (206) 285-3200
telex 32-0098

CLASS XI (VOSS)
Price upon request

COLLECTION PRINCIPLE

As with other Marco Skimmers, the Vessel of Opportunity Skimming System relies on a rotating porous belt and squeeze/scraper assembly to remove oil that is also drawn to the device by an induction pump. Off-loading of product to an attendant vessel follows.



PHYSICAL SPECIFICATIONS

Length (m)	5.83
Beam (m)	2.44
Height (m)	1.88
Weight (kg)	1 383
Materials of Construction	aluminum support arm, mast and vessel; polyurethane belt
Power Unit	Detroit diesel 4-53, 85 HP @ 2 000 rpm
Off-loading Pump	10.2 cm Tuthill model 330
Debris	macerator included
Containment Booms	Goodyear 12-24, two sections each 16.8 m long

MODE OF OPERATION

Unmanned, the skimmer is fastened via two sections of boom held in a V-configuration to an outrigger and support mast secured aboard the mother ship. The system can then be used to recover uncontained slicks. Oil and debris are gravity-fed through a macerator; they are then passed through a pump to the attendant vessel's storage tanks. Inflatable pontoons provide buoyancy and fendering. This configuration allows use of the system in coastal waters in spite of its relatively small size.

PREDICTED PERFORMANCE

No test data are known to exist for the Class XI skimmer.

See also Marco Class I and Class V performance summaries.

Optimum collection results would likely be obtained in calm or moderate wave conditions at tow speeds of about 1-1.5 kn. The problem of vortex formation apparent at certain speeds in the Class V skimmer caused by the hulls should not be a factor with the Class XI since the two booms feed oil directly to the belt. The buoyancy of the pontoons should also assist in the vessel's response in limited wave conditions.

A combination of correct belt speed, induction pump setting and forward velocity would have to be chosen to ensure best possible performance. Oil losses could originate at the points where the boom attaches to the skimmer as well as from mother ship hull interference. As with the other Marco systems, too high a setting of the induction pump, particularly in lighter oils, would have to be avoided in order to prevent the oil from being drawn down and entrained. Overall, the concept appears promising as a self-contained package. Attention to the belt being unnecessarily exposed to sunlight and the avoidance of some debris forms should prolong its life.

As with other skimming packages which can operate from a singel vessel of opportunity, the Class XI can be used to recover free-floating oil. Advantages of this approach include the utilization of storage capacity on the mother ship and the elimination of purchasing expensive hulls, propulsion systems and navigational gear as integral components of the skimmer.

OPTIMUM APPLICATION

In medium and heavy oils; in calm and very moderate sea conditions; at relative speeds of 1-1.5 kn; will process some debris; can be used to chase down uncontained slicks.

OTHER DATA

Marco Pollution Control also market a wide range of other skimmers including Class II, III, VII, etc., ranging in size to at least 18 m and incorporating the same collection principle.

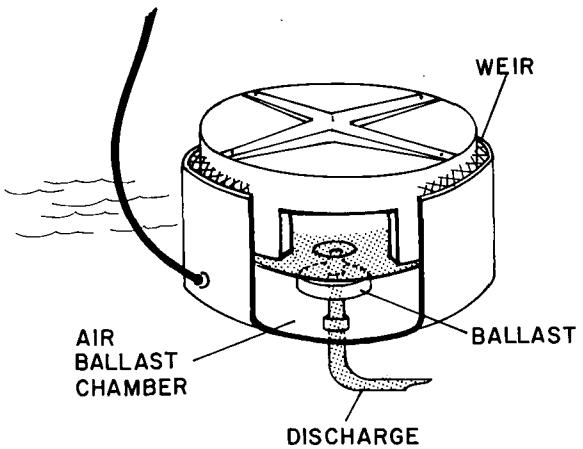
MARTIN F. OLSEN - DEVELOPER
Contact: DeLeuw, Cather/Parsons & Associates
1201 Connecticut Avenue, N.W.
Washington, DC 20036
USA

telephone (202) 452-5200

OLSEN OIL RECLAIMER
Price upon request

COLLECTION PRINCIPLE

A circular weir, supported by an air-ballasted chamber, draws in product to a central off-loading point. From there it is transferred by a pump operated remotely from the skimming head.



PHYSICAL SPECIFICATIONS (prototype device)

Diameter (cm)	114
Height (cm)	50
Draught (with ballast and discharge elbow added) (cm)	50
Material of Construction	polyvinyl chloride
Air Ballast	manually provided
Pump	a 7.6 cm Spate pump was utilized in tests; other similar sized units would be appropriate

MODE OF OPERATION

The skimming head can be deployed by two persons in oil contained and concentrated by a barrier. Level control is maintained by a tube and valve assembly through which air can be injected or released into a separate ballast chamber incorporated in the skimmer. Flow rate is controlled by pumping speed.

PERFORMANCE

In situ testing of a prototype of the Olsen Oil Reclaimer was conducted in the St. Lawrence River at Quebec City during September 1976 on behalf of Environment Canada and the Petroleum Association for Conservation of the Canadian Environment. Best results obtained are as noted:

Air Temp. (°C)	Water Temp. (°C)	Wave Height (cm)	Oil Type	Oil Thickness (mm)	Oil Recovery Rate (L/min)	Oil Content (%)
9	14	0-5	crude	7	8.6	3.4
12	13	0	diesel	10	1.3	1.3

Crude: heavy Iranian, kinematic viscosity 58 SSU @ 37.8°C; API Gravity 30.0°

Diesel: kinematic viscosity 1.90 SSU @ 37.8°C; API Gravity 40.0°

Although a company representative was present during the tests, the skimmer did not function as intended. The device trimmed to one side with the ingress of liquid thus rendering adjustment of the weir difficult at the water/oil interface. Manual trimming was necessary but was hampered by a leak in the bottom flotation unit. Lack of waterplane area was cited as the main reason for instability. The low peformance results reflect these factors.

The skimming head was light, compact and easy to transport and deploy. It was outfitted with tether and lifting eyes. Provision for external ballasting was another feature of the Olsen but, under the circumstances, did not contribute to improved collection efficiencies when connected.

Overall, the water level remained above the weir lip which resulted in water content in the collected product being consistently high.

OPTIMUM APPLICATION

In light and medium viscosity oils contained in significant thicknesses (1 cm and greater); in calm non-flowing, debris-free conditions; with storage/separation facilities.

ADDITIONAL PERFORMANCE INFORMATION

Abdelnour, R. et al., Field Evaluation of Eight Small Stationary Skimmers, Technology Development Report EPS 4 EC-78-5, Environment Canada, Ottawa, Ontario, (May, 1978).

OTHER DATA

Improved production processes and design features were indicated in 1976 by the manufacturer as forthcoming following the field trials of the prototype device.

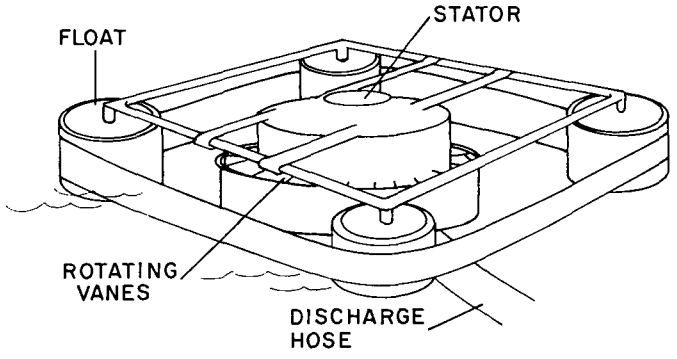
MATTSSON PRODUCKTER AB
PO Box 667
S-451 24 Uddevalla
Sweden

telephone (46) 46 522 36400
telex 42027 FKABS

WALOSEP
(M.E.S.S.)
Price: 477 000 (SEK)
(effective 1-7-81)
includes skimmer, pump
and power pack

COLLECTION PRINCIPLE

A series of vanes rotate around a central stator drawing oil under it and up into a collection chamber. The oil overflows into a discharge hose and is pumped to remote storage while water exits the bottom of the skimming head.



PHYSICAL SPECIFICATIONS (standard model W3)

The system is sold as a three-component package:

	Skimmer	Pump Pack	Power Pack
Length (m)	2.71	1.10	1.50
Width (m)	2.29	1.00	0.80
Height (m)	1.07	1.50	1.50
Weight (kg)	400	1 400	1 600
Materials of Construction	stainless steel rotor, frame; glass-reinforced plastic stator; polyethylene floats		
Other Specifications		screw-type NE 80 BN3 hydraulically driven main pump (10.2 cm discharge hose); membrane-type LBBO hydraulically driven vacuum pump	Lister 3-cylinder air-cooled diesel rated at 44 HP at 2 200 rpm; PVB 29 hydraulic piston pump

MODE OF OPERATION

The skimming head is positioned in a boomed-off area of concentrated oil. The unit is then operated remotely using the power and pump packs. The membrane pump supplies the main screw pump with liquid prior to removal of product by the latter. The system is designed for deployment from vessels and docks, with transfer of recovered oil made to prearranged storage facilities.

PERFORMANCE

In November 1979, the Walosep underwent a series of 19 tank trials at OHMSETT. Optimum results obtained were as follows:

Test Medium	Slick Thickness (mm)	Wave Height & Length (m)	Tow Speed (kn)	Oil Recovery Rate (m^3/h)	Oil Content (%)	Oil Recovered vs Oil Encountered (%)
heavy oil	50.1	0.32 x 6.17	0	54.6	97.7	100+
heavy oil	4.0	0.32 x 6.17	0.5	67.4	61.5	74.2
light oil	7.4	calm	0.5	68.6	80.0	50.9
light oil	4.8	0.49 x 17.57	0.7	97.0	78.0	58.8

The heavy and light test oils had specific gravities of 0.94 and 0.91, with viscosities of 23.0 and 0.55 cm^2/s at 10°C, respectively. A circular boom arrangement was used for stationary tests while a preloaded boom in a catenary shape was utilized for the tow trials.

One of the outstanding features of the Walosep skimmer was the relatively high oil content in the collected product in both light and heavy oil tests and in thin and thick slicks, particularly when compared with other nonsorbent-surface skimmers. The other noteworthy test result was the high oil recovery rates which peaked at 97 m^3/h in wave conditions while the skimmer was being advanced at 0.7 kn.

Oil losses were attributed to resonant waves washing over the skimmer. Generally, better results were obtained in thicker slicks, at higher pumping rates and with heavier oil. The lighter oil is more readily pumped but is also entrained at a faster rate.

Overall, the Walosep was concluded to be a high-capacity skimmer that could perform well in water currents below the failure velocity of booms.

OPTIMUM APPLICATION

In light to heavy oils (excluding non-flowing products); in calm to moderate sea conditions; in thicknesses of oil several millimetres and more contained by a boom; will process some debris.

ADDITIONAL PERFORMANCE INFORMATION

The OHMSETT work was performed under a private user agreement. Release of the data can be requested from the manufacturer.

OTHER DATA

The manufacturer has indicated update of the W3 model with a heavier duty pump capable of processing debris and a submersible transfer unit. A lower-priced WI skimmer is also available that utilizes a single pump/power pack; it has been designed for oil and chemical recovery.

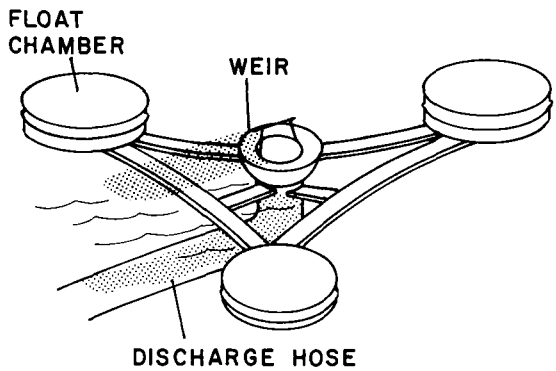
MEGATOR CORP.
562 Alpha Drive
Pittsburgh, PA 15238
USA

telephone (412) 963-9200
telex 81-2573

ALPHA SKIMMER
Base Price: $1 300 (U.S.)
Package Price: $4 521.25 to $5 973.40 (U.S.) depending upon pump capacity selected; includes hoses, couplings, pump, gasoline or electric drive (effective 21-8-81)

COLLECTION PRINCIPLE

A circular weir central to and supported by three floats can be set to accept liquid overflowing the weir lip. Suction is provided by a pump remote from the skimmer.



PHYSICAL SPECIFICATIONS

Overall Diameter (cm)	100.3
Weir Diameter (cm)	17.8
Draught (cm)	22.9
Float Diameter (cm)	29.2
Float Height (cm)	10.2
Discharge Hose Diameter (cm)	2.5 - 3.8
Weight (kg)	8.4
Material of Construction	stainless steel 304
Power Unit	5 HP Honda gasoline engine, air-cooled, hand-started, Mercury clutch; optional Deutz air-cooled diesel, electric start or TEFC electric motor, 3-phase, 230/440 V, 60 Hz, weatherproof
Pump	Megator Sliding-shoe, 2.5, 3.2, 3.8 cm discharge and suction ports, belt driven or direct coupled, various bases available, protective coating optional as well as electric heater

MODE OF OPERATION

Drive and pump are operated remote from the suction head. The latter is deployed from shore or a working platform into boomed-off concentrated oil. Discharge is directed to storage/separation tankage. The skimming head is easily deployed by a single person while the pump/drive assembly can also be purchased as a portable unit requiring several persons to carry it.

PREDICTED PERFORMANCE

Evaluation data on the skimmer are not known to exist.

The Megator Sliding-shoe pump was evaluated by Environment Canada in a laboratory in 1977; it was determined to move lubricating oil, crude and Bunker at "acceptable" rates, apparently unaffected by increasing suction lifts. The unit was judged well-designed for both field operation and maintenance with self-priming prompt.

The simple weir suction head should respond in a manner similar to other such systems, i.e. be applicable to calm water with higher water content resulting at higher pumping rates. The manufacturer's pump should allow the recovery of a broader viscosity range than most weir systems. Cleaning and carrying should be readily achievable.

The Alpha Skimmer appears to be well constructed and suitable for use in lakes, ponds and more protected bodies of water, as the manufacturer states. It would likely operate much more efficiently in slick thicknesses of 1 cm and more. Otherwise, substantial water uptake should be expected (see also Acme Products Company entries). Purchase of all required accessories, including the pump, is possible through the manufacturer who indicates clearly the components comprising the total skimming package.

PREDICTED OPTIMUM APPLICATION

Light to medium viscosity oils contained in substantial thicknesses in debris-free water (very small items - 6 mm - can be passed without damage to the pump); in calm conditions.

ADDITIONAL PERFORMANCE INFORMATION

Purves, W.F. and L.B. Solsberg, Pumps for Oil Spill Cleanup, Technology Development Report EPS 4-EC-78-3, Environment Canada, Ottawa, Ontario, (February, 1978).

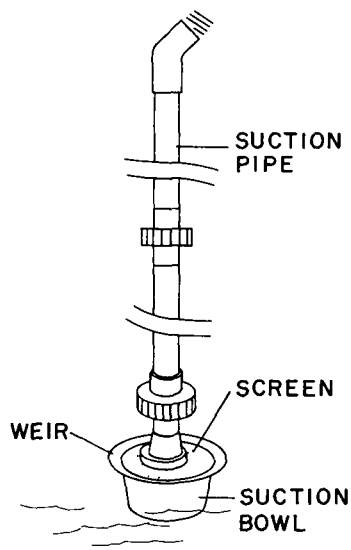
MEGATOR CORP.
562 Alpha Drive
Pittsburgh, PA 15238
USA

telephone (412) 963-9200
telex 81-2573

BETA SKIMMER
Base Price: $572 (U.S.)
includes two 1 m sections of
40 mm plastic suction pipe
and couplings
(effective 21-8-81)
Package price: See Megator
Corp. Alpha Skimmer

COLLECTION PRINCIPLE

Product overflows a simple circular weir and is drawn through a centrally connected pipe to storage.



PHYSICAL SPECIFICATIONS

Weir Diameter (cm)	30.5
Suction Bowl Height (cm)	17.8
Discharge Hose Diameter (cm)	3.8
Weight (kg)	5.0
Materials of Construction	stainless steel suction bowl and screen, plastic discharge pipe
Power Unit and Pump	gasoline, electric or diesel drive powering Megator pump. See Megator Corp. Alpha Skimmer

MODE OF OPERATION

The discharge pipe is held manually in the vertical position with the suction bowl placed in pooled oil and positioned, with the assistance of the flotation element in the bowl, at the optimum operating level. Suction is provided by a remote power pack/pump combination which conveys recovered liquid to storage/separation facilities. The system is suitable for small cleanup operations where space and access are limited.

PREDICTED PERFORMANCE

No evaluation data are known to exist for the Beta Skimmer.

For an indication of the performance of the Megator Sliding-shoe pump, see Megator Corp. Alpha Skimmer.

Because of the pump performance (particularly its self-priming capability), the skimmer should allow the recovery of light and medium viscosity oils in calm water. Larger forms of debris would be prevented from entering the system by the screen provided while other items of debris could be quickly removed by hand. Oil which can flow through the screen perforations would be recovered. As with other weir systems, backup storage/separation facilities would be required to allow the settling and removal of collected water.

The Beta system, like its Alpha counterpart, is available as a complete package from the manufacturer. Application to small spills is clearly stated in the sales literature. Significant concentrations of oil would probably allow the skimmer to function most effectively.

PREDICTED OPTIMUM APPLICATION

Light to medium viscosity oils concentrated in substantial thicknesses (1 cm and more) in calm conditions; recovered liquid directed to storage; operated from wharf, fueling barge, into ditch, etc.

ADDITIONAL PERFORMANCE INFORMATION

Purves, W.F. and L.B. Solsberg, Pumps for Oil Spill Cleanup, Technology Development Report EPS 4-EC-78-3, Environment Canada, Ottawa, Ontario, (February, 1978).

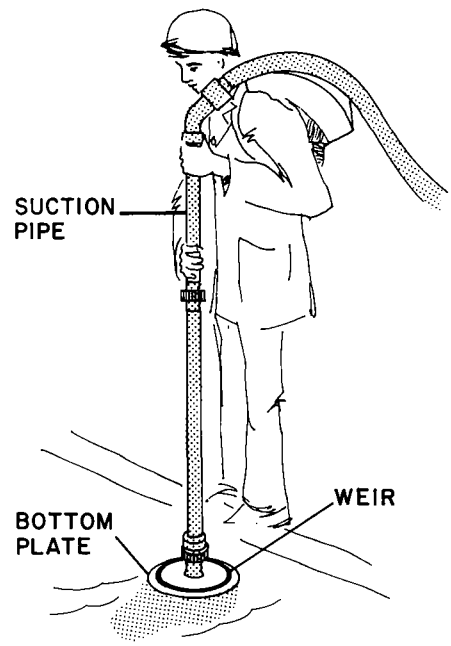
MEGATOR CORP.
562 Alpha Drive
Pittsburgh, PA 15238
USA

telephone (412) 963-9200
telex 81-2573

PUDDLE MOP
Base Price: $242 (U.S.)
includes two 1 m sections of
400 mm plastic pipe and
couplings
(effective 21-8-8)
Package price: See Megator
Corp. Alpha Skimmer

COLLECTION PRINCIPLE

Product flows into a circular weir and is drawn off through a suction pipe to storage.



PHYSICAL SPECIFICATIONS

Overall Diameter (cm)	19.0
Overall Height (cm)	9.5
Discharge Pipe (mm)	400
Minimum Operating Depth (mm)	13
Weight (kg)	3.5
Materials of Construction	stainless steel bottom plate, plastic suction pipe
Power Unit and Pump	gasoline, electric or diesel drive powering Megator pump. See Megator Corp. Alpha Skimmer

MODE OF OPERATION

Designed for use in shallow pools of oil, drains and culverts, the Puddle Mop is held vertically in the liquid to be recovered and positioned with the weir lip below the surface. Suction is provided by a separate power pack and pump.

PERFORMANCE

No performance data are known to be available.

See Megator Corp. Alpha Skimmer for details of performance of Megator's Sliding-shoe pump and Acme Products Company entries for test data on simple weir skimmers.

The Puddle Mop is indicated by the manufacturer to be suitable for use in small pools of oil. The Megator pump should allow this application of the skimming head in products that will flow through the suction pipe. The self-priming characteristics of the pump are known to be very good and so should assist in overcoming the required suction lift.

Application of the skimmer is not foreseen for spills outside the plant where debris interference would likely preclude its use. (Megator's Beta Skimmer would be more suitable in such instances.) Light oils and medium viscosity products can be transferred by the Megator Sliding-shoe pump although the less viscous oils are more apt to create fewer pumping problems. The manufacturer carries the complete line of accessories necessary to set up skimming operations.

PREDICTED OPTIMUM PERFORMANCE

Light to medium viscosity oils contained as pools or in puddles in relatively debris-free conditions (smaller debris forms 6 mm in diameter can be passed by the pump).

ADDITIONAL PERFORMANCE INFORMATION

Purves, W.F. and L.B. Solsberg, Pumps for Oil Spill Cleanup, Technology Development Report EPS 4-EC-78-3, Environment Canada, Ottawa, Ontario, (February, 1978).

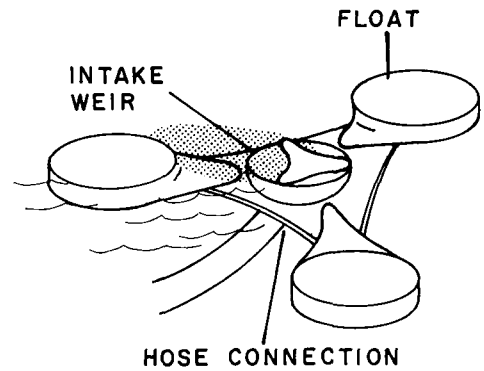
MEGATOR CORP.
562 Alpha Drive
Pittsburgh, PA 15238
USA

telephone (412) 963-9200
telex 81-2573

SIGMA SKIMMER
Base Price: $1 100 (U.S.)
inlcude 3 metres of 3.8 cm
hose (effective 21-8-81)
Package Price: See
Megator Corp. Alpha
Skimmer

COLLECTION PRINCIPLE

A circular intake weir can be raised or lowered by a central adjustment to accept product. Three uniquely shaped flotation chambers support the intake and are designed so as not to interfere with incoming flow. A remotely operated pump provides suction.



PHYSICAL SPECIFICATIONS

Overall Diameter (cm)	94.6
Overall Height (cm)	21.6
Draught (cm)	19.1
Discharge Hose Diameter (cm)	3.8
Weight (kg)	8
Material of Construction	glass-reinforced plastic
Power Unit and Pump	gasoline, electric or diesel drive powering Megator Sliding-shoe pump. See Megator Corp. Alpha Skimmer for further details

MODE OF OPERATION

Driven by a remote power pack/pump package, the Sigma Skimmer is designed for the recovery of smaller spills in quiescent water particularly where portable equipment is required.

PREDICTED PERFORMANCE

No evaluation data are known for the Sigma system.

See also Performance section for Megator Corp. Alpha Skimmer and Acme Products, Co. FS 50SK-17E Skimmer.

The Megator pump should provide the skimmer with suction in a wide range of oils (excluding Bunker C). The skimming head appears to be easily cleaned and lightweight. Higher efficiencies should be expected at lower pumping rates and in very calm conditions.

As with all Megator weir skimmers, the Sigma is available as a complete package that includes all accessories necessary to set up the skimming operation. Sales literature indicates the applicability of the Sigma Skimmer to in-plant oil removal (sumps, settling basins, etc.). Debris could cause interference with recovery operations; it is expected that the unit would best apply to light oils present as a layer 1 cm or more in thickness.

PREDICTED OPTIMUM APPLICATION

In confined areas (sump, settling tank, etc.) or where oil has been contained; in light to medium viscosity oils; in debris-free, calm water.

ADDITIONAL PERFORMANCE INFORMATION

Purves, W.F. and L.B. Solsberg, Pumps for Oil Spill Cleanup, Technology Development Report EPS 4-EC-78-3, Environment Canada, Ottawa, Ontario, (February, 1978).

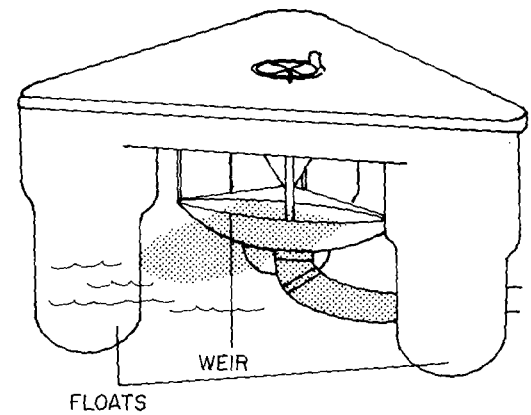
METROPOLITAN PETROLEUM PETROCHEMICALS CO., INC.
25 Caven Point Road,
Jersey City, NJ 07305
USA

telephone (201) 434-4451

MASH 400 SKIMMER
Price: $6 850 (U.S.)
(effective 1-12-76)

COLLECTION PRINCIPLE

A circular weir central to three flotation chambers is adjusted in height to skim a surface layer of oil which is removed to storage by a remote pump.



PHYSICAL SPECIFICATIONS

Overall Length (m)	1.98
Beam (m)	1.80
Draught (m)	0.53
Discharge Hose Diameter (cm)	10.2
Displacement (kg)	227
Materials of Construction	polyester fibreglass body, aluminum marine plating alloy 5086-H32 deck, stainless steel (304) hardware, PVC tubing
Power (for weir height adjustment)	two 12 V DC 30 A H batteries actuate a centre yoke hydraulic ram in 0.038 cm increments
Debris	roller trash screens optional

MODE OF OPERATION

The MASH 400 is designed to be deployed into slicks contained and concentrated by booms. The hydraulic weir control can be operated remotely or by direct manual adjustment. A separate pump is required as well as storage/separation facilities. Manual deployment by two or three persons is possible.

PREDICTED PERFORMANCE

No test data are known for the MASH 400.

See also Megator Corp. Alpha Skimmer.

This simple weir system was one of the few skimmers to be marketed which features a remotely controlled weir adjustment. A battery-operated transistorized circuit allows up-and-down motion of the central collection chamber through a control cable.

The unique features of the skimming concept include the size of the flotation chambers which are large relative to the size of the circular weir. Since much of their bulk is in the vertical plane, it is difficult to predict the amount of stability that they might afford to the device, particularly in steeper, breaking waves. As with most simple weirs, it is probable that the MASH 400 produces best results in slick thicknesses of 1 cm or more, in calm conditions, and in debris-free water.

The remote pump will likely limit suction to light and medium viscosity oils. And, although the flotation chambers are round, their size and position around the weir might impede to some extent the flow of oil into the collection chamber.

Overall, the appealing qualities of the skimmer include the excellent choice of materials (namely fibreglass and aluminum), apparent robustness, and remote weir adjustment. If the skimmer is applied as an oil removal device to separation ponds, lagoons, outfalls, etc. - in accordance with the manufacturer's recommendation -it should provide adequate skimming capability. Less use is foreseen for the unit in spills remote from plant operations.

PREDICTED OPTIMUM APPLICATION

In light and medium visocsity oils contained as slicks of 1 cm or more (or in thinner slicks with subsequent separation facilities); in calm, debris-free water.

OTHER DATA

In January 1977, Environment Canada was informed that the MASH 400 was no longer being manufactured.

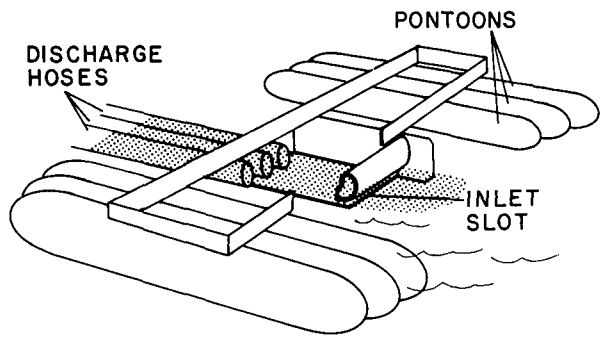
M.G. JOHNSON - DEVELOPER
Mason & Hanger - Silas Mason Co., Inc.
P.O. Box 117
Leonardo, NJ 07737
USA

telephone (201) 291-0680

HIGH SPEED SKIMMER
(Johnson Skimmer)
Price: Skimmer under development

COLLECTION PRINCIPLE

A horizontal intake slot is maintained at an appropriate skimming depth by a system of large flotation units. The oil encountered is first removed by a pump located remotely from the skimming head and then transferred to storage.



PHYSICAL SPECIFICATIONS (approximate)

Length (m)	3
Width (m)	2.7
Average Draught (cm)	2.5
Slot Width (adjustable) (cm)	0 - 5
Weight (kg)	180
Materials of Construction	aluminum body, rubber flotation
Pump	positive displacement; Roper unit rated at 2 650 L/min was used during testing

MODE OF OPERATION

The Johnson Skimmer has been designed for towing at speeds to 6 kn. Two recovery units would be held by support systems, one on either side of a vessel which then would be advanced through an uncontained slick. The recovery pumps would be operated from the vessel to take collected oil to on-board separation /storage tanks. In tests, vertical plunging water jets have been used ahead of the skimmer's inlet to concentrate and direct product back into the unit. These would also form an integral part of the recovery package.

PERFORMANCE

Evaluations of the skimming head and plunging water jets were conducted at OHMSETT in 1980. Both flexible rubber pontoon and rigid flotation models were examined, with the former version permitting higher speed skimming operations. Specifically, water surface following capability was determined to be satisfactory at speeds to 6 kn in both calm water and in regular waves 0.13 m high by 45 m long. At velocities above 4 kn, the effects of the water jet system used to guide and concentrate the oil interferred with data interpretation since slick thickness declined rather than increased at such speeds.

Development work has centred around optimizing the skimmer's hydraulic characteristics, particularly at higher towing rates, and matching encounter rate with off-loading capability. Highest oil recovery rate achieved has been about 37 m^3/h while oil content in the collected liquid peaked at 67%.

Overall, this lightweight skimming system has shown much promise while still in the developmental stage.

OPTIMUM APPLICATION

With positive displacment pump; in calm seas over a range of tow speeds; in light to heavy oils (excluding Bunker fuels).

ADDITIONAL PERFORMANCE INFORMATION

Farlow, J.S. and R.A. Griffiths, OHMSETT Research Overview, 1979-1980, 1981 Oil Spill Conference, American Petroleum Institute, Atlanta, GA, (March, 1981).

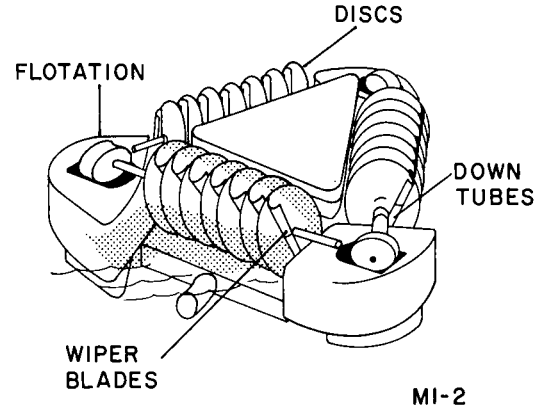
MORRIS INDUSTRIES LTD.
1527 Columbia Street
North Vancouver, British Columbia V7J 1A3
Canada

telephone (604) 986-2189

MI-2
Price: $6 250 (U.S.)
(effective 15-9-81)

COLLECTION PRINCIPLE

Three banks of seven rotating discs each turn in pooled oil. The oil that adheres to the discs is scraped off from both sides by polyethylene wipers and drops into a central sump from which it is pumped to storage.



MI-2

PHYSICAL SPECIFICATIONS

Overall Diameter (cm)	66
Overall Height (cm)	28
Draught (cm)	0.6
Disc Diameter (cm)	17.8
Discharge Hose Diameter (cm)	2.5
Weight (kg)	18
Materials of Construction	PVC discs, fibreglass-reinforced plastic body
Power Unit	12 V, 20 A DC generator/two-speed selection (110 V generator and 110/12 V 20 A converter)
Pump	2.5 cm 12 V booster pump
Other Data	control box, tow transit cases and maintenance and repair kit are included

MODE OF OPERATON

The skimmer is light, portable, and designed for use where access and space may be limited. The skimming component is placed in the spilled product that has been contained; it is then operated remotely via the 12 V source. Storage facilities must be preplanned.

PERFORMANCE

The MI-2 has been tank-tested in Canada during January 1979 and at OHMSETT in October 1978. Optimum results obtained in the calm water, Canadian tests were as follows:

Test Medium	Slick Thickness (mm)	Air Temp. (°C)	Water Temp. (°C)	Disc Speed (rpm)	Oil Content (%)	Oil Recovery Rate (m^3/h)
Crude Oil	9	16.0	12.5	35	97	0.5
Diesel Oil	8	15.0	14.0	39	99	0.2

The U.S. program revealed similar oil recovery rates for two oil types.

The main advantage of using this sorbent surface device is the consistently high oil content of the collected product. Values for both the diesel and crude oil tests ranged from 95 to 99%. Oil recovery rate was lower than the manufacturer's claim; this illustrated to the test team the importance of positioning the skimmer in significant concentrations of oil. In spite of this requirement for high efficiencies, the ability of the discs to draw in trace amounts of oil has been noted. While the discs will process oil in the presence of debris, the latter does interfere to some extent with the oil collection process.

The MI-2 skimming system has been designed as a highly portable, self-contained package. A car battery or portable generator can be used to supply power. The skimmer is intended for smaller spills in calm water where the pickup of oil can take place over time, with periods of unattended operation possible. The manufacturer continues to investigate optional components and fabrication processes in spite of the success that the MI-2 has enjoyed.

OPTIMUM APPLICATION

In light to medium viscosity oils; in calm conditions, in concentrations of oil 1 cm thick and greater; will process oil in some forms of debris.

ADDITIONAL PERFORMANCE INFORMATION

Abdelnour, R. et al., An Evaluation of Oil Skimmers and Pumps, Technology Development Report EPS 4-EC-81-4, Environment Canada, Ottawa Ontario, (December, 1981).

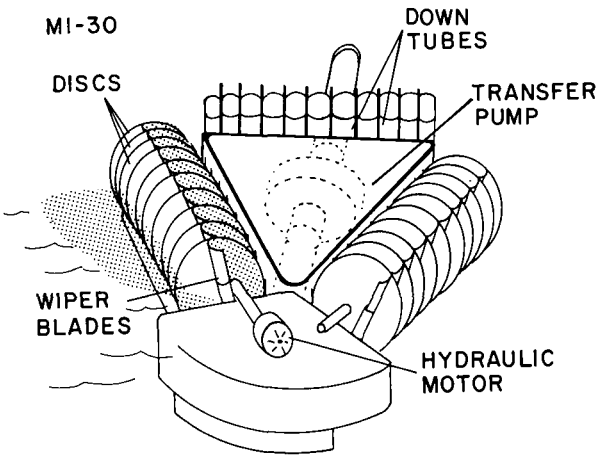
MORRIS INDUSTRIES LTD.
1527 Columbia Street
North Vancouver, British Columbia V7J 1A3
Canada

telephone (604) 986-2189

MI-30
(Three-Square Skimmer)
Price: $19 500 (U.S.)
including power pack
(effective 15-9-81)

COLLECTION PRINCIPLE

Three banks of 10 discs each rotate in oil which adheres to the discs and is scraped off by wiper blades. The oil flows down tubes into a central collection chamber. A pump internal to the skimmer's sump is then actuated to remove collected product to storage.



PHYSICAL SPECIFICATIONS

Overall Diameter (cm)	127
Overall Height (cm)	56
Draught (cm)	20
Disc Diameter (cm)	38
Discharge Hose Diameter (cm)	5.1
Weight (kg)	83
Materials of Construction	PVC discs, fibreglass-reinforced plastic body
Power Unit	Yanmar diesel 6 HP/hydraulic package
Transfer Pump	Granco positive displacement rotary type; 5.1 cm discharge port
Other Data	maintenance and repair kit, storage/transit cover, control package included

MODE OF OPERATION

The MI-30 can be launched by two persons. It is intended for operation within a containment barrier; disc speed and pumping are controlled through the remote power pack. Storage capacity must be prearranged.

PERFORMANCE

Testing of the MI-30 skimmer has seen a continuous upgrading of the product beginning with in situ trials conducted by Environment Canada and the Petroleum Association for Conservation of the Canadian Environment in the St. Lawrence River in October 1976 and progressing through to tank evaluations at OHMSETT in October 1978 and in Kanata, Ontario, in January 1979. The first Canadian tests yielded maximum recovery rates of 1 m^3/h of diesel and 0.7 m^3/h of crude oil in slick thicknesses of 9 and 10 mm, respectively. Lack of stability, coarse control of disc and pump speed, and the unit's centrifugal pump were

cited as factors adversely affecting performance. At OHMSETT, a skimmer with a positive displacement pump, improved control package and greater water planing capability (now standard features) was examined with maximum recovery rates of 1.7 m^3/h obtained for heavy oil and 4.8 m^3/h for light oil, both achieved in 11.5 mm slicks in calm water. Performance declined in wave conditions. Very similar results followed in the 1979 program, with oil content for both diesel and crude generally 96-99%. The power pack was operated outside the tank room at temperatures ranging from -15 to -25°C. Overall, the skimmer functioned well during the time evaluated.

Users report complete satisfaction with the unit. Recovery rates of 5 m^3/h and greater can be expected in slicks several centimetres in thickness. The hydraulic motors may require several hours of running during a "break-in" period before optimum performance is realized. The complete nature of the package and its versatility are cited by operators as the main reasons behind its popularity. The company has continued to improve the skimmer.

OPTIMUM APPLICATION

In light and medium viscosity oils; in significant concentrations of oil (1 cm and greater); in calm conditions; in a range of temperatures; will process oil in the presence of some debris.

ADDITIONAL PERFORMANCE INFORMATION

(1) Abdelnour, R. et al., Field Evaluation of Eight Small Stationary Skimmers, Technology Development Report EPS 4-EC-78-5, Environment Canada, Ottawa Ontario, (May, 1978).

(2) Abdelnour, R. et al., An Evaluation of Oil Skimmers and Pumps, Technology Development Report EPS 4-EC-81-4, Environment Canada, Ottawa, Ontario, (December, 1981).

(3) Smith, G.F. and H.W. Lichte, Summary of US Environmental Protection Agency's OHMSETT Testing, 1974-1979, EPA 600/9-81-007, U.S. Environmental Protection Agency, Cincinnati, OH, (January, 1981).

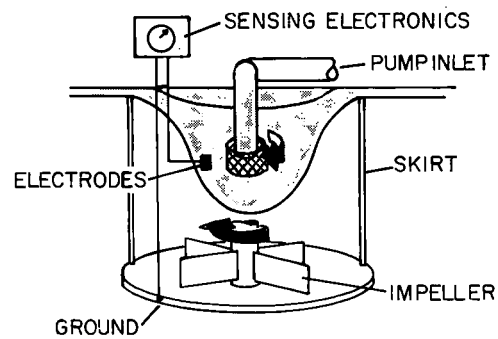
NOUVELLES APPLICATIONS TECHNOLOGIQUES
370, Avenue Napoleon - Bonaparte
92500 Rueil-Malmaison
France

telephone (33) (1) 732 1086
telex NAT 202913F

VORTEX OIL DRINKER
(VIM 5, 25, 150 and VLI 5 and 25)
Price: 64 700 to 156 900
French francs
(effective 14-10-81)

COLLECTION PRINCIPLE

An impeller rotating on a vertical axis creates a vortex at the water's surface drawing in oil which is pumped to storage.



PHYSICAL SPECIFICATIONS (five models available)

	VIM-5	VIM-25	VIM-150	VLI-5	VLI-25
Skirt Diameter (m)	0.60	1	2	0.65	1
Overall Width (m)	1.70	2.50	7.8 x 7.2	1.84	3.60
Overall Height (m)	1.00	1.45	3.5	1.32	1.50
Draught (m)	0.60	0.45	2.5	0.67	0.85
Weight (kg)	39	85	5 000	100	200
Materials of Construction	PVC	PVC	coated steel, polyurethane floats	steel	steel
Impeller Drive	0.5 HP Globe SBRM60 pneumatic motor in all models except VIM-150 with 2 HP hydraulic unit				
Pump	Sandpiper diaphragm in all models except VIM-150 which has Richier P492 or equivalent				
Power Requirements	60 m^3/h (STP) air	120 m^3/h (STP) air	3 HP diesel/ hydraulic	60 m^3/h (STP) air	120 m^3/h (STP) air
Control Skid Dimensions (m x m x m)	0.7 x 0.5 x 0.6	1 x 0.7 x 8	2 x 1.8 x 2.2	0.94 x 0.70 x 1.15	
Control Skid Weight (kg)	40	55	1 500	70	80

MODE OF OPERATION

The vortex module is deployed into a contained slick and operated remotely through a skid-mounted control and pumping unit. Various models have been conceived for use ranging from industrial sumps to open water spills. Attendant storage is required, with launching method determined by skimmer weight and size.

PREDICTED PERFORMANCE

No independent test data for the Vortex Oil Drinker are known.

The primary oil attracting and removal feature of the skimmer, in addition to the off-loading pump, is the rotating action of the impeller at 30 rpm. The vortex induced by the impeller should result in the surface layer of oil and water from a circular area several metres in diameter being drawn into the pump inlet although the degree of concentration of product within the vortex is an unknown factor. Higher oil content might be expected in calm conditions, when the inward movement of water and oil could be sustained, and in significant thicknesses of product that would allow the formation of a central core of oil.

Conversely, it is suspected that moderate wave conditions, particularly short breaking waves, would impede the migration of product toward the skimmer. Thin slicks might also result in excessive water pickup, in which case oil/water mixing could also result.

In tests conducted for the U.S. Environmental Protection Agency in 1970 (see Additional Performance Information below), a skimming concept was examined that utilized a pump-induced vortex and vacuum suction or Coanda nozzle (fluid attachment eductor). It was concluded that recovery rate was influenced by oil characteristics and the presence of waves. Emulsion formation resulted with the nozzle although a circular area of influence in calm conditions was apparent. It is interesting to note that the EPA study recommended a liquid pumping system and enclosed vortex chamber (not subject to the lateral movement of the vortex by waves); these two features are incorporated in the Vortex Oil Drinker.

PREDICTED OPTIMUM APPLICATION

In light and medium viscosity oils; contained in significant thicknesses (1 cm and greater) in calm conditions, debris-free (for models without grill); requires attendant storage and possibly oil/water separation.

ADDITIONAL PERFORMANCE INFORMATION

Pacific Northwest Laboratories, Recovery of Oil Spills Using Vortex Assisted Airlift System, 15080DJM07/70, U.S. Environmental Protection Agency, Cincinnati, OH, (July, 1970).

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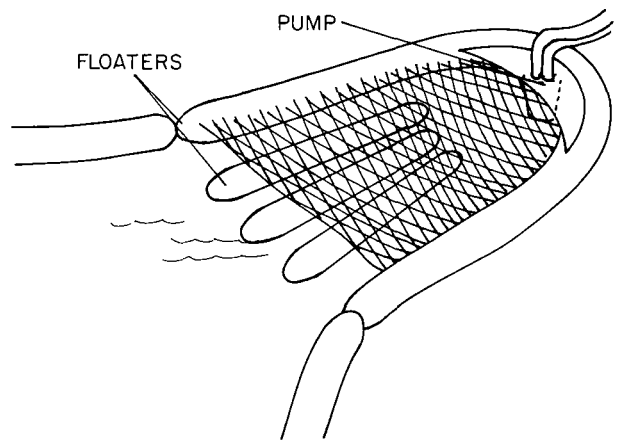
Norway

telephone (47 2) 41 9000
telex 16640 NYLAN N

AKER OIL TRAWL
(Romsdals Fiskevegnfabrikk or
Ro-Fi Oil Trawl)
Price upon request

COLLECTION PRINCIPLE

Two booms direct oil through a series of inflated tubes into a collection area where oil accumulates and can be transferred by a pump positioned in the aft end of the open-bottom unit.



PHYSICAL SPECIFICATIONS (prototype unit)

Oil Booms (two)	Length (m)	15
	Freeboard (m)	0.8
	Draught (m)	0.8
Oil Trawl	Buoyancy Elements (four) - Diameter (m)	0.70
	Inflatable Perimeter - Diameter (m)	0.35
	Length (m)	20
Materials of Construction	PVC-coated canvas with covering net	
Total Weight (kg)	1 800	
Pump	Thune Eureka AS centrifugal pump	
Power Unit	100 HP air-cooled diesel/hydraulic package weighing (with pump) 1 100 kg	

MODE OF OPERATION

Two vessels tow the unitized oil booms and trawl through uncontained slicks while a trailing ship is used both as a platform for the power pack and for collected oil/water storage and separation. The system has been designed for coastal and offshore use and requires crane facilities for launching.

PERFORMANCE

Offshore testing of a prototype Aker Oil Trawl was conducted in the North Sea off Alesund, Norway, in June 1980 under the auspices of the Norwegian Oil Pollution Control Research and Development Program (PFO). The Ship Research Institute of Norway also participated in the trials. The full-scale prototype unit was

examined on one occasion using a 49% water-in-oil emulsion of SAE 30 lube oil having an apparent viscosity of 11 000 mPa•s. The device recovered approximately 50% of 30 m^3 of emulsion released in 2.5 m significant wave heights. Relative velocity ranged from 1.4 to 2.0 kn and the average wave period was 7 s.

In a second series of trials, 30 m^3 of a 67% water-in-oil emulsion were released with an apparent viscosity measured at 25 000 mPa•s. At tow speeds of 1.2-1.4 kn in a significant wave height of 1.3 m with an average period of 4.4 s, the Aker recovered about 75% of the oil released.

In both evaluation runs, 85-90% free water was collected. It was concluded that pump capacity could have been reduced to increase the oil content in the recovered fluid. Overall performance was judged to be good, with the main oil loss mechanism attributed to underflow of product at the point of attachment between the deflector boom and main body of the skimmer.

The noteworthy features of the system appear to be its excellent wave-conforming characteristics, unitized boom/skimmer configuration, high pumping capacity and rugged construction.

OPTIMUM APPLICATION

Offshore in light to heavy oils several millimetres and more in thickness; in calm to moderate offshore sea conditions; in debris-free water; positioned downstream from an oil release or towed through uncontained slicks.

ADDITIONAL PERFORMANCE INFORMATION

Langfeldt, J.N. and M. Wold, Full Scale Tests with Oil Recovery Systems Offshore Norway June 1980, Oil Pollution Control Research and Development Program, Oslo, Norway, (June, 1981).

OTHER DATA

A hybrid device which combines the design of the Aker Oil Trawl with the Fiskeredskap Oiltrawl has been pursued by the PFO (see latter entry for additional test results).

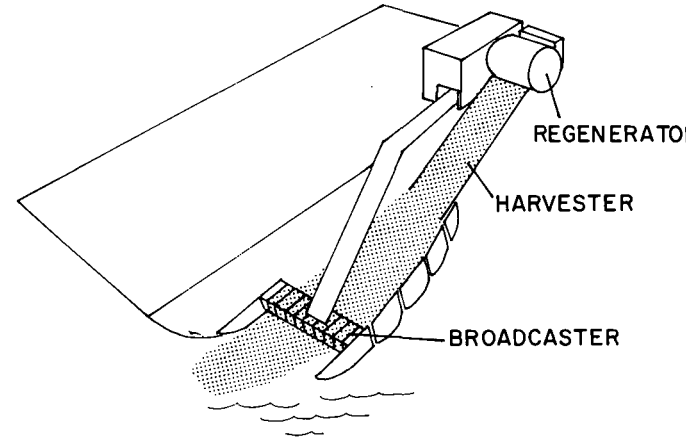
OCEAN DESIGN ENGINEERING CORP.
600 East Ocean Street
Long Beach, CA 90802
USA

telephone (714) 979-8782

MSORS
(Mechanized Sorbent Oil Recovery System) or SOP (Surface Oil Pickup) Skimmer
Price not applicable

COLLECTION PRINCIPLE

Foam chips are broadcast onto floating oil within a herding channel to initiate the recovery process. The oil-laden chips are then collected by a porous harvesting belt and regenerated by a roller and a mesh belt that partially envelops the roller. A return conveyor moves the sorbent back to the broadcaster for redistribution.



PHYSICAL SPECIFICATIONS (dimensions relate to SOP skimmer)

Length (booms retracted) (m)	13.6
Beam (m)	5.6
Sweep Width (m)	6.1
Draught (empty) (cm)	78.7
Discharge Hose Diameter (cm)	10.2
Weight (kg)	19 050 (empty) 24 940 (full)
Storage Capacity (L)	5 678
Power Requirements	twin GM 453 diesel engines; diesel-powered hydraulic broadcast unit
Pumping Unit	twin pumps (unspecified)
Sorbent Chips	reticulated (open cell) polyurethane foam 31.5 pores/cm, 7.6 cm x 7.6 cm x 0.6 cm

MODE OF OPERATION

The MSORS was designed to uniformly distribute sorbent in the high wind and wave conditions common to offshore environments. Once the sorbent has contacted oil, it is squeezed, the oil collected, and the sorbent rebroadcast. The prototype was developed for use in conjunction with barge-type vessels and offshore work boats. It is air-transportable.

PERFORMANCE

The sorbent recovery system developed by Ocean Design Engineering Corp. was evaluated as a prototype at OHMSETT between October and December, 1976. The test served to demonstrate the capability of the

concept to recover oil in high wind and wave conditions; however, some mechanical and design difficulties were encountered. The oil recovery rate peaked at 15 m^3/h, with oil content in the collected liquid varying between 20% and 61%. Highest percentage of oil picked up versus oil encountered was 57%; this was achieved at a speed of 2.0 kn in a 0.5 m harbour chop. These results are somewhat similar to those obtained for the Seaward International sorbent system.

In the case of MSORS, chip loss was experienced beneath the harvester while water saturation of the chips resulted due to the use of fire hoses and prolonged soaking. Emulsification of the collected liquid was also noted due to its double passage through the regenerator belt.

While at first glance the herding channel would appear to offer improved contact between sorbent and oil as well as the prevention of loss of chips, it actually contributes to the underflow of chips and limits the speed at which the system can be operated. In preliminary sea trials, the escape of chips was also observed (at a rate of 0.03% of the total number present per minute). Overall, however, both the tank trials and in situ work were judged by test personnel to be successful in that they demonstrated the potential of this open sea oil recovery system.

OPTIMUM APPLICATION

In light to medium viscosity oils collected at relative velocities of about 2 kn; in moderate sea conditions; will process some debris.

ADDITIONAL PERFORMANCE INFORMATION

(1) Brunner, D.E., MSORS Performance Testing Summary, TM-M-54-77-1, U.S. Naval Civil Engineering Laboratory, Port Hueneme, CA, (1977).

(2) Brunner, D.E., J.J. Der and D. Hall, An Offshore Mechanized Sorbent Oil Recovery System Using Vessels of Opportunity, Proceedings of the 1977 Oil Spill Conference, American Petroleum Institute, New Orleans, LA, (March 8-10, 1977).

OTHER DATA

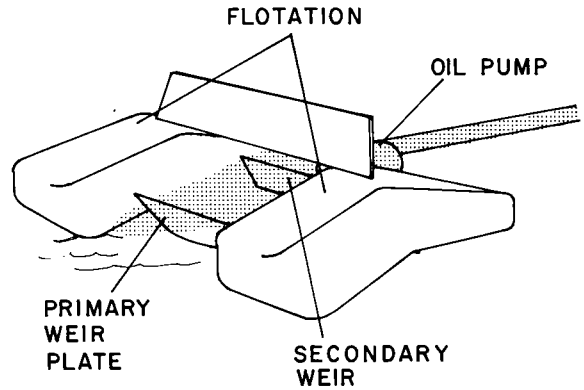
Ocean Design Engineering Corp. drew upon their patented SOP (Surface Oil Pickup) system in participating in the development of the MSORS concept. Work was conducted by the Civil Engineering Laboratory under the sponsorship of the U.S. Navy Supervisor of Salvage. Feasibility studies of the approach were originally directed by the U.S. Environmental Protection Agency. Ocean Design has also marketed its product as the SWATH (Sheltered Waters Absorbent/Trash Harvester).

OCEAN SYSTEMS, INC.
11440 Isaac Newton Industrial Square
North Reston, VA 22010
USA

OIL RECOVERY SYSTEM-125
(ORS-125)
also other model designations
Price upon request

COLLECTION PRINCIPLE

A primary weir accepts product overflowing the weir lip while a secondary weir interconnected by fabric serves to further separate oil and water. Product is then pumped to storage. The skimming component comprises the apex link of a containment boom deployed in a catenary.



PHYSICAL SPECIFICATIONS (ORS-125 only)

The ORS-125 (High Seas/Harbour System), ORS-1000 and ORS-2000 skimmers have been marketed.

Overall Length (m)	1.2
Beam (m)	2.1
Height (m)	1.2
Discharge Hose Diameter (cm)	7.6
Weight (kg)	154
Power Requirements	air compressor supplying 28.3 L/min at 680 kPa
Pump	double diaphragm air-operated unit; occupies space 0.6 m x 0.6 m

MODE OF OPERATION

Sections of boom are attached to the skimming head, one on either side of the inlet. The total system is then towed by two vessels and advanced through an uncontained slick, with product removed by an on-board pump to storage on a third trailing vessel or to facilities on one of the towing craft. A remotely positioned air compressor must also be used in conjunction with the pump. Crane launching is required with various models available and intended for use in harbour, river and coastal applications.

PERFORMANCE

ORS systems have been evaluated at OHMSETT on three occasions. In August/September 1974, the ORS-1000 was tested while in July and again in September and October 1975, the ORS-125 was examined.

Test results were somewhat erratic because no clear indicator was provided for the operator to control recovery rate (and hence oil content). The system was limited to a minimum speed of between 0.75 and 1 kn for oil recovery since a buildup of product is first required before transfer of significant volumes is possible. Equally clearly, a maximum relative velocity of between 1.5 and 1.75 kn exists beyond which boom failure occurs, the sinking of the primary weir results, and oil collection ceases. The ORS-125 was found to be highly

wave-sensitive since the depth of the weirs fluctuates, thus changing water uptake particularly in the secondary weir where final oil/water separation takes place. Recovery rate was found to increase with increasing encounter rate. In all test programs, the ORS-125 displayed a marked improvement in recovering lube-type oils (with higher viscosities) over lighter oils such as naphtha and No. 2 Fuel Oil. Tank trials showed that the advancing weir system was not capable of picking up very light oils (naphtha included) having a viscosity in the range of 0.10 cm^2/s.

Optimum Test Results, ORS-125, July 1975 (approximations taken from graphical data)

Test Medium	Slick Thickness (mm)	Wave Height (cm)	Tow Speed (kn)	Oil Recovery Rate (m^3/h)	Oil Content (%)
Lube Oil	2	0	1.2	13.2	100
No. 2 Fuel Oil	2	0	1.2	7.5	50

Lube Oil: viscosity 1.08 cm^2/s; S.G. 0.87
No. 2 Fuel Oil: viscosity 0.091 cm^2/s; S.G. 0.85

OPTIMUM APPLICATION

In calm, debris-free conditions at relative velocities approximating 1.25 kn; in light to medium viscosity oils (excluding very light oils such as naphtha, etc.); with storage/separation facilities.

ADDITIONAL PERFORMANCE INFORMATION

(1) Griffiths, R.A., Performance Tests of Off-the-Shelf Oil Skimmers, Paper No. OTC 2696, Offshore Technology Conference, Houston, TX, (May, 1976).

(2) McCracken, W.E. and J.H. Schwartz, Performance Testing of Spill Control Devices on Floatable Hazardous Materials, EPA 600/2-77-222, U.S. Environmental Protection Agency, Cincinnati, OH, (1977).

(3) Smith, G.F. and H.W. Lichte, Summary of US Environmental Protection Agency's OHMSETT Testing, 1974-1979, EPA 600/9-81-007, U.S. Environmental Protection Agency, Cincinnati, OH, (January, 1981).

OTHER DATA

Several written inquiries to the manufacturer elicited no response. Availability of skimmers is unknown.

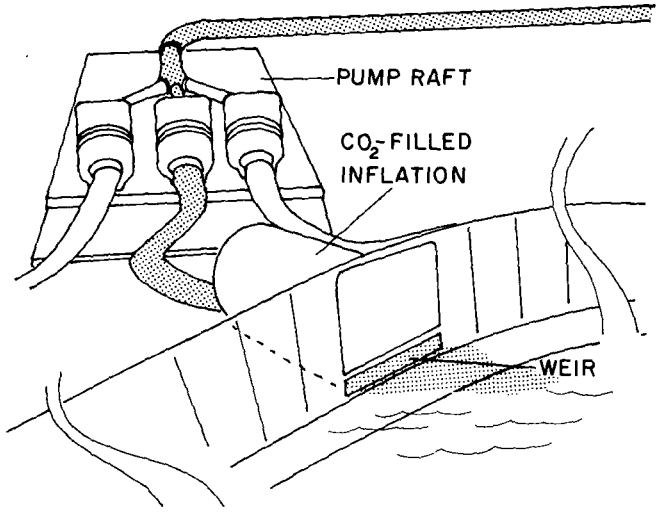
OFFSHORE DEVICES, INC.
Building 43
Summit Industrial Park
Peabody, MA 01960
USA

telephone (617) 286-0767

HIGH SEAS SKIMMING AND PUMPING SYSTEM
(U.S. Coast Guard Skimming Barrier, VOSS)
Price: $250 000 (U.S.) with container
(effective 1-9-81)

COLLECTION PRINCIPLE

Product is concentrated by the boom which contains six weir components at its apex. As the barrier is advanced in a U-configuration, three pumps on a trailing platform are operated to transfer oil to storage/separation facilities. Outriggers and rigid panels provide stability.



PHYSICAL SPECIFICATIONS

Length (m)	187 (11 m of skimming section)
Total Height (cm)	122
Draught (cm)	69
Weight (kg/m)	23.8 (262 kg skimming section)
Shipping Weight (loaded) (kg)	7 000
Materials of Construction	elastomer-coated two-ply nylon, steel/ethafoam panels
Pumps	three double-acting diaphragm pumps, 10.2 cm discharge, 7.6 cm suction
Pump Float	3.28 m x 1.43 m x 0.91 m at 440 kg
Power Requirements	hydraulic drive 76 L/min at 1 360 kPa
Inflatable Floats	automatic CO_2 inflation system

MODE OF OPERATION

Two towing vessels take up either end of the Skimming Barrier and manoeuver it through a slick. The trailing pumps are operated from a remote position to transfer collected product to an attendant barge or other large-capacity craft. The system is stored in a container and self-inflates when removed for deployment. It was designed for offshore countermeasures operations.

A more recently marketed product includes 19.8 m of the Skimming Barrier and is called the Vessel of Opportunity Skimming System (VOSS). It is held by an outrigger boom at the side of a ship with product transferred by pump through a separator to on-board storage. All necessary components comprising the skimming package can be purchased (price: $137 000 (U.S.) effective 1-12-81).

PERFORMANCE

Extensive evaluation of the U.S. Coast Guard Skimming Barrier has been conducted. Test programs include work carried out at OHMSETT in 1975 and 1977 as well as sea trials in 1976 and 1981. OHMSETT data are reported for highest values of oil recovery rate and oil content.

Test Medium	Sea Conditions	Tow speed (kn)	Oil Recovery Rate (m^3/h)	Oil Content (%)
heavy oil	calm	0.74	87.4	83
heavy oil	28.7 cm wave	1.0	109.9	64
medium oil	calm	0.74	79.5	80
medium oil	calm	1.0	97.9	60

A preload of 19 m^3 was presented to 25 m of the boom towed in a catenary so that a 15 cm thickness of oil formed in front of the six weir components. Highest oil content measurements were noted in calm conditions at about 0.75 kn while oil recovery rates peaked at 1 kn. At higher tow speeds and in greater wave heights performance declined, particularly for the medium oil trials.

The seakeeping characteristics of the device were judged to be satisfactory; overall performance was very good at lower speeds and in calm and moderate wave conditions. The diaphragm pumps required various seal replacements but otherwise maintained high capacity transfer rates. The skimming barrier concept offers a very efficient use of the simple weir approach; when used as intended, it combines the basic countermeasures operations of oil containment and removal.

The VOSS package offers increased versatility in chasing down uncontained slicks. It also eliminates the need to purchase a costly hull, propulsion system and navigational equipment as part of the skimmer. The VOSS should display performance trends similar to the Skimming Barrier.

OPTIMUM APPLICATION

At tow speeds of 0.75-1 kn; in significant concentrations of oil so that 10-20 cm of oil can be accumulated at the weir inlets; in calm and moderate sea states; will process some debris.

ADDITIONAL PERFORMANCE INFORMATION

(1) Lichte, H.W., Skimming Barrier Performance Evaluation: Offshore Version and Harbour Version, 1979 Oil Spill Conference, Los Angeles, CA, (1979).

(2) Lichte, H.W. and M.K. Breslin, Performance Testing of Three Offshore Skimming Devices, EPA 600/7-78-082, U.S. Environmental Protection Agency, Cincinnati, OH, (1978).

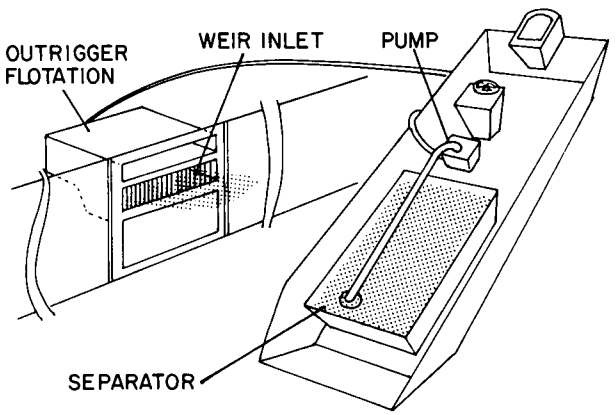
OFFSHORE DEVICES, INC.
Building 43
Summit Industrial Park,
Peabody, MA 01960
USA

telephone (617) 286-0767

SCOOP
Price: $85 000 (U.S.)
(effective 1-9-81)
depending on options

COLLECTION PRINCIPLE

Product concentrated by a boom overflows two or four simple weir sections incorporated in the boom structure and located at its apex. The liquid is then pumped to a separator tank from which water is discharged; concentrated oil is transferred to separate storage facilities. Boom stability is provided by rigid panels and outrigger floats.



PHYSICAL SPECIFICATIONS

	Barrier	Vessel	Separator
Length (m)	20.7	9.1	1.47
Width	--	2.4	1.07
Height (m)	0.61		1.22
Draught (cm)	34	38	--
Capacity (L)	--	--	1 325
Weight (kg)	238	varies with power option	238 (empty)
Materials of Construction	elastomer-coated nylon; aluminum stiffness; ethafoam flotation; lead ballast	fibreglass, foamcore sides	aluminum or fibreglass; sight glass
Weir Opening	43 cm x 6 cm		
Propulsion	170 HP gasoline inboard/outboard engine, optional twin outboard motors		
Vessel Speed	2.5 kt (depends on power mode selected)		
Pump	double acting diaphragm, hydraulically driven, 7.6 cm suction and 10.2 cm discharge ports, 45 kg cast aluminum housing		
Other Data	also includes two 1 895 L rubber storage bladders		

MODE OF OPERATION

The SCOOP Vessel can be trailered and launched via ramp or crane. It, along with a second craft, tow either end of the boom in a catenary to contain and concentrate free-floating slicks. Once liquid has been collected and pumped to the separator where water is removed, the oil is transferred to a towed bladder. Deployment and retrieval of the barrier can be quickly accomplished by two persons. Use is intended for lakes, harbours and other more sheltered waterways.

PERFORMANCE

Both in situ and tank evaluations have been conducted of the SCOOP system. The former was undertaken on behalf of Environment Canada near Annapolis, Maryland, in August 1978 and the latter in May of the same year. Separate testing of the pump and separator components has also been documented.

At OHMSETT, numerical data were also recorded for the system as a whole with the following optimum results.

Heavy Oil Tests (7.00 cm^2/s at 28.8°C; S.G. 0.936)

	Tow Speed (kn)	Wave Height x Length (m)	Separator Flow Rate (m^3/h)
Oil Recovered vs Oil Encountered = 100%	0.75	0.6 Harbour Chop	22.7
Oil Content = 100%	1.0	0	49
Oil Recovery Rate = 11.5 m^3/h	0.75	0.3 x 9	15.5

In light oil tests, best results were obtained in calm conditions at tow speeds of 0.75 kn; specifically, Oil Recovered vs Oil Encountered was 89%, Oil Content was 26% and Oil Recovery Rate was 7.6 m^3/h measured at separator flow rates of 11.9, 36.4 and 19.8 m^3/h, respectively. Examination involved the presentation of about 1 m^3 of oil rather than the 4 m^3 projected by the test team to fully load the barrier. The separator nominal design flow rate of 13.6 m^3/h was exceeded with excellent results in the heavy oils while the efficient processing of light oil required staying within design criteria.

Comprehensive testing has also shown operating limits to depend on pump capacity and boom tow speed. The pumping rates achieved were 51 m^3/h for pure oil with a viscosity of 7.00 cm^2 at 28.8°C; oil retention at speeds up to 1.25 kn was possible although results were inconclusive.

The manufacturer has incorporated several design changes (partially as a result of the various test programs) and has constantly upgraded the product. Improved hydraulic controls and vessel stability, a strengthened vent stand pipe on the separator, as well as a number of available options have increased the effectiveness of the SCOOP.

Overall, the Canadian test team found the system to be highly manoeuverable and the boom and weirs to be stable.

OPTIMUM APPLICATION

In light and medium viscosity oils; in calm conditions; at tow speeds of about 0.75 kn; in debris-free water; with significant concentrations of oil (at least several centimetres).

ADDITIONAL PERFORMANCE INFORMATION

(1) Abdelnour, R. et al., An Evaluation of Oil Skimmers and Pumps, Technology Development Report EPS 4-EC-81-4, Environment Canada, Ottawa, Ontario, (December, 1981).

(2) Graham, D.J., R.W. Urban, M.K. Breslin and M.G. Johnson, OHMSETT Evaluation Tests: Three Oil Skimmers and a Water Jet Herder, EPA 600/7-80-220, U.S. Environmental Protection Agency, Cincinnati, OH, (1980).

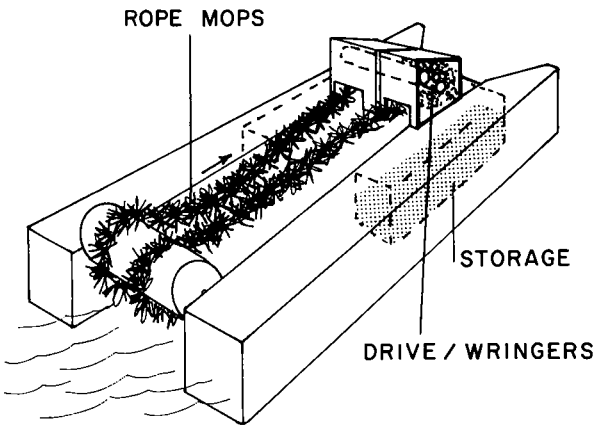
OIL MOP, INC.
Engineers Road
P.O. Drawer P
Belle Chasse, LA 70037
USA

telephone (504) 394-6110
telex 58 7486

DYNAMIC SKIMMER
(Zero Relative Velocity,
ZRV Skimmer)
Price upon request

COLLECTION PRINCIPLE

A series of endless polypropylene rope mops are pulled along the water's surface between the hulls of a catamaran from bow to stern so that zero relative velocity results between the mops and the water. Oil is wrung by drive/roller assemblies and then transferred to storage.



PHYSICAL SPECIFICATIONS

	Series I	Series II
Overall Length (m)	11.6	14.1
Beam (m)	3.7	4.0
Draught - Empty (cm)	30	45
- Full (cm)	61	90
Number & Size of Mops	six at 23 cm diameter	unspecified
Storage Capacity (L)	757	14 000
Weight (kg)	9 060	unspecified
Power Unit	two diesel engines @ 112 HP hydraulic package	twin 130 HP diesel engines
Propulsion	outdrive units	Volvo Penta 280B outdrive units
Pumps	positive displacement Tuthill Lobe type	unspecified

Information on Series II Dynamic Skimmer or Anti Pollution Vessel was released 8-8-81 by O.M.I. Limited UK.

MODE OF OPERATION

The Dynamic Skimmer has been designed to chase down uncontained slicks as a self-contained skimming unit. Both Series I and II models would have to be used in conjunction with attendant storage due to limited on-board capacity (based on past performance). Operation would be restricted to harbour and nearshore waters.

PERFORMANCE

The ZRV concept has been evaluated twice at OHMSETT, first in November/December 1976, followed by a program in April 1977. The initial trials largely served to define test procedures and the feasibility of the

approach including recommendations which would allow for a more successful operation. Highest average results, obtained in calm water in 3 mm slicks, are reported for the 1977 program:

Heavy Oil (30.00 cm^2/s)	Tow Speed (kn)	Light Oil (0.09 cm^2/s)	Two Speed (kn)
Oil Recovered vs	1	Oil Recovered vs	2
Oil Encountered = 71%		Oil Encountered = 78%	
Oil Content = 77%	2	Oil Content = 70%	2
Oil Recovery Rate = 13 m^3/h	3	Oil Recovery Rate = 17.3 m^3/h	4

A higher percentage of light oil encountered was recovered versus heavier oil although this percentage declined with increasing speed of advance. The rate of pickup of the light oil was consistently higher as well, even in wave heights of 0.6 and 0.8 m.

Three factors limited machine performance. At speeds greater than 3 kn, heavy oil caused the mop strands to adhere to the wringer rollers thereby jamming them, and light oil was flung off the stern return roller. The former problem was subsequently corrected by the manufacturer who redesigned the bow wringer assembly. A simple cowling would stop the light oil losses. A second limiting criterion is vessel speed. Higher speeds result in shorter mop/oil contact time and less efficient operation; data trends, however, seem to indicate equivalent oil recovery rates over the speed range of 2-5 kn. Some slippage of mops over the squeeze rollers in heavy oil tests resulted in a third oil loss mechanism. This was due to the drag of the oil-laden mops against the drip pan.

Overall, the Dynamic Skimmer appears to have added considerably to the versatility of the oleophilic rope recovery concept in terms of recovery rate and the applicability to various conditions of sea state and debris infestation. Testing has provided useful design data.

OPTIMUM APPLICATION

In a range of oil viscosities but most efficient in light oils; in oil several millimetres in thickness and greater; at relative velocities of 2-4 kn; in calm and moderate sea conditions; will process oil in most forms of debris; avoid using in Bunker fuels.

ADDITIONAL PERFORMANCE INFORMATION

(1) Breslin, M.K., Performance Testing of Oil Mop Zero Relative Velocity Oil Skimmer, EPA 600/7-78-060, U.S. Environmental Protection Agency, Cincinnati, OH, (1978).

(2) Urban, R.W. and D.J. Graham, Performance Tests of Four Selected Oil Spill Skimmers, EPA 600/2-78-204, U.S. Environmental Protection Agency, Cincinnati, OH, (1978).

OTHER DATA

In the UK: O.M.I. Limited
Canon Bridge Works
Cannon Lane
Tonbridge
Kent TN9 1PP

telephone Tonbridge (44)(0732) 352125
telex 95345 (OMIEURG)

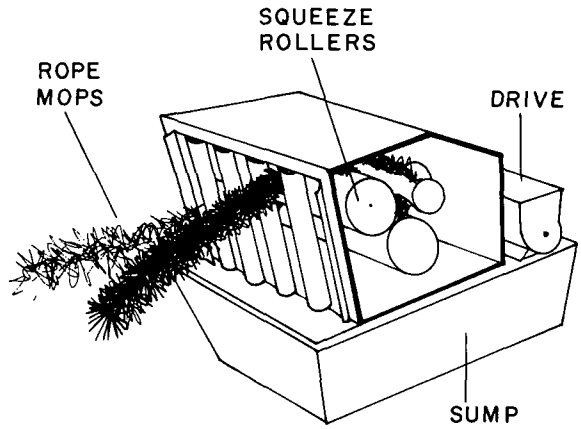
OIL MOP, INC.
Engineers Road
P.O. Drawer P
Belle Chasse, LA 70037
USA
(For UK information see preceeding entry)

telephone (504) 394-6110
telex 58 7486

Mk I, II, IV Series
Mk I-4
Mk II-4
Mk II-9D
Mk IV-16DP
Price upon request

COLLECTION PRINCIPLE

Oil preferentially adheres to an endless woven rope mop which is pulled and wrung by a roller/drive assembly. The end of the mop remote from the power source passes around one or more anchored tail pulleys. Collected product drops into a sump from which it is pumped to storage.



PHYSICAL SPECIFICATIONS (E-electric; D-diesel)

	Mk I-4E	Mk I-4D	Mk II-4E	Mk II-4D	Mk II-9D	Mk IV-16DP
Length (cm)	104	104	79	114	183	305
Width (cm)	48	55	31	64	112	227
Height (cm)	51	81	39	81	130	215
Storage Capacity (L)	--	--	--	175	684	3 657
Dry Weight (kg)	86	106	34	204	725	3 600
Materials of Construction	polypropylene fibre rope mop, steel wringer housing, neoprene rollers					
Maximum Mop Length (m)	75	76	7.6	91	610	610
Diameter (cm)	10.2	10.2	10.2	10.2	10.2	23
Power Requirement (continuous HP)	0.5	4.1 @ 3 600 rpm	two fractional HP motors 115 V, 60 Hz	3.5 @ 3 600 rpm	6.5 @ 3 600 rpm	37.5 @ 1 800 rpm
Mop Speed (m/min)	14	14-19	12.5	14.33	21.42	0-45
Pump	in Mk II and IV series only; varies in size up to the 7.6 cm centrifugal trash pump in the Mk IV					

The Mk II series skimmers have optional 115/230 V, 60 Hz single-phase drives with reduced continuous horsepower.

MODE OF OPERATION

The power/wringer unit can be operated from any suitable working platform or from shore to take up previously contained and concentrated oil. Diesel units incorporate a clutch for wringer activation; the drive mechanism varies in different models. Electric units require an external power source.

PERFORMANCE

In Canada, in situ testing of the Mk II-9 was conducted in 1975 followed by its examination with an electric preheater in 1977. Tests have also been carried out at Warren Spring Laboratory in the UK and at OHMSETT in the U.S.

Optimum Results Mk II-9D (*U.S. trials)

Sea Conditions	Test Medium	Viscosity (cm^2/s)	Thickness (mm)	Oil Recovery Rate (m^3/h)	Oil Content (%)
10-15 cm waves	crude oil	0.06 at 37.8°C	5	2.3	71.5
10-15 cm waves	emulsion	22.27 at 20°C	5	0.5	77
calm*	diocytl phthalate	0.792 at 16°C	--	10.0	98.3

With a 200 kW preheater, the Mk II-9D recovered Bunker C at a rate of 0.6 m^3/h from a boomed-off area in the St. Lawrence River. When applied at OHMSETT as a Vessel of Opportunity Skimmer System (VOSS) or "over-the-side" concept in July 1978, oil recovery rates peaked at 11.1 m^3/h in heavy oil in a 0.6 m harbour chop and at 14.8 m^3/h in light oil in calm conditions using two mops. Tow speeds were 1.5 and 3.0 kn, respectively; maximum oil content was 68% in heavy oil and 48% in light oil. Performance has been found to be sensitive to oil viscosity and rope mop speed and is less affected by debris and wave conditions. Transfer time of oil to rope increases with viscosity although more viscous products generally result in a higher oil content in the collected liquid. Improved rollers and pump selection have added to the machine's capability; users generally report successful application in spills of a range of oils. Past problems of drum scoring and emulsification are largely overcome.

OPTIMUM APPLICATION

In light to heavy viscosity oils excluding non-flowing products; in calm and moderate wave conditions; in thicknesses of oil several millimetres and more; in many forms of debris.

ADDITIONAL PERFORMANCE INFORMATION

(1) Graham, D.J., R.W. Urban, M.K. Breslin and M.C. Johnson, OHMSETT Evaluation Tests: Three Oil Skimmers and a Water Jet Herder, EPA 600/7-80-020, U.S. Environmental Protection Agency, Cincinnati, OH, (1980).

(2) McCracken, W.E. and J.H. Schwartz, Performance Testing of Spill Control Devices on Floatable Hazardous Materials, EPA 600/2-77-222, U.S. Environmental Protection Agency, Cincinnati, OH, (1977).

(3) Solsberg, L.B. et al., Field Evaluation of Seven Oil Spill Recovery Devices, Technology Development Report EPS 4-EC-76-3, Environment Canada, Ottawa, Ontario, (October, 1976).

(4) Thomas, D.H., Evaluation Trials on Equipment Manufactured by OMI Ltd., Tonbridge, Kent, The Oil Mop Mark II-9DP, Warren Spring Laboratory, Stevenage, UK, (1978).

(5) Tidmarsh, G.D. and L.B. Solsberg, Field Evaluation of Oil Mop and Preheat Unit, Technology Development Report EPS 4-EC-77-12, Environment Canada, Ottawa, Ontario, (November, 1977).

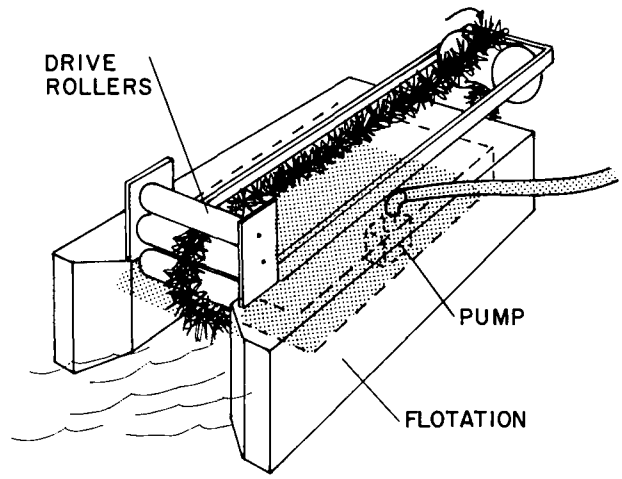
OIL MOP POLLUTION CONTROL LTD.
Unit 11
1765 Shawson Drive,
Mississauga, Ontario L4W 1N8
Canada

telephone (416) 677-6320

OIL MOP REMOTE SKIMMER
Price, prototype only,
upon request

COLLECTION PRINCIPLE

Two loops of polypropylene woven rope mop travel between the hulls of a catamaran pulled by a drive roller mechanism. Oil adhering to the rope mop is deposited in an on-board sump and transferred to storage facilities.



PHYSICAL SPECIFICATIONS

Length (m)	1.9
Beam (m)	1.3
Draught (cm)	15-23
Discharge Hose Diameter (cm)	6.4
Weight (kg)	approximately 350
Collection Reservoir (L)	60
Rope Mop Diameter (cm)	25.4
Length (m)	3
Speed (m/s)	0.21
Power Unit	220 V, 4.2 A, 1/2 HP electric motor
Propulsion	one fixed, one rotatable propeller at stern; each independently driven by 110 V, 15 A source
Pump	Tsurumi submersible centrifugal pump

MODE OF OPERATION

For this prototype device, an external source of electricity is required which connects to a remote control console. Vessel speed, turning, mop travel and pumping are functions operated from the panel through direct hook-up to the skimmer. The device is designed for manoeuvering in a contained, concentrated slick while controlled from an adjacent working platform (dock or vessel) to which recovered product would be directed. Crane launching is required.

PERFORMANCE

Evaluation of the Remote Skimmer was undertaken on behalf of Environment Canada in a test tank near Ottawa in January 1979 and at OHMSETT in August 1979. The optimum U.S. test results are noted below:

Heavy Oil (3.80 cm^2/s)	Tow Speed (kn)	Waves, Height x Length (m)	Slick Thickness (mm)
Oil Content = 96%	0.5	0	6
Oil Recovery Rate = 2.6 m^3/h	1.0	0	6
Light Oil (1.65 cm^2/s)			
Oil Content = 93%	0.5	0.2 x 7.0	9
Oil Recovery Rate = 2.7 m^3/h	1.0	0	9

These results closely correlate with the Canadian evaluation program which yielded maximum oil recovery rates and oil content in a 1 cm slick of 1.9 m^3/h and 95% in diesel and 1.4 m^3/h and 95% in crude oil, respectively.

Testing pinpointed design features which similarly affected the larger Dynamic Skimmer and which required attention. Three powered rollers were recommended to prevent mop slippage in high viscosity oils. An examination of contact time between oil and rope mops was deemed important so that the mop speed corresponded with the time taken to saturate it while traveling between the hulls. In addition, replacement of the centrifugal pump with a positive displacement model was felt necessary to ensure processing capability over a range of oil viscosities. Manoeuverability was also found to be limited in some wave conditions which also caused the collected oil onboard the skimmer to slosh excessively when the vessel pitched forward.

The manufacturer, who was present during the trials, has constructed a larger (4 m) catamaran skimmer driven by a diesel/hydraulic package and operated by remote radio control. It features a more stable pontoon system, positive displacement pump and improved wringer system, and is scheduled for evaluation in 1982.

OPTIMUM APPLICATION

In a range of oils contained in thicknesses of several millimetres and greater; in calm to limited wave conditions in many forms of debris; used with attendant storage capacity.

ADDITIONAL PERFORMANCE INFORMATION

(1) Abdelnour, R. et al., An Evaluation of Oil Skimmers and Pumps, Technology Development Report EPS 4-EC-81-4, Environment Canada, Ottawa, Ontario, (December, 1981).

(2) Lichte, H.W. et al., Performance Testing of Four Skimming Systems, U.S. Environmental Protection Agency, Cincinnati, OH, (in preparation) (1980).

OIL RECOVERY INTERNATIONAL
Tukton Bridge
Christchurch
Dorset BH23 1JS
UK

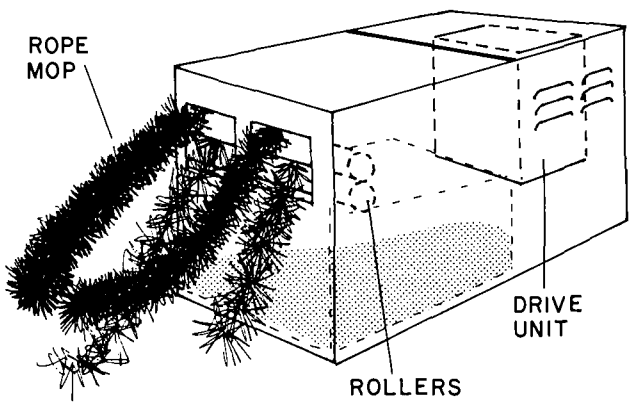
telephone Christchurch (44)(0202)486666
telex 41354 OILMOP G

MOP DRIVE/OIL EXTRACTION SYSTEMS
(Jaws 550, Piranha 1000, Barracuda 2000, Force Seven Ocean System)
Price upon request

COLLECTION PRINCIPLE

The spilled oil adheres to polypropylene rope mops which are then squeezed by drive rollers. The recovered product is transferred to separate storage facilities.

PIRANHA 1000



PHYSICAL SPECIFICATIONS

	Jaws 550	Piranha 1000	Barracuda 2000	Force Seven
Length (m)	0.42	0.92	1.54	4.5
Width (m)	0.40	0.54	0.72	2.43
Height (m)	0.56	0.62	0.87	2.00
Weight (kg)	56.3	146	396	6 000
Materials of Construction	nylon-coated steel housing, polypropylene rope mop			
Mop Speed (m/min)	19	7 to 30	variable	variable
Mop Diameter (cm)	15	15	15/30	76
Power Unit	0.5 HP electric motor	1.5 HP 415 V, 3-phase motor	6.5 HP Petter diesel	80 HP Ford diesel
Optional Drives	pneumatic motor	gasoline, air, diesel, 220 V	air, 3 HP electric	--
Other Features	attaches to collection tank	trolley available	trailer, steam kit optional	explosion-proof systems
Storage Capacity (L)	--	34	187	flexible tanks 25 000 to 90 000
Pumps	--	--	1.25 cm Granco	2 Allweiler or Mono

MODE OF OPERATION

All systems are operated from a working platform. The 550 was designed for limited access spills, the 1000 for settling tanks, the 2000 for harbours, and the Force Seven for offshore applications. Storage facilities are required; an external power source is required with air and electric models.

PREDICTED PERFORMANCE

See also entries for Oil Mop Incorporated.

The rope mop concept has been comprehensively evaluated and has been found to perform well in a wide range of oil viscosities. The recovery principle allows operation in moderate wave conditions and in many forms of debris.

Although efficiencies will vary with mop speed and oil type, it can generally be expected that oil recovery rates will be higher in lighter oils than in heavier oils. The latter, however, should yield higher oil content in the recovered product. Jamming of the rollers and/or mop slippage may occur in very viscous fuels, i.e. Bunker C.

All smaller systems should operate most effectively in oil that has been contained and concentrated by a boom.

The main advantage seen for the Force Seven Ocean System is the intended application of a proven collection principle in an offshore environment using a single ship. Factors adversely affecting performance may include excessive vessel speed and interference, the batch nature and complexity of the deployment procedure, and mechanical difficulties. Crew experience and a comprehensive maintenance program would be vital to maximum utilization of the system and minimum "down time".

PREDICTED OPTIMUM APPLICATION

In light to heavy oils that have been contained and concentrated (except for Force Seven); will process oil in many forms of debris and in moderate wave conditions.

ADDITIONAL PERFORMANCE INFORMATION

Lynch, B.W.J., J.F. Nightingale and D.H. Thomas, Report on OPI Oil Recovery Equipment, The Barracuda and Piranha Machines Manufactured by Oil Recovery International, Christchurch, Dorset, Warren Spring Laboratory, Stevenage, UK, (1978).

OTHER DATA

The systems are also marketed by:

Star Offshore Services Ltd.
9 Henrietta Place
London, WIM9AG
UK

telephone (44)01-637 7881
telex 264989

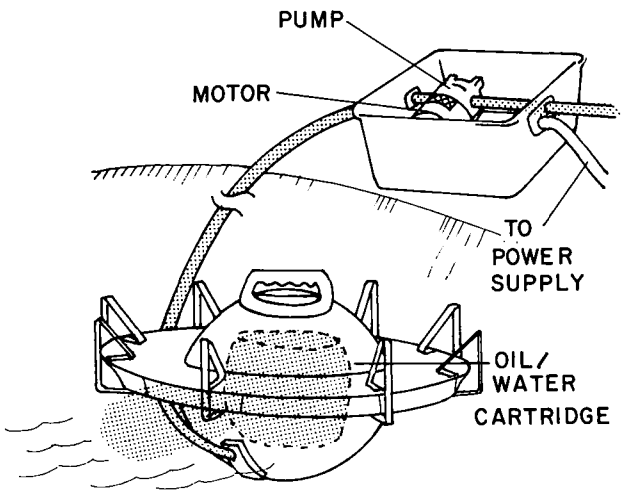
OIL RECOVERY SYSTEMS, INC
Main Street
Greenville, NH 03048
USA

telephone (603) 878-2500

SCAVENGER
Price upon request

COLLECTION PRINCIPLE

An oil/water separator cartridge allows the ingress of oil into a central sump. A level control automatically activates a remote pump to transfer product.



PHYSICAL SPECIFICATIONS

Diameter (cm)	44.5
Height (cm)	24.1
Draught (cm)	12.7
Discharge Hose Diameter (cm)	1.9
Weight (kg)	5
Materials of Construction	PVC body, fibreglass case
Drive	1/4 HP, 115 V AC, 4.2 A, 172 rpm explosion-proof motor
Pump	Roper 2 AMO3 pump with strainer
Other Data	the total system weighs 52 kg and is contained in a cubic case measuring 61 cm across. Various cartridges are available for different oil types

MODE OF OPERATION

The Scavenger was designed for well, ditch and groundwater oil recovery or other situations in which it can collect a seepage of oil over an extended period of time. Automatic pumping and shut-off systems allow for unattended skimming. The skimmer is highly portable; storage capacity must be preplanned and a power source secured.

PERFORMANCE

The Scavenger was evaluated on behalf of Environment Canada and the Petroleum Association for Conservation of the Canadian Environment during October 1976 in the St. Lawrence River at Quebec City. The following optimum results were obtained using diesel oil:

Air Temp. (°C)	Water Temp. (°C)	Wave Height (cm)	Oil Thickness (mm)	Oil Recovery Rate (L/min)	Oil Content (%)
10	12	0	4	0.47	100
12	12	0	10	0.38	100

This well-engineered, carefully constructed skimmer functioned as designed in both automatic and manual control modes. Comprehensive instructions allow its operation by untrained personnel. Recovery rate is relatively low as designed; however, product purity is high. Wave action results in a rolling movement of the skimmer which reduces efficiency.

Although not available at the time of testing, other cartridges should permit the recovery of a range of oil viscosities.

The skimmers has been widely applied to a variety of groundwater contamination problems and users report satisfaction with its performance. In particular, its small size has permitted access to difficult-to-reach places (wells, sewers, etc.) and prolonged skimming has been successfully conducted using the Scavenger without operator supervision.

OPTIMUM APPLICATION

In very light to medium viscosity oils that are contained or slowly accumulated; in calm, debris-free conditions; where access is limited and/or prolonged recovery of minor amounts of oil is required; will function in several millimetres of product.

ADDITIONAL PERFORMANCE INFORMATION

Abdelnour, R. et al., Field Evaluation of Eight Small Stationary Skimmers, Technology Development Report EPS 4-EC-78-5, Environment Canada, Ottawa, Ontario, (May, 1978).

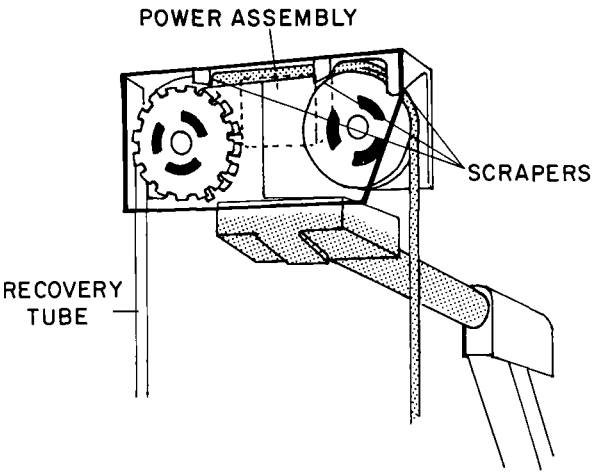
OIL SKIMMERS INCORPORATED
P.O. Box 33092
Cleveland, OH 44133
USA

telephone (216) 237-4600
telex 810 427 9130

MODELS 6-V, 5-H
(Brill Skimmers)
Price: 5-H $1 395 (U.S.)
6-V $2 625 (U.S.)
Plus motor and accessories
(effective 12-1-81)

COLLECTION PRINCIPLE

Oil preferentially adheres to a loop of sealed plastic tubing which moves over the water's surface. A series of scrapers associated with the drive assembly remove the collected oil which is then conveyed to storage.



PHYSICAL SPECIFICATIONS

	5-H	6-V
Length (cm)	71.6	50.8
Width (cm)	36.5	27.9
Height (cm)	31.4	45.4
Weight with Motor (kg)	29.5	56.7
Drive	1/2 HP, 1 725 rpm NEMA electric motor, models available in single- and three-phase, 60 Hz, from 115 V to 460 V, explosion-proof, fan cooled or non-vented	
Optional Equipment	balanced, cantilevered and angle frame mounts; decanting system and heat rod; spare parts package; cover and spout assembly for 6-V only	

MODE OF OPERATION

The drive/scraper unit is mounted as a permanent installation above the oil to be removed. The 6-V is designed for application to settling ponds and sumps while the 5-H can be utilized in tanks and vats. Both systems have been engineered for low removal rates and continuous operations; they could be applied to groundwater spills once a support stand, a power source and storage capacity have been arranged.

PREDICTED PERFORMANCE

No performance data are known to exist for the 6-V and 5-H Skimmers.

See also comments provided for Aerodyne Development Corporation Skimmer.

The company literature indicates that a comprehensive engineering effort has been expended in designing the skimming unit and support systems for the 5-H and 6-V models. The manufacturer states that recovery rates range from 38 L/h in light oil to 227 L/h in heavy oil. These values appear to be reasonable in comparison to the performance figures of other sorbent surface devices.

Although recovery rates are relatively low, oil content should approach 100% (depending upon the amount of water entrained with the oil). Wave heights of several centimetres should not impede the capability of the system but rather coat the tube more completely. Skimming in debris should be possible and operation feasible over a range of temperatures when used in conjunction with the heater system (at lower temperatures). Slippage of the drive mechanism should not be a problem due to the limited weight carried by the recovery tube.

A continuous presentation of product to the device would be necessary as well as operation in stationary, non-flowing conditions. Compatibility of the medium to which the skimming system is exposed is also necessary so that no deterioration of the collection tube occurs.

PREDICTED OPTIMUM APPLICATION

As a permanent installation; in a wide range of oil viscosities; in forms of debris that allow the tube to remain in contact with the oil; in low recovery rate operations; on a continuous basis.

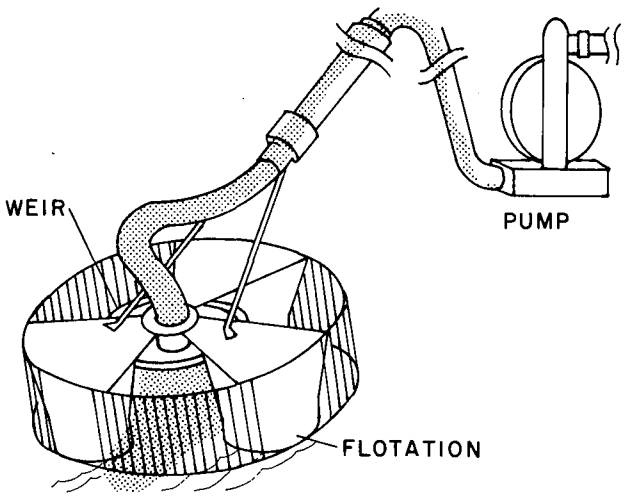
PARKER SYSTEMS INC.
P.O. Box 1652
Norfolk, VA 23501
USA

telephone (804) 543-0647

OIL HAWG
100 A
Price upon request

COLLECTION PRINCIPLE

A self-adjusting weir central to three supporting floats accepts product that overflows the weir lip. Transfer of the collected oil is made by remote pump.



PHYSICAL SPECIFICATIONS

Diameter (cm)	109
Height (cm)	41
Draught (cm)	20 - 25
Discharge Hose Diameter (cm)	5
Weight (kg)	17
Material of Construction	aluminum
Pump Unit	M-8-P aluminum double diaphragm air pump, 680 kPa, 566 to 2 265 L/min; self-priming centrifugal pump also available
Debris	strainers 1.3 cm mesh (for light oil) and 5 cm x 20 cm screen (for heavy oil)
Additional Features	4.6 m control arm is standard

MODE OF OPERATION

The skimming head is lightweight and portable but requires an air compressor or other pump/motor combination for operation. The unit has been designed for oil collection in a contained area while being operated from shore, a pier, or other working platform. Storage/separation capacity must be planned.

PREDICTED PERFORMANCE

No performance data for this skimmer are known.

See also Industrial and Municipal Engineering Oela III.

The Oil Hawg should perform well in light and medium viscosity oils, i.e. in situations where product flows unimpeded over the adjustable weir and then can be readily suctioned off to storage. Performance likely will decline in heavier oils. The device will also be less efficient in moderate wave conditions although the outrigger flotation units should generally provide a stable skimming arrangement.

Highest recovery rates should be realized in substantial slick thicknesses and in debris-free conditions. While the strainers will prevent items from entering the system, they are likely to clog in the presence of substantial quantities of debris.

Water content of the collected liquid is likely to be relatively high, particularly in thinner slicks; separation facilities may be required. The double diaphragm pump should not emulsify collected oil and water to a large degree; gravity separation should thus be possible.

Overall, the portability of the skimming head, choice of pump, inclusion of control arm and self-adjusting nature of the weir should all contribute to satisfactory performance. The availability of an air compressor and its ability to function in cold weather (should that be a factor) are also prime considerations.

PREDICTED OPTIMUM APPLICATION

In light and medium viscosity oils contained in significant (1 cm and more) thicknesses; in debris-free, calm water; with storage /separation capacity.

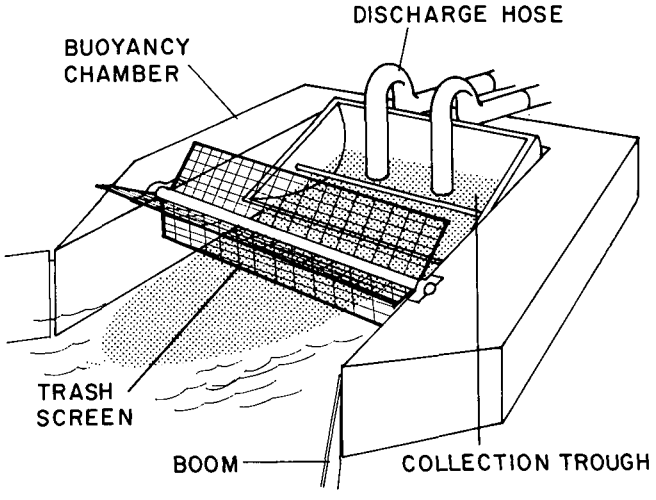
PEMBINA EQUIPMENT DESIGN CO. LTD.
P.O. Box 1994
Drayton Valley, Alberta T0E 0M0
Canada

telephone (403) 542-5518

PEDCO SKIMMER
Price upon request

COLLECTION PRINCIPLE

Two pontoons support between them a self-levelling weir over which product flows. The product collects in a trough which forms the aft section of the weir, and from there is transferred to storage by remote pump.



PHYSICAL SPECIFICATIONS

	Four-Foot Model (1.2 m)	Eight-Foot Model (2.4 m)
Overall Length (m)	1.68	1.68
Overall Width (m)	1.96	3.15
Overall Height (m)	0.79	0.79
Weir Width (m)	1.22	2.43
Draught (cm)	10	10
Suction Hose Diameter (cm)	7.6	unspecified
Weight (kg)	55	83
Material of Construction	aluminum in both models	
Debris	unique three-sided screen available	

MODE OF OPERATION

The PEDCO skimmers function in either stationary or flowing conditions. In the case of the latter, booms attach to either side of the unit and direct product into the weir. The pumping rate determines the angle at which the collection trough sits so that either more or less oil is removed (depending on slick thickness). Storage/separation facilities should be planned.

PERFORMANCE

Testing of the Four-Foot PEDCO was undertaken in October 1976 in the St. Lawrence River on behalf of Environment Canada and the Petroleum Association for Conservation of the Canadian Environment. Optimum results were as follows:

Air Temp. (°C)	Water Temp. (°C)	Wave Height (cm)	Current (kn)	Oil Type	Oil Thickness (mm)	Oil Content (%)	Oil Recovered vs Oil Encountered (%)
15	14	0	0.5	crude	14	21.6	94.2
16	13.5	0	0.8	diesel	1	4.4	28.2
16	14	0-3	0.9	emulsion	5	10.2	6.6

Crude: Iranian, API Gravity 30° to 43°

Diesel: blend, 0.020 to 0.043 cm^2/s at 15°C

Testing clearly demonstrated that the PEDCO functions best when encountering a substantial thickness of oil at a rate that is matched by the off-loading pumping rate. It is also evident that the machine can be used most effectively in calm, flowing conditions. Performance declines in slick thicknesses of only several millimetres and in waves that are 5-10 cm in height. Evaluation results suggest that oil/water separation and storage facilities are required for skimming a layer of oil less than 1-2 cm thick.

The main oil loss mechanism was attributed to underflow of the product resulting from the back buoyancy chamber being perpendicular to flow, and to excessive oscillation of the collection trough in wave conditions. These are factors which can largely be overcome by applying the device in limited wave and current situations. In the prototype device tested, it was apparent that ultimate fabrication processes, choice of tethering, lifting and connection hardware, as well as ballasting arrangements, had still to be selected.

Overall, this lightweight skimmer with one moving part seems to be ideally suited for the removal of spilled oil in rivers once sizing requirements have been clarified by the purchaser. Recovery rates will depend on the choice of pump.

OPTIMUM APPLICATION

In light and medium viscosity oils several centimetres in thickness; used in calm, flowing conditions in conjunction with booms; will process some debris; follow up with separation/storage capacity.

ADDITIONAL PERFORMANCE INFORMATION

Solsberg, L.B., W.G. Wallace and M.A. Dunne, Field Evaluation of Oil Spill Recovery Devices: Phase Two, Technology Development Report EPS 4-EC-77-14, Environment Canada, Ottawa, Ontario, (December, 1977).

OTHER DATA

A Two-Foot (0.6 m) PEDCO Ice Slot Skimmer has also been successfully tested in the recovery of oil from a slot cut in river ice. In addition, the company now markets the Mini Pedco which can be deployed in water, is also 0.6 m in width, and weighs 39 kg.

PETRO-FIBER, OLJESANERING, AB
Bokhallaregatan 35 D
S-211 56 Malmo
Sweden

telephone, telex unavailable

SORBENT DISTRIBUTION/ RECOVERY SYSTEM
Price upon request

COLLECTION PRINCIPLE

Commercial fishing nets are used to retrieve a fibrous polyethylene/paraffin wax sorbent.

PHYSICAL SPECIFICATIONS

Net:	mesh size variable, 5 to 30 mm
Sorbent:	paraffin base, fibrous polyethylene, melting point 95°C, oleophic properties

MODE OF OPERATION

The sorbent is broadcast onto the spilled oil; the fishing nets are deployed (by commercial fishermen) to retrieve the sorbent/oil mixture. Once recovered, the collected material is heated until the sorbent dissolves and the total liquid is then ready for refining. The oiled nets would be disposed of (and replacements provided). Appropriate storage facilities would have to be selected, such as open top tanks, etc.

PERFORMANCE

The Petro-Fiber sorbent system was evaluated at OHMSETT in August 1979 through a grant from the Swedish government. Oil barriers with net skirts (5, 10, 20 and 30 mm mesh) as well as a fishing net (12.5 mm mesh size) were applied in the tests. The sorbent was found to work well in both high and low viscosity oils. Performance improved in waves as greater contact between sorbent and oil resulted.

The 30 mm mesh net was judged to offer optimum performance since it allowed water to escape more easily than did the 5 through 20 mm mesh sizes. Very little water was collected with the sorbed oil; oil-to-sorbent ratios varied from 5:1 to 10:1 during the tests. (Generally, it has been found that hydrocarbon-derivative sorbents as well as wax-base products are effective in recovering spilled oil but limited because of the batch nature of the collection process and limited amounts of oil that can be sorbed using this method.)

The Petro-Fiber system experienced some difficulties with material bridging in the broadcaster which "can be corrected by redesign", particularly with a view to increasing sorbent broadcast rate.

Overall, the trials served to demonstrate the utility of the sorbent in taking up oil and the feasibility of heating the sorbent/oil mixture to recover the oil. Specific recovery procedures, storage requirements and refining methods were recommended as items requiring further research.

OPTIMUM APPLICATION

In medium and high viscosity oils; in moderate wave conditions; in concentrations of oil several millimetres and more; net mesh size 30 mm.

ADDITIONAL PERFORMANCE INFORMATION

Dr. Bertril Brandin
Petro-Fiber Oljesanering AB
Bokhallaregatan 35 D
S-211 56 Malmo
Sweden

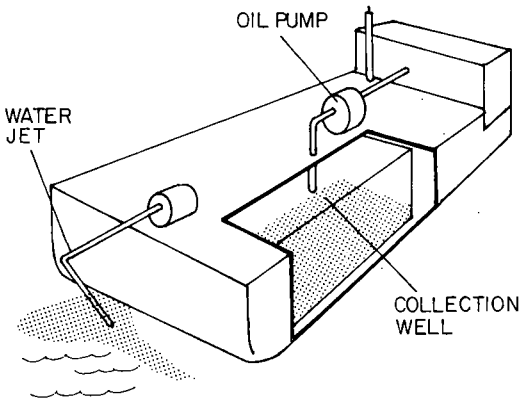
PRICE-DARNALL OF ALABAMA INC.
2962 Demetropolis Road
Mobile, AL 36609
USA

telephone (205) 661-6612

PUP MACHINE
Price upon request

COLLECTION PRINCIPLE

A simple weir mounted between the hulls of a catamaran accepts product directed to it by the current created by water jets.



PHYSICAL SPECIFICATIONS (three models available)

	E-24	D-24	D-64
Length (m)	1.83	2.44	4.88
Beam (m)	1.52	1.52	2.44
Height (cm)	173	173	173
Draught (cm)	10.2	15.2	20.3
Weight (kg)	113	249	544
Power Unit	1 HP diesel	Lister diesel power pack	Lister diesel power pack
Pump	Gorman Rupp 811	Gorman Rupp 82D2	Gorman Rupp 83B2

MODE OF OPERATION

The skimmers are operated in stationary slicks, preferably contained by oil barriers. Where power packs are involved, these would be operated from a suitable adjacent working platform and product directed to storage. Crane launching is required and an off-loading pump must also be obtained.

PREDICTED PERFORMANCE

No evaluation data are known for the PUP machine.

Water jet enhancement systems are present in a variety of forms including the nozzle array and baffle system of Agar Corporation's OS-100 and the water/jet collection chamber of Skimovex B.V.'s Skimjet. All such machines are dependent upon the action of the water stream to direct liquid into a recovery area where further oil/water separation can take place followed by the off-loading of the oil phase. The characteristics of the water jet are therefore important to the efficiency of the operation which will depend upon the pressure of the spray, its configuration, the angle at which it strikes the water's surface and its areal influence.

In the case of the PUP machine, the simple weir will likely accept significant volumes of water overflowing the weir. Oil content in the recovered liquid is likely to be further reduced by wave activity or a significant relative velocity between the oil and the skimmer (probably in excess of 0.5 kn). Both conditions would serve to disrupt the continuity of the surface layer of oil contacting the weir.

Performance should prove to be highest in non-flowing situations where significant thicknesses of oil have accumulated and interference from debris is unlikely. Overall, the simplicity of the design is appealing; however, the water jet system as a means to improve stationary weir skimming has yet to be proven.

PREDICTED OPTIMUM APPLICATION

In light to medium viscosity oils contained in thicknesses 1 cm and more, as stationary pools; in calm, debris-free water.

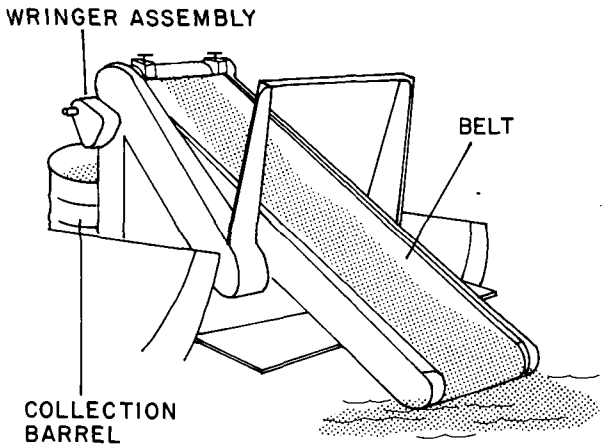
R.B.H. CYBERNETICS (1970) LTD.
P.O. Box 4205
Postal Station A
Victoria, British Columbia V8X 3X8
Canada

telephone (604) 478-3122

SLICKLICKER
(Oleovator)
Price upon request

COLLECTION PRINCIPLE

An inclined sorbent belt is rotated when immersed at its lower end in oil. Product clinging to the belt is removed by a wringing mechanism and then deposited in containers provided for this purpose.



PHYSICAL SPECIFICATIONS

Belt	Length (cm)	975
	Width (cm)	85
	Material	canvas-backed terry cloth
Conveyor Boom	Length (cm)	457
	Width (cm)	100
	Material	steel
Drive Unit	8 HP gasoline Briggs and Stratton engine, hydraulic drive	
Total Weight (kg)	680	

MODE OF OPERATION

The Slicklicker is usually mounted at the bow of a suitable vessel so that is can be quickly transported to the spill site. The belt is then lowered into stationary oil contained by a boom and recovered product directed into open drums or other containers placed beneath the upper end of the belt. The system has been designed for operations in harbours and coastal regions.

PERFORMANCE

Testing was conducted on behalf of Environment Canada in 1975 with the following results:

Air Temp. (°C)	Water Temp. (°C)	Wave Height (cm)	Belt Speed (m/s)	Oil Type	Oil Thickness (mm)	Oil Recovery Rate (L/min)	Oil Content (%)
3	2	0	0.70	crude	5	3.5	9.3
3	2	0	0.47	emulsion	5	11.3	30

These limited test results serve to indicate performance trends and are not representative of the optimum capability of the Slicklicker. A belt speed must be selected so that maximum contact with the product is allowed while not either driving away oil on the surface or entraining it. Slower belt speeds (0.15-0.5 m/s) seem to be best. The higher the viscosity of the oil and the thicker the layer of the slick, the more efficiently the machine operates. Additional testing and field use have also indicated manual assistance of product/belt contact and stationary deployment under calm conditions in residual fuels such as Bunker C are desirable operating factors. Recovery rate has been found to be independent of the depth of extension of the belt in the oil. The skimming component's capability to function in waves is primarily a function of the vessel on which it is positioned.

Design and construction studies of the Slicklicker have focussed on further performance improvements. Modifications have been suggested including the choice of belt material and drive mechanism, the incorporation of a squeeze/roller assembly, addition of a heat exchanger, single point lifting hardware, relocation of gas tank, as well as other changes related to specific engineering details.

Overall, the Slicklicker continues to be extensively applied to spills in Canadian waters, particularly for heavy fuels contained by boom. It functions best in protected waterways and will process many forms of debris.

OPTIMUM APPLICATION

In viscous oils contained as stationary pools; in calm conditions; manually attended for oil pickup and debris conveyed by the belt; storage capacity must be arranged.

ADDITIONAL PERFORMANCE INFORMATION

(1) Solsberg, L.B., C.W. Ross, W.J. Logan and M.F. Fingas, Field Evaluation of Seven Oil Spill Recovery Devices, Technology Development Report EPS 4-EC-76-3, Environment Canada, Ottawa, Ontario, (October, 1976).

(2) Wallace, W.G. and C. Banks, Report on the Design and Construction of Modifications to the Slicklicker Oil Skimmer, Environment Canada, Ottawa, Ontario, (March, 1980) (unpublished).

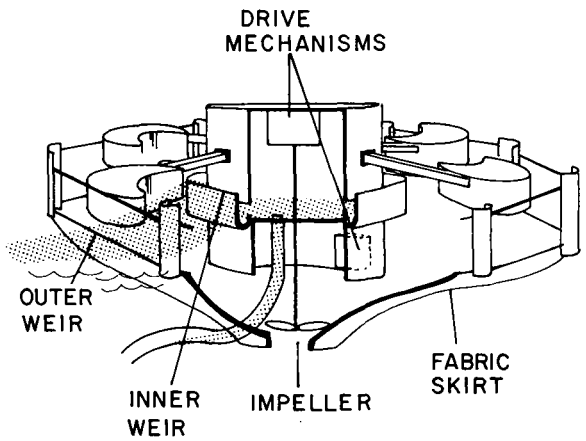
REYNOLDS SUBMARINE SERVICES CORP.
P.O. Box 27002
Richmond, VA 23261
USA

telephone (703) 282-2301

MEDUSA SYSTEM
Price upon request

COLLECTION PRINCIPLE

Oil and water overflow an outer flexible circular weir with the oil flowing over an inner weir and concentrating in a central sump. The water is forced out an exit port in the skimmer bottom by an impeller while an on-board transfer pump conveys the concentrated oil to a remote storage point. Both weirs are self-adjusting.



PHYSICAL SPECIFICATIONS

Overall Diameter (m)	5.5
Approximate Height (m)	1.5
Draught (m)	1.37
Discharge Hose Diameter (cm)	7.6
Weight (kg)	1 134
Materials of Construction	marine-grade aluminum alloy; oil-impermeable fabric skirt
Power Unit	optional electric, air and gasoline engine drives available (HP, make, etc. unspecified)
Debris	screen included (removable)

MODE OF OPERATION

Both the size and construction of the Medusa suggest nearshore as well as offshore applications. As a stationary skimmer, the device must be deployed by crane into a slick contained and concentrated by oil booms. Drives for both the water impeller and oil transfer pump are housed in a central flotation core so that only an external source of power is required. Storage facilities would also have to be preplanned to accept recovered product.

PREDICTED PERFORMANCE

No evaluation data are known for the Medusa system.

See also entry for Alsthom Atlantique Cyclonet S.

Testing of a similar concept by Environment Canada (see above reference) revealed that the continuous removal of water largely determines whether or not the ingress of oil will take place as intended. The formation of a vortex is probably not as important as ensuring the smooth flow of the oil phase over the weirs. In the case of the Medusa Skimmer, the device offers advantages over similar units (simple vortex-forming machines) in that it incorporates self-adjusting weirs which should substantially increase the oil content of the collected liquid. (Other vortex skimmers either feature a simple weir or a chamber where oil is supposed to collect and be drawn off to storage.) The Medusa's configuration of flotation elements should result in the skimmer remaining stable in small wave conditions and thus contribute further to optimum functioning of the hydro-adjustable weirs.

As with other vortex or weir skimmers, performance will probably be reduced in breaking waves, thinner slicks and debris infestations. Shorter-period waves (harbour chop conditions) can be expected to curtail the ability of the impeller to draw oil from any significant distance, say several metres, beyond the skimmer. The location of the transfer pump on-board the system and below the collection sump should facilitate the oil transfer process.

Overall, the Medusa appears to be a comprehensively designed system incorporating a series of collection components aimed at maximizing oil content (two adjustable weirs, flow enhancement vanes, water removal, inner sump with pump, stabilizing floats, etc.). Compared with most smaller skimmers, the oil pathway/processing mechanism is much more complex in the Medusa. With an appropriate schedule of maintenance and operation training, the skimmer should function satisfactorily.

PREDICTED OPTIMUM APPLICATION

In light to medium viscosity oils contained as slicks 1 cm and greater in thickness; in debris-free, calm conditions.

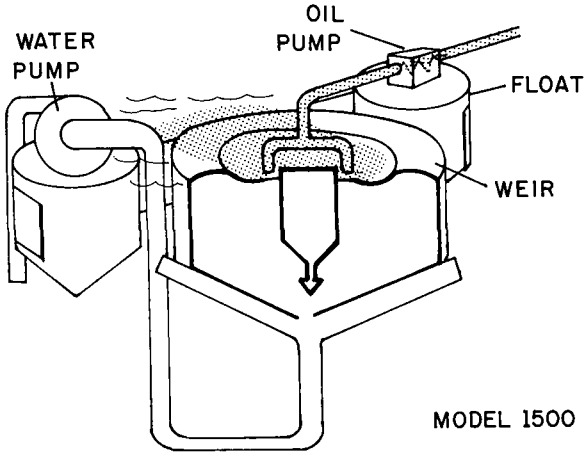
RHEINWERFT GmbH & CO.
6500 Mainz 25
Postfach 3
West Germany

telephone (0 61 31) 4 60 57
telex 04-187736

OIL REMOVAL PLANT
Price upon request

COLLECTION PRINCIPLE

A water pump draws oil into a floating open top chamber supported by three floats by lowering the water level within the chamber. A second remote pump is then used to suction off the surface layer of oil that collects in the skimming head.



MODEL 1500

PHYSICAL SPECIFICATIONS

	500	1000	1000A	1500	1500A	3000
Overall Diameter (cm)	170	300	300	450	450	900
Well Diameter (cm)	50	100	100	150	150	300
Draught (cm)	60	90	130	130	150	250
Weight - with Pumps (kg)	420	600	850	1 800	2 000	10 000
Materials of Construction	steel covered with oil-resistant paint					
Water Pump (kW)	1.5	1.5	1.5	4.0	4.0	7.5
Type	all units have centrifugal water pumps					
Oil Pump (kW)	0.36	0.36	0.75	2@1.1	2@1.1	2@2.5
Type	model 500 has piston oil pump; all other models have eccentric screw pump automatically operated					
Power Unit	air-cooled Deutz diesel engine, Polyma Generating Set (in various sizes) 220/380 V, 50 Hz					
Debris Grill	present in 1500 and 3000 series skimmers only					

MODE OF OPERATION

The skimming head is positioned in contained concentrated oil and connected to the remote power source drive package. The water pump is then actuated until sufficient oil accumulates so that product off-loading can occur. The skimming system has been designed in various models for harbour and coastal operations in a range of wave conditions. Crane launching and separate storage capacity are required.

PREDICTED PERFORMANCE

No performance data are known to exist for the Rheinwerft skimmers.

Performance of the skimmers will likely be highly dependent upon matching the flow rates of the two pumps (oil and water transfer units). Rates would have to be selected that allow the collection of a liquid high in oil content. Otherwise, the collection of much water and subsequent mixing by the oil recovery pump may occur.

Although the flotation system appears to offer good stability to the skimmer, it is anticipated that moderate wave activity will interfere with the oil collection process. This would occur as the surface layer of oil drawn toward the skimmer would be disrupted. Waves could conceivably also result in excessive volumes of water overflowing the weir lip. Interference by debris could also prove troublesome in the smaller models.

Overall, the skimmers appear to be rugged in design, and the choice of pumps and drives appropriate for their application. Like most weir systems, the Rheinwerft skimmers probably best apply to less viscous products that easily pass over the weir lip and that have been previously contained and concentrated by oil booms.

PREDICTED OPTIMUM APPLICATION

In light to medium viscosity oils contained by boom; in debris-free, calm water; with storage/separation facilities; operated at preselected oil and water pumping rates.

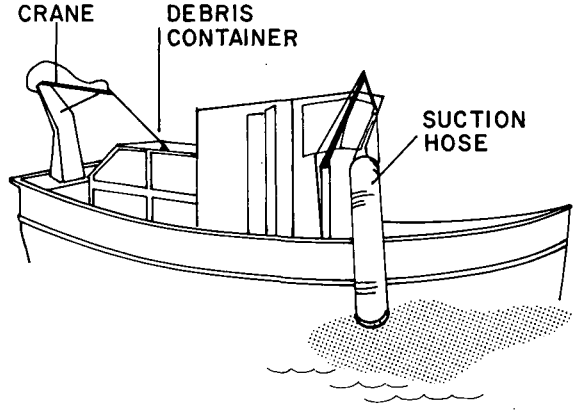
SAMSEL ROPE AND MARINE SUPPLY
Pollution Recovery Systems Division
1310 Old River Road
Cleveland, OH 44113
USA

telephone (216) 241-6318

SAMSEL RECOVERY SYSTEM
Price upon request

COLLECTION PRINCIPLE

A simple suction hose attached to a vacuum system is used to skim oil and smaller forms of debris; a crane assists in the recovery of larger oily solids.



PHYSICAL SPECIFICATIONS (recovery vessels)

Overall Length (m)	17
Beam (m)	4.3
Height (including mast) (m)	4.6
Maximum Draught (m)	1.4 (empty) to 1.7 (loaded)
Maximum Weight (kg)	9 070 (dry) to 18 140 (loaded)
Storage Capacity	7 571 L (liquid), 9.2 m^3 (solids)
Power Units	185 HP main diesel engine, twin 150 HP auxiliary diesel engines
Pumping Systems	Gorman Rupp 10.2 cm trash pump plus main engine-driven vacuum system (unspecified)

MODE OF OPERATION

The recovery vessel is a self-contained oil collection system that is usually used in conjunction with 152 m of oil barrier. Product would first be contained and concentrated with the use of smaller vessels, and the main vacuum suction hose then placed in the slick and skimming commenced. The Samsel system has been designed for harbour and coastal operations. In the case of a larger spill, additional storage capacity would be required due to the potentially high suction rates and relatively limited on-board holding facilities.

PREDICTED PERFORMANCE

The Samsel is a relatively unique system marketed as a vessel/vacuum recovery package. No performance data are known for the unit.

A vacuum system has been evaluated at OHMSETT (see entry under Industrial and Municipal Engineering). Based on the U.S. test results, it is likely that the Samsel equipment will yield maximum oil recovery rates in thicker slicks of contained oil that is relatively low in viscosity (up to several cm^2/s). Hose length, oil viscosity and slick thickness should not, however, significantly alter the oil content in any collected liquid. This would probably be more a function of vacuum blower speed. The U.S. tank trials also suggest that the addition of a simple weir to the suction inlet could significantly raise the oil/water ratio (a factor of two was realized in the test program). The Samsel appears to be designed specifically for the recovery of spilled oil and debris and should be well suited for such application.

While Samsel's permanently boat-mounted vacuum system does not provide the versatility of a vacuum truck (which can be operated from a barge and also travel on land), it does offer quicker response, more manoeuverability and better access to slicks in harbours. A usual configuration of a self-contained vacuum or suction vessel is in barge-form (as available from local cleanup contractors), thus offering the advantage of higher storage capacity.

An average expected oil recovery rate for the Samsel vessel (with 7.6 m^3 storage capacity) would be about 2-5 m^3/h (in thicker slicks), thus allowing its operation for 1.5-4 h. Any water pickup and subsequent mixing would further reduce its operating time. Overall, the concept is appealing as a dedicated harbour craft where a more frequent or chronic pollution problem exists.

PREDICTED OPTIMUM APPLICATION

In light to medium viscosity oils contained in thicknesses of 2 cm or more; in calm water; with the addition of a weir skimming head; will process some debris when used as an open hose suction device; at higher blower speeds.

SANDVIK CONVEYOR CANADA LTD.
5675 Royalmount Ave.
Montreal, Quebec H4P 1K3
Canada

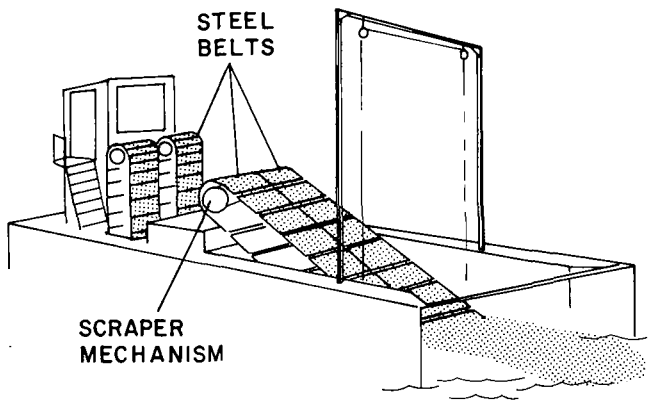
telephone (514) 735-1341
telex 05-267506

SANDVIK
Belt Skimmer 200 & 400
Piranha
Price upon request

COLLECTION PRINCIPLE

An endless steel conveyor belt is rotated through oil which adheres to it. A scraper system removes the collected oil from both sides of the belt from which point it is conveyed to storage.

PIRANHA



PHYSICAL SPECIFICATIONS

	200	400	Piranha
Overall Length (m)	0.73-4.28	2.5-5.5	12.19
Overall Width (m)	0.50	0.54	4.86
Height (m)	--	--	5.35
Belt Width (m)	0.20	0.40	5.35
Maximum Draught (m)	--	--	1.1
Belt Speed (m/min)	7 to 10	25 maximum	variable
Weight	variable	variable	15 tonnes
Materials of Construction	stainless steel belt, steel support (hull) structure		
Power Unit/Drive	0.18 kW electric source	0.35 kW electric source	Perkins 4.236 m marine diesel; 81 HP/43 A generators

MODE OF OPERATION

The Belt Skimmer 200 is designed for permanent installation vertically or in the inclined position as a continuous oil processor. The 400 Skimmer can be similarly applied as a fixed oil removal device or installed on a vessel for remote oil spill operations. An external source of electricity is required for both the 200 and 400 units. The Piranha is a self-contained oil collection vessel that converts to a multi-purpose working platform. It has been designed for use in lakes and harbours as an advancing oil recovery machine.

PREDICTED PERFORMANCE

No performance data are known for the Sandvik.

See Aerodyne Development Corp. for remarks pertinent to the Belt Skimmers 200 and 400. Refer also to R.B.H. Cybernetics (1970) Ltd. Slicklicker for comments which are of relevance to the Piranha Skimmer.

Manufacturer's claims in the case of the 200 and 400 Skimmers of recovery rates of 0.15-1.0 m^3/h are reasonable to expect for a permanent oil collection process in a sump or separator effected by a rotating endless belt. Products with a wide range of viscosity will adhere to the stainless steel; however, the more viscous oils will require some form of heating for stripping from the belt at temperatures approaching or below the pour point. Since waves are not likely to be a factor and the belt can function in debris, the main concern would be to ensure continuous contact between the belt and the oil. In this regard, wind might be a consideration due to herding of product away from the belt.

The Piranha Skimmer should also be capable of recovering a wide range of oils but would likely require the input of additional energy for the removal and transfer of very viscous products. It is anticipated that in the advancing mode the main oil loss mechanism would be due to the entrainment of product under the belt. (Forces imparted by the belt to the oil as it advanced could cause these losses.) Performance might also decline in wave conditions that would either create splash at the belt/water interface or result in excessive vessel pitch or roll. Vessel speed could affect collection efficiencies so that, for example, at higher relative velocities performance would decline. Stationary recovery operations with the Piranha should be possible as well as the collection of debris, particularly with manual assistance.

PREDICTED OPTIMUM APPLICATION

In light to heavy oils; in calm water, in most forms of debris; as fixed installations or when advanced (in the case of the Piranha and 400 systems) at speeds of about 1 kn.

OTHER DATA

Contact information for the Canadian member company is given. Manufacturing centres operated by Sandvik exist in the U.S., in European countries and elsewhere.

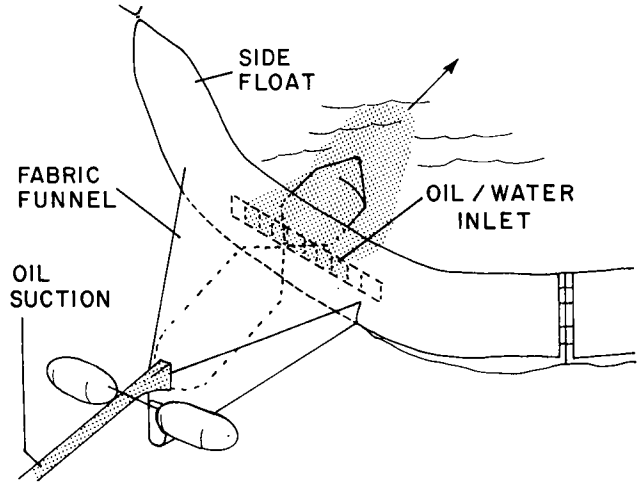
SAPIENS
23-27 Avenue de Neuilly
F-75116 Paris
France

telephone (33)(1)745 23 52

SIRENE OIL RECOVERY SYSTEM
Price upon request

COLLECTION PRINCIPLE

Oil is concentrated by an inflated boom which directs product through an inlet at its apex and into a narrowing funnel. At the rear of the funnel, a suction box accepts the oil which is then pumped to storage remote from the skimming system. Water leaves through a large, lower exit port.



PHYSICAL SPECIFICATIONS

Overall Length (m)	36.50	Total Weight (kg)	1 030
Length of One Wing (m)	14.50	Weight of Wings/Hose (kg)	340
Length of Centre Section (m)	7.50	Weight of Centre Section (kg)	260
Maximum Static Depth (m)	1.35	Weight of Pump Unit (kg)	320
Maximum Skirt Draught (m)	0.45	Weight of Tow Chain (kg/m)	3.5
Maximum Freeboard (m)	0.85	Inflation Pressure (kPa)	0.20
Diameter of Wing Floats (m)	0.70		
Diameter of Central Float (m)	0.50		
Diameter of Second Stage Float (m)	0.42		
Materials of Construction	flexible fabric boom; aluminum suction box and floats; nylon tension member		
Pumps	two Wilden M-15 double-acting diaphragm pumps; 11 cm discharge hose; drive unspecified		

MODE OF OPERATION

Two towing vessels are required to advance the Sirene System through an uncontained slick. The vessels also serve as platforms for the pumps and for collected oil storage. The length of the ballast chain is adjustable so that the degree of concavity of the boom under tow can be selected, i.e. higher tow speeds = smaller curvature. The size and design of the system suggest offshore and coastal applications although manual launching is possible.

PERFORMANCE

Evaluation of the Sirene was undertaken in July 1979 at OHMSETT with the following best results for 43 trial runs:

Heavy Oil ($7.00\ cm^2/s$ @ 28.8°C; S.G. 0.936)	Tow Speed (kn)	Wave Height (m)	Medium Oil ($2.00\ cm^2/s$ @ 28.8°C; S.G. 0.927)	Tow Speed (kn)	Wave Height (m)
Oil Recovered vs Oil Encountered = 100%	0.75	0	Oil Recovered vs Oil Presented = 99%	0.75	all
Oil Content = 67.7%	1.25	0.7	Oil Content = 62%	1.25	0.7
Oil Recovery Rate = 50.8 m^3/h	1.25	0.7	Oil Recovery Rate = 51.9 m^3/h	1.25	0.7

The 0.7 m wave generated was a short period "harbour chop".

Highest values of the three performance parameters measured were consistently obtained in wave conditions with the exception of the test noted. System saturation was never achieved so that still higher values are possible.

The substantial cylindrical flotation and concave skirt design were cited as reasons for no splashover and absence of device heave (constant freeboard) in wave conditions at various tow speeds. Slick thickness determined oil recovery and oil content but not the percentage of oil collected vs oil encountered.

Performance was found to be limited due to oil entrainement at about 0.75 kn at the attachment points between the side units and rear (collection) section, at the large floats at the sides of the inlet, and through the water discharge port. Entrainement also resulted with the buildup of product both in front of and directly in the inlet due to limited pumping capacity and low flow rates in the suction box.

Few mechanical difficulties were encountered although adhesive failure at a seam perhaps due to immersion in oil required attention.

The most noteworthy increase in performance was obtained by directing to the device a slick the width of the collection system thus avoiding losses due to the entrainment of oil at attachment points and floats as specified above. Fourfold increases in performance were achieved.

OPTIMUM APPLICATION

In medium to heavy oils at tow speeds of 0.75 kn and less; in moderate wave conditions; in slick thicknesses of several centimetres; in debris-free water.

ADDITIONAL PERFORMANCE INFORMATION

Lichte, H.W. et al., Performance Testing of Four Skimming Systems, U.S. Environmental Protection Agency, Cincinnati, OH, (in preparation) (1980).

OTHER DATA

Device availability should be verified.

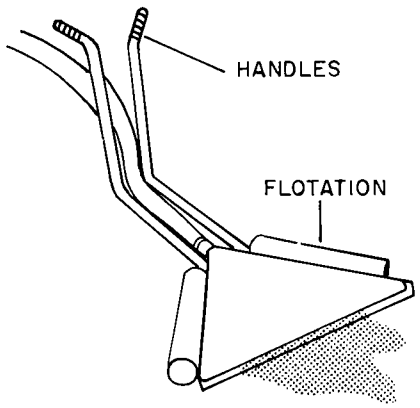
SCAN COMB LTD.
Borgundveien 83
Alesund
Norway

telephone (071) 24-486
telex 42 769 SCANC

SKIMMINI
SKIMMY
SKIMMAX
Price upon request

COLLECTION PRINCIPLE

A floating simple weir accepts product overflowing the weir lip. A remotely located pumping unit effects collection and transfer.



PHYSICAL SPECIFICATIONS

	Skimmini	Skimmy	Skimmax
Weir Diameter (cm)	60	100	200
Discharge Hose Diameter (cm)	3.8	5.1	6.4
Valve (cm)	3.2	3.8	5.1
Power/Pump Unit	pumps up to 7.6 cm	suitable pumps and vacuum trucks	

MODE OF OPERATION

The skimmers are designed with extended handles and flotation so that operation is possible both from shore and from water-based working platforms. The spill should be contained by booms and the skimming head positioned within the concentrated oil. A pump or vacuum truck provides suction to the skimmers, with control achieved by a valve in the intake line. Launching can be readily accomplished by two persons in the case of the Skimmax, and by one person for the smaller models.

PREDICTED PERFORMANCE

No test data are known to exist.

See also entries for the Acme Products Company skimmers.

The Scan Comb Ltd. skimmers were specifically designed to function in conjunction with vacuum trucks or smaller pumping systems. Their use thus is intended for minor incidents or where accumulations of oil along

the shore or in a harbour have resulted following a larger oil release. Like other simple weir systems, the Scan Comb devices will probably perform best in calm conditions and in less viscous oil that has been previously contained and concentrated by a boom. Factors adversely affecting the machines' efficiency are likely to include interference from debris, small breaking waves and the uptake of significant volumes of water (unless slick thicknesses of several centimetres are involved).

Other more specific comments on the equipment can be made with respect to its handling. The 7.6 cm discharge hose may create some problems insofar as its bulk and the manoeuverability of the device are concerned. Provision will thus have to be made so that it does not snag, that support is provided, and/or that adequate flotation is assured. The supporting handles are unique and would appear to be only suited where shallow areas are being cleaned and the skimmer can be manually directed by personnel walking it through the contaminant.

Overall, the Skim- products seem to be ruggedly constructed, simple in design, and should complement and improve upon open-ended hose skimming.

PREDICTED OPTIMUM APPLICATION

In light to medium viscosity oils contained as a layer several centimetres in thickness; in debris-free, calm conditions; when used in conjunction with a vacuum truck; in shallow water areas.

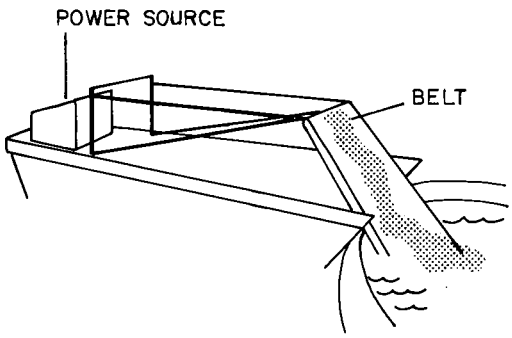
SCANDINAVIAN OIL SERVICE
Stora Badhusgatan 20
S-411 21 Gothenburg
Sweden

telephone (46) (031) 17-85-30

SOS CONTINUOUS OIL SKIMMER
Price upon request

COLLECTION PRINCIPLE

Oil adheres to a rotating sorbent belt which is then scraped. Product either flows into a container or is pumped to a remote tank.



PHYSICAL SPECIFICATIONS (conveyor only)

Standard Length (m)	3 (or lengths to order)
Overall Width (m)	1.7
Belt Width (m)	1.5
Weight (kg)	250
Materials of Construction	coated nylon-reinforced PVC belt, coated steel frame
Power Unit	4.3 HP explosion-proof gasoline engine coupled to sprocket/chain drive on belt
Pump (optional)	eccentric screw unit with feed auger compatible with 4.3 HP drive; weight 80 kg
Other Data	non-reusable nylon-reinforced PVC collapsible containers also available

The conveyor belt is affixed towards one end of a suitable vessel. The belt is then placed in a slick contained by oil booms and the rotational speed controlled through a simple throttle. Collected product must be either transferred to an attendant facility or preplanned in the form of suitable containers to receive the oil as it is scraped from the belt. The system is designed for harbour and protected water applications; launching and use are dependent upon the selection of working platform.

PREDICTED PERFORMANCE

No evaluation data are known to exist for the SOS Skimmer.

See also entry for R.B.H. Cybernetics (1970) Ltd. Slicklicker.

The SOS appears to be typical of a number of conventional sorbent belt skimmers. As such, it should be capable of collecting a wide range of products while being positioned in a stationary, contained pool of oil. It is suspected that manual feeding of oil will assist in the oil removal process particularly where uncontinuous slicks are involved. While the machine should experience no difficulties in retrieving debris, manual attention would also be required as concerns its removal from the belt.

The factors which are believed to be significant to the skimmer's best performance are the absence of waves (which would cause interference at the water/belt interface), quiescent or non-flowing water conditions (so that there is no vortex formation nor the possibility of oil entrainment), and the application to more viscous products which would adhere to the sorbent surface. In the case of the latter, Bunker C might be recoverable by the belt but could cause equipment breakdown or other problems due to its weight and consistency particularly at lower temperatures. The batch nature of the collection process for this type of equipment also usually proves to be a factor limiting performance.

The SOS features a belt material highly suited to the task; it is attached via a positive-drive chain mechanism which should also prove of benefit to machine performance (the sprocket arrangement should be checked for its action in debris). Overall, the skimmer appears to be well-engineered and simple in design and construction.

PREDICTED OPTIMUM PERFORMANCE

In medium to highly viscous products contained by booms in significant thicknesses; in calm, non-flowing conditions; will process most forms of debris.

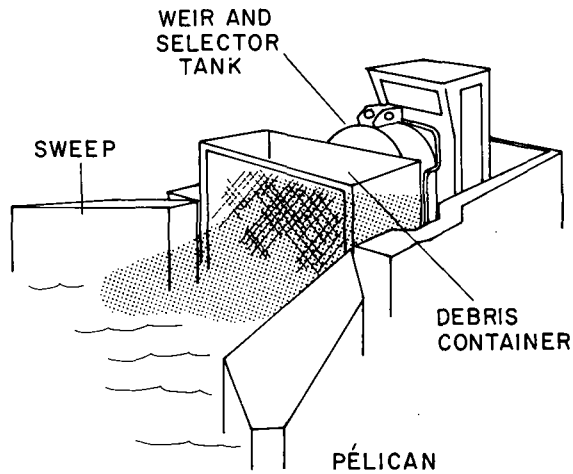
S.C.D. PELICAN S.A.
20-22, place du Château
78100 Saint-Germain-en-Laye
France

telephone (33) (1) 973-82 12
telex MTAINER 698 904 F

PELICAN HYDRAULIC OIL SKIMMER, GOELAND
Price upon request

COLLECTION PRINCIPLE

A suction head remains at a constant level of submersion to accept a floating layer of oil. Product is then conveyed to a tank under vacuum where further oil/water separation occurs. Water is suctioned off and the oil transferred to remote storage facilities.



PHYSICAL SPECIFICATIONS

	Pelican	Goeland
Length (m)	10.60	1.90
Width (m)	2.50	2.40
Height (m)	3.50	1.80
Draught (m)	0.90	0.30
Weight (kg)	8 200	150
Material of Construction	steel	
Main Engine and Drive	Renault Marine 140 D 6-cylinder diesel, 4 HP hydraulic engine	power unit unspecified - water pressure over 2 bars
Auxiliary Engine	CLM XDP 490 4-cylinder diesel	
Additional Features	the Pelican is available as a multi-purpose vessel capable of debris collection, oil recovery, aeration and weed cutting	

MODE OF OPERATION

The Pelican is a self-contained, self-propelled vessel capable of either chasing down slicks or operating in the static mode. The Goeland is a smaller oil recovery unit that functions through a water pressure line while positioned in a slick. Both skimmers require tankage external to the device proper for recovered product. They have been designed for use in sheltered waterways and require crane launching.

PREDICTED PERFORMANCE

No performance data are known.

See also summary for Global Oil Recovery Systems, Inc. DiPerna Sweeper (GORS No. 1). Based on the evaluation at OHMSETT of a device that operates on a similar principle, it can be expected that the S.C.D. Pelican Skimmers will operate optimally in calm conditions so that product is accepted by the suction head without due interference from reflected wave activity, splashover and excessive movement of the inlet. Water pumping rate is likely critical to machine performance. This would allow evacuation of the separator tanks and the ingress of oil so that a proper mass balance is maintained between product in and product out. Performance will probably decline in moderate wave conditions and at relative velocities between the skimmer and oil in excess of 1.5-2 kn. The main oil loss mechanism is predicted to be the entrainment of oil that occurs either due to carryunder in front of the inlet or through incomplete separation in the vacuum tank. While lighter oils will separate more quickly in the skimmer, the collection of medium to heavy viscosity oils should also be possible if present as discrete layers.

Overall, factors which will have a bearing on performance are the skimming action and wave response of the suction head, adequacy of power supply to provide optimum pumping rates, and residence time of product in the separation chamber.

PREDICTED OPTIMUM PERFORMANCE

In calm conditions; in light to heavy viscosity oils (excluding Bunker products) several centimetres in thickness; at relative velocities less than 1.5 kn.

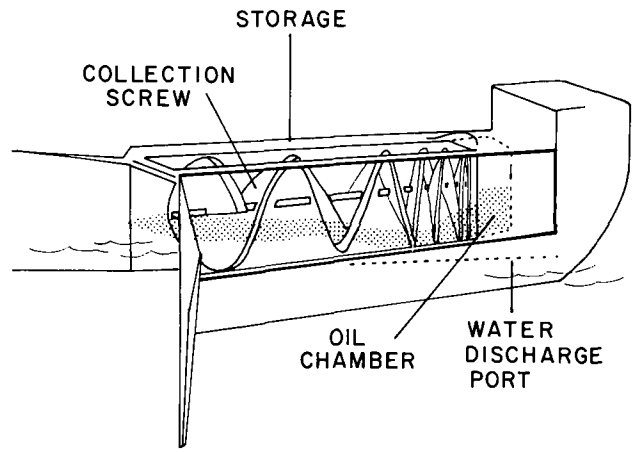
SEA CLEAN O.R.E. LTD.
Route de Riaz, 2
1630 Bulle
Switzerland

telephone (41) (029) 25757
telex 940060 SEA CH

SEA CLEAN SKIMMER
Price upon request

COLLECTION PRINCIPLE

Oil and water enter a multi-thread screw in a casing. The pitch of the threads progressively diminishes so that the oil phase thickens. It is then removed to storage by a pump from a chamber situated at the aft end of the screw. Water exits through an opening below the screw casing.



PHYSICAL SPECIFICATIONS (single collection screw boat)

Overall Length (m)	14.60
Beam (m)	12.10
Height (m)	3.95
Draught (m)	4.40
Displacement (tonne)	9.3
Collection Screw Diameter (m)	1.5
Approximate Screw Length (m)	7.10
Power Units	twin main diesels rated at 90 HP, auxiliary diesel engine unspecified
Pump	unspecified
Debris	screen included

MODE OF OPERATION

The recovery approach has been conceived for incorporation as a single unit in a smaller vessel, for attachment on either side of an amphibious vehicle, and as multiple, parallel units in a dedicated oil collection craft. The vessel would be manoeuvered through uncontained slicks in conjunction with deflector booms attached to either side of the skimming inlet. Product would be stored on board or in attendant vessels. Offshore and coastal operations are the intended areas of application of Sea Clean's oil removal devices.

PREDICTED PERFORMANCE

Although extensive laboratory work on concept development has been reported, independent test data on a prototype or production model have not been obtained.

The success of this unique approach will depend upon a distinct oil phase forming in the suction chamber at the aft end of the screw. The progressing cavity should convey product to the collection area, concentrating the oil as the space between the threads narrows. Factors limiting this desired performance might be related to initial interference at the skimmer inlet either due to the hydraulic effect of hulls or vessel non conformity due to waves and resultant splash. Oil entrainment could also result either as oil is drawn down before entering the screw or, once in the machine, below the screw casing at the point where water exits.

Optimum performance should be possible if a proper match of vessel speed (i.e. oil/water encounter rate) and screw velocity are maintained so that the oil entrainment phenomena are either minimized or eliminated. The existence of a well-defined surface layer of oil, whether thin or thick, should also contribute to maximizing performance if it is collected and finally concentrated as a distinct oil phase. Mixing energy of the screw should be minimal if it behaves similarly to other loose-tolerance progressing cavities. The processing of some debris should be possible.

In summary, wave conformity, a distinct slick, and mass balance of product in versus product out should result in an effective device.

PREDICTED OPTIMUM APPLICATION

In light to heavy oils, in thicknesses present as a distinct layer; in calm and moderate sea states; at relative velocities where the screw capacity matches or exceeds the encounter rate of product; operation in both the stationary or advancing modes should be possible as well as in a variety of debris forms.

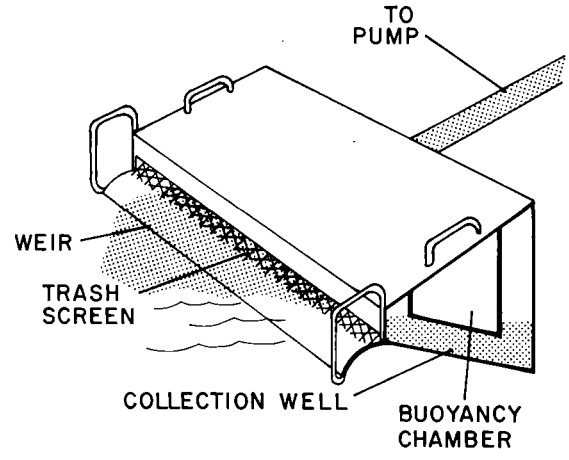
SEAWARD INTERNATIONAL INC.
6269 Leesburg Pike
Falls Church, VA 22044
USA

telephone (703) 534-3500
telex 899455

SLURP
Price: $1 495 (U.S.) in stainless steel;
$1 545 (U.S.) in aluminum
(effective 1-6-81)

COLLECTION PRINCIPLE

The Self-Levelling Unit for Removing Pollution (SLURP) incorporates a hydro-adjustable weir over which oil flows into a collection well. A remotely positioned pump controls the immersion depth of the weir and the collection rate.



PHYSICAL SPECIFICATIONS

	Aluminum	Stainless Steel
Length (cm)	93.5	93.5
Width (cm)	66.2	66.2
Height (cm)	26.7	38.1
Approx. Draught (cm)	12	25
Weight (kg)	16	26
Discharge Hose Diameter	3.8 cm (5.1 cm discharge port)	
Pump Unit	3.8 cm self-priming centrifugal pump, either electric powered or driven by a 3 HP Briggs & Stratton gasoline engine, is available	
Debris	screen outfitted	
Other Options	6 m positioning wand, debris fence, oil/water separator, collapsible storage container, etc.	

MODE OF OPERATION

The SLURP was designed for quick deployment into stationary, concentrated slicks. Collection rate is usually controlled by pump speed and a valve on the suction line. Single person deployment is possible; however, subsequent oil/water separation should be planned.

PERFORMANCE

Developed by the Esso Research Centre in the UK, a SLURP skimming head and a 7.6 cm Spate (induced flow) pump driven by a 3 HP Petter diesel were tested in situ on behalf of Environment Canada in early 1975. Optimum results obtained were as follows:

Air Temp. (°C)	Water Temp. (°C)	Wave Height (cm)	Test Medium	Oil Thickness (mm)	Oil Recovery Rate (m^3/h)	Oil Content (%)
3.2	1.5	10-15	crude	5	0.47	15.3
3.2	1.8	0	emulsion	10	1.42	23.7

Crude: Arabian, API Gravity 33.5°; viscosity 0.0604 cm^2/s @ 37.80°C

Emulsion: 70.5% water; viscosity 8.80 cm^2/s @ 20°C

The sea trials indicated the SLURP to be more effective in recovering thicker slicks of 1 cm and greater. The device functioned equally well in calm and moderate wave conditions although mixing of oil and water in the collection well was noted in waves. Subsequent emulsification of the oil and water was attributed to the action of the pump.

It was also noted that a more continuous procedure was possible with an oil that readily overflowed the weir. Otherwise, the thicker oil was not drawn away at a constant rate with the result that the weir immersed repeatedly to accept the underlying water. Operating limitations also related to the up and down (porpoising) motion of the skimmer due to excessively high pumping rates and a stiffened discharge hose at the temperatures tested.

Overall, the SLURP was determined to be a low-cost, portable unit capable of operating over a limited range of wave conditions but with a tendency to collect a relatively stable mixture of oil and water. As now marketed, the wider choice of pumps, inclusion of control valve, addition of quick-disconnect fittings and PVC-nitrile hose should provide improved performance.

OPTIMUM PERFORMANCE

In lighter oils contained in thicknesses of 1 cm and greater; in debris-free conditions; operated with pump that minimizes mixing at rates that allow smooth, continuous oil collection and discharge; followed by oil/water separation.

ADDITIONAL INFORMATION

(1) McCracken, W.E., Performance Testing of Selected Inland Oil Spill Control Equipment, EPA 600/2-79-150, U.S. Environmental Protection Agency, (1977).

(2) Solsberg, L.B. et al., Field Evaluation of Seven Oil Spill Recovery Devices, Technology Development Report EPS 4-EC-76-3, Environment Canada, Ottawa, Ontario, (October, 1976).

OTHER DATA

The SLURP was evaluated at OHMSETT in May 1975 with numerical results reported similar to those noted in the Canadian field trials.

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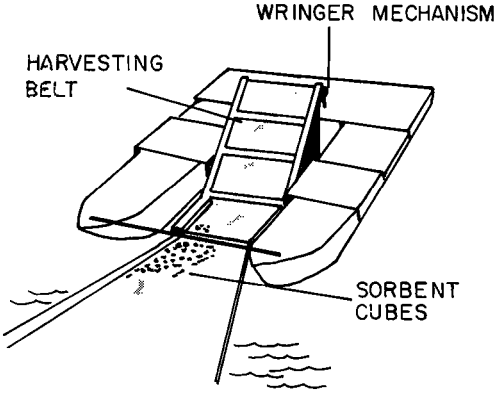
SORBENT OIL RECOVERY SYSTEM
Price not applicable

COLLECTION PRINCIPLE

Sorbent cubes are broadcast onto spilled oil and a belt is used to harvest the cubes. These are then wrung out, the oil transferred to storage, and the cubes redistributed into the spill.



PHYSICAL SPECIFICATIONS

	Broadcaster	Harvester	Regenerator
Length (m)	1.43	3.7	2.44
Width (m)	0.61	1.4	0.94
Height (m)	0.99	2.2	1.77
Weight (kg)	80	140	820
Power (kW)	5.2, gasoline	7.8, gasoline	12, gasoline
Main Components	Dayton Blower No. 4C131 Duct 7.3 m long, 20 mm diameter	13 mm mesh stainless steel round wire belt 3.7 m x 0.91 m	upper polyester/ polyurethane belt 2.7 m x 0.61 m; lower stainless steel wire cloth 6.1 m x 0.61 m x 7.1 mm
Sorbent	open pore polyurethane		

MODE OF OPERATION

The reusable sorbent oil recovery system is intended for use in harbours, rivers, and in the vicinity of piers and pilings. The broadcaster and harvester can be operated directly on the water's surface and within containment booms while the regenerator is positioned remotely. Separate storage must be preplanned.

PERFORMANCE

Tank evaluations of Seaward's Sorbent Oil Recovery System were conducted using a prototype device at OHMSETT on two separate occasions in 1975. The first series of tests involved the presentation at 19°C of naphtha (0.065 cm^2/s), octanol (0.124 cm^2/s) and dioctyl phthalate (0.788 cm^2/s). The device recovered 60-

80% of the test medium it encountered even when subjected to random wave surface conditions. The absorption of various substances varied, with tests using naphtha in calm conditions showing the lowest water content (at 20%) of any trial run.

In the second series of evaluations, oil was presented to the skimmer at relative velocities up to 5 kn, wave heights to 0.3 m, and in slick thicknesses between 0.24 and 0.84 mm. Oil recovered versus oil encountered ranged from 100% under best conditions down to about 40% under the most adverse wave and relative velocity situations. The prototype system thus demonstrated the validity of the concept. Optimum collection rate was 10.5 m^3/h in a 0.5 mm slick when operated at a relative velocity of 2.5 kn and a sorbent distribution rate of 17.4 m^3/h.

Sorbent losses were termed negligible due to wind at wind velocities to 15 kn. Maximum losses (of less than 2%) occurred at 5 kn sweep speeds in 0.3 m breaking waves. The recovered liquid contained 38-79% oil, was not highly emulsified, and separated rapidly by gravity.

Test personnel reported the highly mobile system could be improved by operating with a "sorbent logjam" in front of the harvester to increase contact time between the oil and sorbent. Another recommendation related to improved tracking of a squeeze belt in the regenerator through the application of standard drive roller lagging.

OPTIMUM APPLICATION

In light to medium viscosity oils present as slicks less than 1 mm in thickness at relative velocities of 2.5 kn and a sorbent distribution rate of about 17 m^3/h using a sorbent concentrator in front of the harvester.

ADDITIONAL PERFORMANCE INFORMATION

(1) Dorrler, J.S. and J.H. Shaw, A Distributed Reusable Sorbent Oil Recovery System, Proceedings of the 1977 Oil Spill Conference, American Petroleum Institute, New Orleans, LA, (1977).

(2) McCracken, W.E. and J.H. Schwartz, Performance Testing of Spill Control Devices on Floatable Hazardous Materials, EPA 600/2-77-222, U.S. Environmental Protection Agency, Cincinnati, OH, (1979).

(3) Shaw, S.H., R.P. Bishop and R.S. Powers, Development of a Sorbent Distribution and Recovery System, EPA 600/7-27-217, U.S. Environmental Protection Agency, Cincinnati, OH, (1978).

OTHER DATA

Development work was sponsored by the U.S. Environmental Protection Agency subsequent to feasibility studies of the sorbent oil recovery approach.

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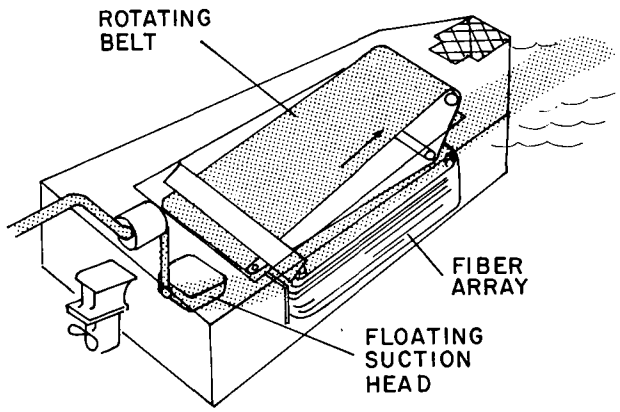
STREAMING-FIBER SKIMMER
Price not applicable

COLLECTION PRINCIPLE

An array of fibres positioned between the hulls of a catamaran and free-floating on the water's surface decelerates an oil layer encountered so that it accumulates and can be pumped off through a floating suction head. An oleophilic, porous belt sweeping beneath the fibres assists in the collection process.



PHYSICAL SPECIFICATIONS (proposed large-scale model)

Overall Length (m)	11.73	Fibre Diameter (mm)	0.059
Beam (m)	4.57	Fibre Spacing (mm)	0.57
Hull Depth (m)	1.98	Fibre Array	4.57 m x 1.02 m
Operating Draught (m)	1.37	Fibre Break Strength (kg)	6.8
Hull Displacement (kg)	20 317		
Vessel Weight (kg)	11 350		
Storage Capacity (L)	6 625		
Propulsion	twin 115 HP GM 3-53 diesels, Stewart & Stevenson diesel drive DD-3-53-MN outdrives		
Pumps	two lobe-type units, hydraulically driven @ 13 600 kPA		
Debris	grill, rake, tray and sweeper cart		
Materials of Construction	aluminum catamaran, superstructure, and pickup head, nylon fibres, reticulated urethane foam belt.		

MODE OF OPERATION

The large-scale Streaming-Fiber Skimmer would be operated as a self-contained, propelled vessel and used with or without deflection booms to chase down uncontained slicks. Designed to work where a relative velocity exists between the skimmer and the oil, it could also be towed or moored. It has been designed for transport by Hercules C-130 aircraft.

PERFORMANCE

Testing of prototype models of the Streaming-Fiber concept was undertaken at OHMSETT in 1976 and 1977. A 9.8 m catamaran incorporating a 5.2 m long fibre bundle was examined in the first test series and showed no oil losses in a 2 mm slick at 2 kn, slight losses at 4 kn, and significant losses at 5 and 6 kn in calm conditions.

Collection capability was reduced in various wave conditions, with 28% of the oil recovered (vs oil encountered) at 2 kn in a harbour chop and 0% at higher velocities in all wave conditions. The belt was determined to assist in sweeping oil when in contact with the oil layer.

A modified device was evaluated in 1977 which featured a sorbent belt, fibre support modules floating independently of the hull, adjustable slack in the fibres, and floating suction head.

Although mechanical failures in the belt drive mechanism terminated testing, a number of conclusions were reached. A foam belt entrapped oil thereby improving performance; however, the Velco belt drive concept did not allow proper tracking, and the belt itself may have impeded flowthrough of oil. Lighter oils were recovered more efficiently than heavier oils at higher speeds. Although wave conformance of the slack fibres was found, they did not appear to benefit recovery performance. Recommendations were made for a positive tracking (chain) belt drive, elimination of slack in the fibres and belt, and a more stable structure.

OPTIMUM APPLICATION

In light to medium viscosity oils; in calm conditions; at speeds to 2 kn; will process some forms of debris; with attendant storage capacity.

ADDITIONAL PERFORMANCE INFORMATION

(1) Beach, R.L. and D.W. Durfee, Development of a Streaming-Fiber Oil Spill Control System Stage II-Modifications to Large-Scale Model, U.S. Coast Guard, Washington, DC, (1978).

(2) Getman, J.H., Performance Tests of Three Fast Current Oil Recovery Devices, 1977 Oil Spill Conference, American Petroleum Institute, New Orleans, LA, (1977).

OTHER DATA

The physical specifications reflect the design of an advanced prototype machine prepared for the U.S. Coast Guard as an oil skimmer alternative to their ZRV skimming concept. Note also that the position of the belt has changed in various models, appearing above the fibre bundle in several proposed designs (Reference 2 above) but finally located below the fibres in more recent engineering drawings. The U.S. Coast Guard should be contacted for the status of this concept.

SEP-EGMO
Boulevard Marfille
29283 Brest
France

telephone (33) 98 44 27 88/9
telex 940660 CODE233

EGMOPOL
Price: (Egmolap) 260 000 French francs;
(Egmopol) 680 000 French francs
(effective 1-3-81)

COLLECTION PRINCIPLE

Rotating paddles move product up an inclined perforated plate through which water drains. Oil and debris are collected in a sump located at the top edge of the plate.

PHYSICAL SPECIFICATIONS

	Egmolap Skimmer	Egmopol 1 Boat
Length (m)	3.0	11.7
Beam (m)	2.4	3.7
Height (m)	1.0	1.4
Draught (m)	--	0.8-1.2
Weight (kg)	250	7 000
Oil Storage Capacity (m^3)	0	20
Pump	unspecified	unspecified
Power Unit	diesel power package, unspecified	

MODE OF OPERATION

The skimmers can be used in both stationary and advancing modes to remove contained and free-floating oil. Crane launching is required, with use intended for harbours and, generally, moderate sea conditions.

PREDICTED PERFORMANCE

Evaluation data are not known for the Egmopol skimmers.

See entry for Anti-Pollution Inc., Paddle-Wheel or Clowsor Skimmer.

In an OHMSETT testing program of the similarly designed Clowsor Skimmer, oil recovery rates exceeding 20 m^3/h were recorded. Because of an absence of engineering details, it is not possible to determine whether the test data directly apply to the Egmopol concept. More general trends should, however, be possible to point out. These include the higher efficiencies of the approach in heavy oil versus light oil (say 20.00 cm^2/s versus 2.00 cm^2/s) and the dependence of recovery rate on the off-loading pump selected. Thicker slicks should produce both higher oil content and higher pump-off rates.

A predominant oil loss mechanism may be the entrainment of oil as the rotating paddles contact the water's surface. The skimmer body itself might also contribute to entrainment losses of oil at relative velocities in excess of 0.5 kn, although this comment would have to be verified. Other criteria limiting performance are likely to be short, breaking waves as well as other larger wave forms; paddle speeds that are either too slow or too fast; and oils of too low a viscosity that will be less subject to the action of the paddles. The processing of some debris forms should be possible.

Commentary on the general robustness of the machine, choice of materials and engineering components cannot be made due to the lack of more detailed information.

PREDICTED OPTIMUM APPLICATION

In thick slicks, several centimetres and more, of medium to heavy oil (excluding Bunker C); in calm, non-flowing water; will process some debris.

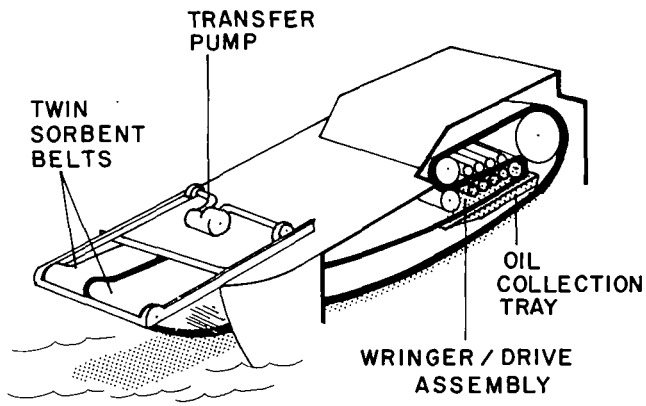
SHELL DEVELOPMENT COMPANY
E-1340 Westholow Research Center
P.O. Box 1380
Houston, TX 77001
USA

telephone (713) 493-7094

ZRV SORBENT BELT SKIMMER
(USCG Zero Relative Velocity Skimmer)
Price not applicable

COLLECTION PRINCIPLE

Two sorbent belts are rotated between the hulls of a vessel so that their speed matches the advance rate of the craft. Oil is squeezed from the sorbent material by a scraper and a wringer mechanism featuring a progressively decreasing gap. The oil is then conveyed to an intermediate holding area on board and finally to ultimate storage.



PHYSICAL SPECIFICATIONS (approximate, based on prototype)

Length (m)	13.7
Beam (m)	6.7
Height (m)	4.9
Draught (m)	1.1
Contact Length of Belt (m)	12.2
Belt Width	two @ 1.2 m each
Weight (tonne)	28.6
Storage Capacity (L)	7 600 (intermediate holding area)
Materials of Construction	aluminum hull and superstructure, belt composite of synthetic turf, needled polypropylene and woven Dacron
Power Units	three 653 GM diesel engines rated at 174 HP (continuous); two provide propulsion, the third drives hydraulic systems
Vessel Speed	6 kt
Transfer Units	multiple vane-type pumps

MODE OF OPERATION

The prototype ZRV Skimmer has been designed as a self-propelled device capable of chasing down uncontained slicks in wave heights of 1.2 m and at high speeds or in currents. Attendant storage is required. In its present form, primary applications are in harbours and other protected waterways including near-coastal situations. The ZRV disassembles so that transport is possible on three flatbed trucks, with launching achieved by crane. The prototype was designed to demonstrate the feasibility of the ZRV belt concept so that ultimately a variety of configurations might evolve incorporating this collection principle.

PERFORMANCE

The ZRV Skimmer, a prototype device, resulted from a comprehensive development program begun in 1975. The concept has been extensively evaluated in a series of more than 170 trial runs conducted at OHMSETT in September and October of 1979; maximum performance results are reported for a 3 mm slick:

	2 kn			4 kn			6 kn		
	OR vs OE (%)	OC (%)	ORR (m^3/h)	OR vs OE (%)	OC (%)	ORR (m^3/h)	OR vs OE (%)	OC (%)	ORR (m^3/h)
Calm	92	85	27.9	100	70	63.1	95	64	87.2
0.5 m Harbour Chop	93	51	28.6	94	54	55	81	56	84
0.7 m Harbour Chop	--	--	--	72	60	43.4	--	--	--
0.4 m x 9.5 m Wave	72	41	21.8	76	48	45.2	62	47	55.2

O R vs O E = Oil Recovered vs Oil Encountered
O C = Oil Content
O R R = Oil Recovery Rate

Oil recovery rate peaked at 107 m^3/h in a 10.4 mm slick, with the oil content measured at 54%; 53% of the slick that was encountered was recovered. In general, performance was judged to be "high" at all tow speeds tested, with overall better results obtained in heavier oils in 3 mm slicks although recovery rates were greater in a 5 mm slick of light oil. The belts also performed optimally when run slack and at speeds about 0.5-1.0 kn faster than the ZRV. Waves decreased performance due to vessel motion. Oil losses were attributed to the belt contacting the skimmer's underside in waves, the belt hold-down device entraining oil in waves and in calm conditions at 6 kn, and bars, braces and rollers contacting the belt. All such loss mechanisms could be easily rectified by adjustments in clearance tolerances between the belt and the skimmer.

The prototype system was easily assembled by three men within a few hours using a 70 tonne crane. The skimmer was found to be slightly underpowered; all on-board systems could not be run simultaneously at peak rates. Plunging water jets were determined to improve performance and were incorporated permanently as oil concentrating devices.

OPTIMUM APPLICATION

In light to heavy oils excluding Bunker C, with the belt run slack in thicknesses of several millimetres or more at speeds to 6 kn (and likely beyond); should be operable in most forms of debris; used with attendant storage; at belt speeds exceeding encounter rate by 0.5-1 kn and in sea conditions to 1.2 m significant wave heights.

ADDITIONAL PERFORMANCE INFORMATION

(1) Breslin, M.K., Performance Tests of High Speed ZRV Oil Skimmer, U.S. Department of Transportation, U.S. Coast Guard, Office of Research and Development, CG-D-42-80, (June, 1980).

(2) Smith, G.F. and H.W. Lichte, Summary of US Environmental Protection Agency's OHMSETT Testing 1974-1979, EPA 600/9-81-077, U.S. Environmental Protection Agency, Cincinnati, OH, (January, 1981).

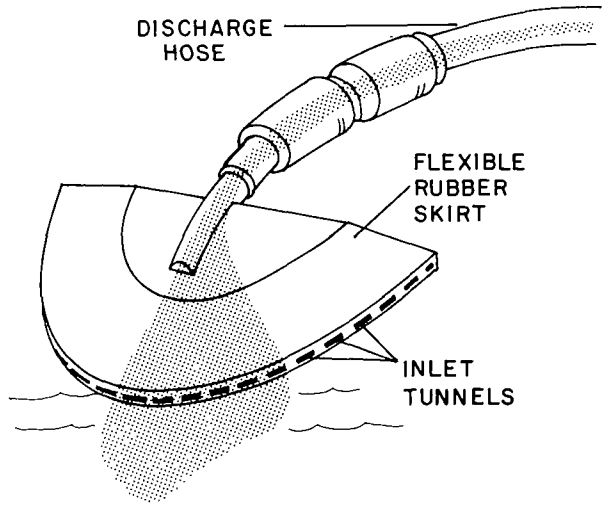
SLICKBAR, INC.
250 Pequot Avenue
Southport, CT 06490
USA

telephone (203) 255-2601

FLEXIBLE MANTA RAY
Price upon request

COLLECTION PRINCIPLE

A series of rectangular tunnels in a floating suction head allow the ingress of product which flows to a central discharge hose through which it is conveyed to storage by remote pump.



PHYSICAL SPECIFICATIONS

Weir Length (cm)	152
Tunnel Openings (two sizes)	1.3 cm and 2.5 cm x 1.3 cm
Draught (cm)	7.6
Discharge Hose Diameter (cm)	7.6
Weight (kg)	26.3
Material of Construction	flexible nitrile rubber
Maximum Design Vacuum Pressure	51 kPa
Pump Unit	skimmer head compatible with company's Slickskim Model 60 unit 7.5 HP gasoline engine-driven single diaphragm pump; Model 160 system 3.6 HP diesel engine or equivalent gasoline/electric motor and double-diaphragm pump; and Trans-vac 500-D 40 HP diesel-driven vacuum pump, separator and rotary discharge pump.

MODE OF OPERATION

The skimmer is designed for deployment into a stationary slick contained and concentrated by a boom. A remotely located pump is used to withdraw oil through the floating suction head. The company's largest pumping system allows multiple unit hook-up and provides oil/water separation. Manual launching by a single person is easily accomplished.

PERFORMANCE

Evaluation of the Manta Ray Flexible Skimmer has been conducted both as tank tests in May 1975 at OHMSETT and in situ in October 1977 in the St. Lawrence River on behalf of Environment Canada and the Petroleum Association for Conservation of the Canadian Environment.

Optimum Canadian Test Results (2.5 cm opening model)

Air Temp. (°C)	Water Temp. (°C)	Wave Height (cm)	Test Medium	Oil Thickness (mm)	Oil Recovery Rate (m^3/h)	Oil Content (%)
12	12	0	crude	3	0.29	3.4
12	12	0	crude	10	1.33	10.4
8	12	0	diesel	3	0.36	3.6
10	12	0	diesel	10	1.00	10.6
Optimum U.S. Test Results (2.5 cm opening)						
24	20	30	lube	25.4	3.1	20.4
32	25	0	lube	25.4	2.5	61.9
Optimum U.S. Test Results (1.3 cm opening)						
21	20	60	lube	25.4	4.5	37.5
25	20	30	lube	25.4	2.6	68.6

crude: Iranian, viscosity 58 SSU @ 37.8°C; API Gravity 30.0°

diesel: viscosity 1.90 SSU @ 37.8°C; API Gravity 40.0°

pump: 7.6 cm induced-flow Spate unit in Canadian tests; Marlow self-priming double-diaphragm in U.S. tests

lube oil: viscosity 2.72-3.30 cm^2/s at test temperatures

The U.S. and Canadian test programs clearly illustrate that recovery capacity for this skimmer depends upon slick thickness. Both recovery rate and oil content improve markedly in slick thicknesses of 1 cm, with the latter particularly higher in calmer conditions. The Canadian tests further demonstrated that deployment in one orientation maximized oil entry. Overall, the skimmer has been found to be well constructed, easy to use, and requires no adjustments for operation. Provision for debris is not included.

OPTIMUM APPLICATION

In light to medium viscosity oils; in debris-free conditions; in calm water; in oil thicknesses 1 cm and greater.

ADDITIONAL PERFORMANCE INFORMATION

(1) Abdelnour, R. et al., Field Evaluation of Eight Small Stationary Skimmers, Technology Development Report EPS 4-EC-78-5, Environment Canada, Ottawa, Ontario, (May, 1978).

(2) McCracken, W.E., Performance Testing of Selected Inland Oil Spill Control Equipment, EPA 600/2-77-150, U.S. Environmental Protection Agency, (1977).

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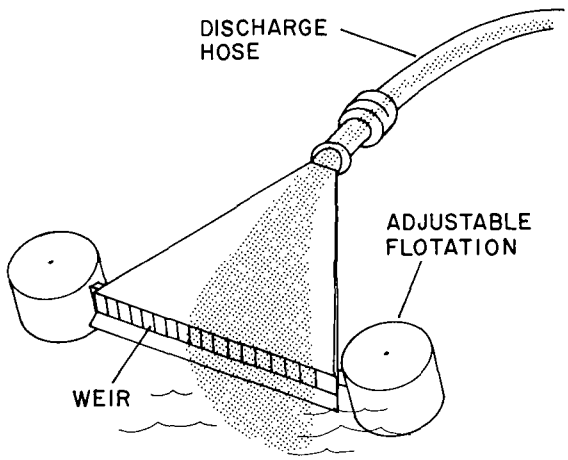
telephone (203) 255-2601

RIGID MANTA RAY
(High Capacity Adjustable Head, Model II)
Price upon request

COLLECTION PRINCIPLE

Product enters a series of openings in a floating suction head and is drawn off by a remotely located pump. Several configurations of skimmer head are available.



PHYSICAL SPECIFICATIONS

	Adjustable Head (pictured)	Model II
Configuration	triangular	quadrant
Weir Length (cm)	122	122
Height of Openings (cm)	5.1	0.6, 1.3, 2.5
Draught (cm)	17.8	7.6
Discharge Hose Diameter (cm)	10.2	7.6, 10.2
Weight (kg)	34.5	13.2
Materials of Construction	aluminum	nitrile rubber over aluminum
Maximum Design Vacuum Pressure (kPa)	51	51
Pump Unit	Slickskim 60 single-diaphragm, 160 double-diaphragm, and Trans-Vac 500-D vacuum/rotary pump units are compatible (see also entry for Slickbar, Inc. Flexible Manta Ray)	
Adjustable Floats	two	none

MODE OF OPERATION

The skimmer is positioned in a stationary slick as a single system or as multiple units; product is withdrawn by a remote pumping system. Manual launching is readily done; adjustment is possible of the all-aluminum suction head only. Storage capacity and oil/water separation in thinner slicks must be planned.

PERFORMANCE

The Rigid Manta Ray has been extensively evaluated in both the United States and Canada. U.S. tank tests at OHMSETT were conducted in May and September of 1975; in situ trials were undertaken in Canada in October 1977.

Canadian Optimum Test Results (adjustable head)

Air Temp. (°C)	Water Temp. (°C)	Wave Height (cm)	Test Medium	Oil Thickness (mm)	Oil Recovery Rate (m^3/h)	Oil Content (%)
9	12	0-5	crude	1	0.12	4.6
12	12	0	crude	10	0.78	14.8
8	12	0	diesel	4	0.19	4.8
12	12	0	diesel	10	1.42	12.7
U.S. Optimum Test Results (adjustable head)						
24	32	0	No. 2 fuel	25.4	22.7	22.2
U.S.S Optimum Test Results (2.5 cm opening)						
16	14	60	lube	25.4	18.25	7.0
14	16	0	lube	25.4	3.53	43.7

crude: Iranian, viscosity 58 SSU @ 37.8°C; API Gravity 30.0°
diesel: 1.90 SSU @ 37.8°C, API Gravity 40.0°
lube oil: 19.10-26.97 cm^2/s at test temperatures
No. 2 Fuel: 0.10 cm^2/s at test temperatures
pump: Canadian results - 7.6 cm Spate (induced-flow) pump; U.S. trials - Marlow, self-priming unit

Both test programs reveal the Manta Ray to function optimally in significant thicknesses (1 cm and greater) of lighter oils in calm conditions. Water content in the collected product can be relatively high; test teams report that precise adjustment of the weir level is necessary to achieve best results for the aluminum model. Personnel also report that pumping rates should be selected with care to ensure a steady collection process. Overall, the Rigid Manta Ray Skimmers have been observed to be of simple design and well fabricated.

OPTIMUM PERFORMANCE

In light to medium viscosity oils contained as slicks 1 cm or greater in thickness; in debris-free, calm conditions; with separator/storage capacity; operated at selected weir levels (in adjustable model) and pumping rates.

ADDITIONAL PERFORMANCE INFORMATION

(1) Abdelnour, R. et al., Field Evaluation of Eight Small Stationary Skimmers, Technology Development Report EPS 4-EC-78-5, Environment Canada, Ottawa, Ontario, (May, 1978).

(2) McCracken, W.E., Performance Testing of Selected Inland Oil Spill Control Equipment, EPA 600/2-77-150, U.S. Environmental Protection Agency, (1977).

OTHER DATA

Recovery capability in octanol, naphtha and dioctyl phthalate is reported for the 2.5 cm skimmer based on OHMSETT testing. McCracken, W.E. and J.H. Schwartz, Performance Testing of Spill Control Devices on Floatable Hazardous Materials, EPA 600/2-77-222, U.S. Environmental Protection Agency, Cincinnati, OH, (1977).

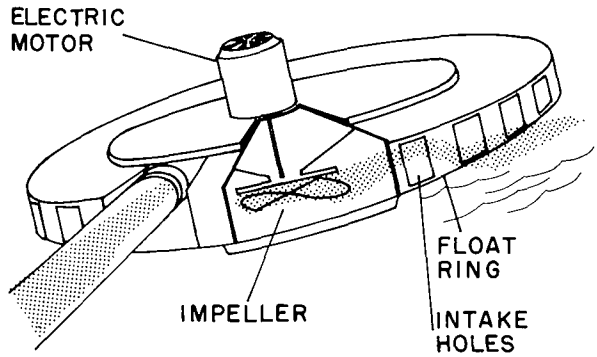
SUNSHINE CHEMICAL CORPORATION
P.O. Box 17041
West Hartford, CT 06117
USA

telephone (203) 232-9227

SEA BROOM
(Model B)
Price not applicable

COLLECTION PRINCIPLE

Product enters through openings in a circular float ring and is conveyed to storage by a geared centrifugal pump incorporated in the skimming head.



PHYSICAL SPECIFICATIONS

Diameter (m)	1.22
Height (m)	0.46
Discharge Hose Diameter	10.2
Weight (kg)	57
Materials of Construction	fibreglass body, aluminum discharge fitting
Power Unit	5 HP 4-cycle gasoline engine with optional pneumatic and electric motors
Pump	geared centrifugal pump

MODE OF OPERATION

The Sea Broom is designed for use in contained slicks. It can be easily launched by two persons and operated from a suitable working platform such as dock, shore or boat. Collected product is directed to prearranged storage facilities. Pneumatic and electric models require external power sources.

PREDICTED PERFORMANCE

No evaluation data are known for the Sea Broom.

See also entry for Watermaster Pumps and Pollution Equipment.

In situ evaluation by Environment Canada of a similar skimmer showed the concept to recover substantial volumes of water with either diesel or fresh crude oil if these were presented as slicks 1-2 cm or less in thickness. While total liquid pumping rates were very high (at 25 m^3/h), typical oil recovery rates of 0.5 m^3/h were recorded. This leads to the conclusion that the Sea Broom and other suction head skimmers should only be considered for use where a significant layer of oil has accumulated, perhaps of the order of 5 cm or more. In this way, the oil phase can be transferred over the skimmer's weir and through the impeller, with little or no

water, at high flow rates. Otherwise (in thin slicks), the underflow of water into the device is very pronounced, so much so that backup storage/separation facilities become impractical due to the excessive volumes involved.

Other factors which are also likely to lead to improved performance include utilization of the skimmer in wave-free conditions (again, to minimize water uptake), in non-flowing situations, in light oils, and in areas with little or no debris.

Overall, the Sea Broom appears to be rugged, light in weight, and highly portable. Care should be taken when using it to ensure that the 10.2 cm discharge hose does not interfere with deployment or positioning. Although a price has not been specified, the cost of similar systems suggests that the Sea Broom would provide good value for the money if properly applied.

PREDICTED OPTIMUM APPLICATION

In light oils contained as slicks 5 cm or more in thickness; in calm, debris-free water; in non-flowing conditions.

OTHER DATA

A request for information in 1981 from Sunshine Chemical Corp. resulted in data on the company's dispersant and spill sampling products only.

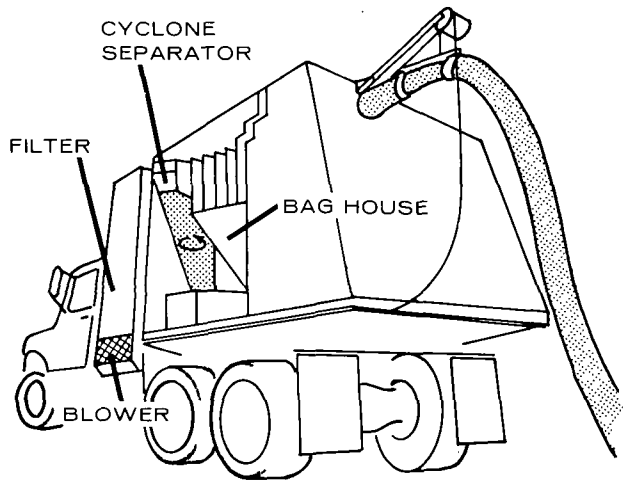
SUPER PRODUCTS
P.O. Box 27225
Milwaukee, WI 53227
USA

telephone (414) 541-5300

SUPERSUCKER
Air conveyor
Price upon request

COLLECTION PRINCIPLE

Air conveying systems typically consist of a collector body, filtering stages and a blower or vacuum pump. A large diameter tube, usually 10-20 cm, extends from a point near or at the top of the collection chamber and is used to draw liquid into the device.



PHYSICAL SPECIFICATIONS (data for three models are given; other units are available).

	Model 1009	Model 2009	Model 3509
Length - Excluding Truck (m)	4.27	4.27	4.55
Capacity (m^3)	6.9	6.9	6.9
Weight - Excluding Truck (kg)	5 895	6 125	7 030
Rated Air Flow (m^3/min)	28.3	56.6	99.1
Rated Vacuum (m H_2O)	5.08	5.08	5.08
Other Data	typical overall height is 3.6 m, with the collector body occupying 2.5 vertical metres; tube diameters are 10 cm, 15 cm and 20 cm; positive displacement vacuum pump		

MODE OF OPERATION

Air conveying systems are usually used as self-contained packages that include truck cab, control panel and collection unit. For oil spills, they can be driven to a shore or dock or operated from a barge to recover slicks that have naturally accumulated or have been concentrated by boom. They are also utilized as the off-loading and shuttle vehicle to take liquid recovered by waterborne skimmers to ultimate storage or disposal points.

PERFORMANCE

In 1980, a Vactor Model 2045 manufactured by Peabody Meyers Corporation of Streator, Illinois, was evaluated at OHMSETT. In 13 calm water tests, recovery rate averaged 7.2 m^3/h of a 61% oil (and water) mixture. The oil recovery rate ranged from 0.4 to 7.8 m^3/h, with oil content varying between 28% and 86%. Both light oil (0.07 cm^2/s at 28.8 °C) and heavy oil (7.00 cm^2/s at 28.8 °C) were presented to the device as slicks 2 to 25 mm in thickness.

Generally, lower blower speeds (1 100-1 450 rpm) resulted in higher oil content in thin slicks while higher speeds (1 800 rpm) worked well on thicker slicks. Oil recovery rate was determined to be a function of slick thickness and was not affected by altering blower speed or oil viscosity. Both the recovery rate and oil content decreased with the addition of hose sections. It was also found that best results were obtained with the end of the hose held 9.5 cm above the slick.

Test personnel recommended the addition of sight gauges to assist in determining the volume of oil and water phases in the collection tank. They also pointed out the advantage of adding an outlet for the removal of free water and oil (many trucks are equipped with valves for removing liquid accumulating above settled solids and typically unload like dump trucks). Difficulty was anticipated in handling long lengths of the large diameter suction tube, particularly where manoeuvering it might be required.

OPTIMUM APPLICATION

In light to heavy oils (including Bunker C), in thicknesses from several millimetres; at lower blower speeds in thin slicks and at higher speeds in thicker oil layers; will process debris; operates best with shorter lengths of suction tube with the end held about 9 cm above the slick.

ADDITIONAL PERFORMANCE INFORMATION

(1) Farlow, J.S. and R.A. Griffiths, OHMSETT Research Overview 1979-1980, Proceedings of the 1981 Oil Spill Conference, Atlanta, GA, pp. 661-666, (March 2-5, 1980).

(2) Smith, G.F., Vacuum and Air Conveyor System Tests for Oil Spill Recovery, U.S. Environmental Protection Agency, Cincinnati, OH, (in preparation) (1981).

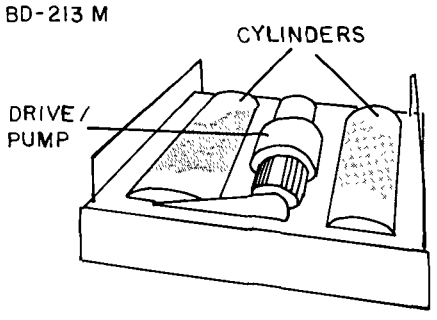
SURFACE SEPARATOR SYSTEMS, INC.
103 Mellor Avenue
Baltimore, MD 21228
USA

telephone (301) 747-4744

SSS SKIMMERS
(Earle System)
numerous model designations
Price upon request

COLLECTION PRINCIPLE

Plastic cylinders are rotated within a frame in floating oil. The oil adheres to the cylinders which are then wiped by synthetic rubber blades. A pump transfers collected product to storage tanks, either shore-based or on board, depending upon the model.



PHYSICAL SPECIFICATIONS

Model designations include BD-208A, BD-213, BD-213M, BD-213G, BD-213R, D-113R, V-116, D-108A, BD-318, etc., each with different specifications. Dry weights vary from 57 kg (D-108A) up to 28.7 tonnes (self-propelled vessel).

Model BD-213M Specifications:

Overall Length (m)	1.61
Overall Beam (m)	1.44
Height (m)	0.81
Draught (m)	0.27
Discharge Outlet Diameter (m)	3.8
Weight (kg)	340
Materials of Construction	fibreglass-reinforced epoxy cylinders, stainless fittings, synthetic rubber wipers, foam flotation/steel covered
Power Unit	squirrel cage induction, explosion-proof motors in various sizes with optional air, hydraulic, gasoline or diesel engines
Pump	self-priming, progressing cavity; steel rotor within synthetic rubber stator housed in cast iron

MODE OF OPERATION

The skimmers are available as self-propelled vessels designed for chasing down uncontained slicks and as smaller units for use in permanent installations or in minor, contained spills. All models include recovery cylinder(s), drive mechanism and transfer pump.

PREDICTED PERFORMANCE

No evaluation data are known for Surface Separator Systems, Inc. skimming equipment.

The rotating drum concept is reviewed according to flume test results under the entry Clear Seas Atlantic Ltd. - OSCAR.

It has been determined that oil will adhere to the surface of a rotating drum with the rate of recovery dependent upon the properties of the oil, slick thickness, and rotational speed. Generally, recovery rates of 1-2 m^3/h have been recorded for a drum rotation of 5-30 rpm using a steel cylinder 3 m long and 2.44 m in diameter. Highest oil content of the recovered fluid in diesel oil tests was measured at 67%, while in a more viscous oil blend (8.07 cm^2/s at 15°C) the maximum oil content was 96%.

Factors adversely affecting performance have been noted to be high drum speed, deep submergence of the drums, relative velocities exceeding 0.5 kn, and breaking waves. In all such instances, entrainment of oil into the water column results in a reduction in the total volume of the oil layer available for recovery.

It is also interesting to observe that for a drum 2.44 m in diameter, optimum settings of 5 rpm and a submergence depth of 30 cm were recorded for thin slicks; in thicker slicks (1 cm and greater), maximum recovery rate and efficiency were obtained at 30 rpm and a submergence depth of 4 cm.

In the case of the SSS Skimmers, the devices available as either permanent installation units or vessels that could be utilized for the recovery of stationary, concentrated oil would probably represent best potential applications of the concept. Machines would then have to be investigated individually for selection of optimum operating parameters. Debris should not pose a problem.

PREDICTED OPTIMUM APPLICATION

In non-flowing or slow-moving slicks (less than 0.5 kn) of several millimetres to several centimetres in thickness; in calm conditions likely at rotational speeds of 5-30 rpm; at preselected drum submergence depth; will process most oil types in many forms of debris.

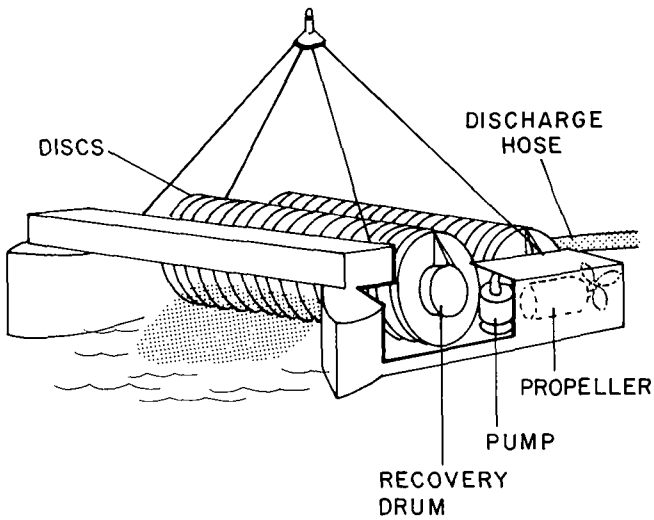
THUNE-EUREKA A/S
P.O. Box 38
N-3401 Lier
Norway

telephone (47) (03) 85 04 0400
telex 18608 THUNE N

THUNE-EUREKA
(Euroskimmer)
Price: No. 1 $869 510 (U.S.)
No. 2 $389 350 (U.S.)
No. 3 $89 672 (U.S.)
includes skimmer, hoses and winch, power pack and crane

COLLECTION PRINCIPLE

Discs rotate through a layer of floating oil which adheres to them. The oil is then removed by scrapers and flows into a central sump from which it is pumped by an on-board transfer system to storage in an attendant vessel.



PHYSICAL SPECIFICATIONS

Three sizes of skimmer are available which incorporate the same oil collection principle.

	Euroskimmer 1	Euroskimmer 2	Euroskimmer 3
Length (m)	6.0	3.5	3.5
Width (m)	6.0	3.0	2.8
Height (m)	2.4	2.2	2.6
Disc Diameter (m)	1.4	--	--
Maximum Draught (cm)	60	60	adjustable
Discharge Hose Diameter (cm)	18	--	--
Weight (kg)	6 500	2 000	950
Material of Construction	marine grade aluminum alloy hull		
Pump and Power Unit	CCN 100 or 150 pump driven by water-cooled diesel/hydraulic pack of 67 to 263 HP; twin 750 kPa thrusters on Models 1 and 2		
Other Features	approximate weights for the No. 1 model components are 6.5 tonne skimmer, 8.5 tonne hose winch with hoses, 6.5 tonne power pack and 14 tonne deck crane		

MODE OF OPERATION

Crane launching into a contained, stationary slick is required. Control and operation of the skimmer take place remotely via the power pack from an attendant vessel which also accepts collected product. Similar

shore-based operations could also be implemented. Euroskimmers 1 and 2 are self-propelled once deployed from the mother ship.

PREDICTED PERFORMANCE

See also Frank Mohn Fusa A/S Framo ACW-400 and Morris Industries MI-30 summaries.

The discs should be capable of removing a wide range of oils, with a viscosity up to several thousand mPa•s. Response would be limited in shorter breaking waves, i.e. in wave forms that did not allow the machine to conform more or less with the up and down movement of the surface layer of oil. Because the skimmer is usually operated remotely, it is not influenced by vessel interferences. On the other hand, the advantages gained by direct attachment of the skimming head through an arm are lost. The CCN pump is widely known and appears to be highly suited for its application.

The skimmer models No. 1 and 2 are self-propelled. This feature should be viewed as a means to relocate the skimmer within a contained area so that removal of more concentrated slicks is possible. It is unlikely that skimming in the advancing mode will result in substantial oil collection rates (refer to MI-80 test results in reference given below). The substantial weight of the Euroskimmer 1 package at 35.5 tonnes requires thorough preplanning as does the deck space requirement of 128 m^2.

PREDICTED OPTIMUM APPLICATION

In light to medium viscosity oils; in calm to moderate seas; in contained, stationary concentrations of oil; should be capable of processing many debris forms.

ADDITIONAL PERFORMANCE INFORMATION

(1) The Ship Research Institute of Norway has tested the Euroskimmer under private contract; data may not be available.

(2) A Winter Evaluation of Oil Skimmers and Booms, Environmental Emergency Branch, Environment Canada, Ottawa, Ontario, (in preparation) (1981).

OTHER DATA

The Euroskimmer has been marketed by:

Internationally

Bennex Marine Products and Services
N. Tolbodkai
P.O. Box 1992
N-5011 Begen-Nordnes
Norway

telephone (47) (475) 21 41 61
telex 42908 SEAN

In Canada

Newfound Trading Ltd.
206-11 Morris Drive
Burnside Industrial Park
Dartmouth, Nova Scotia
B3B 1M2 Canada

telephone (902) 463-3470
telex 019-31607

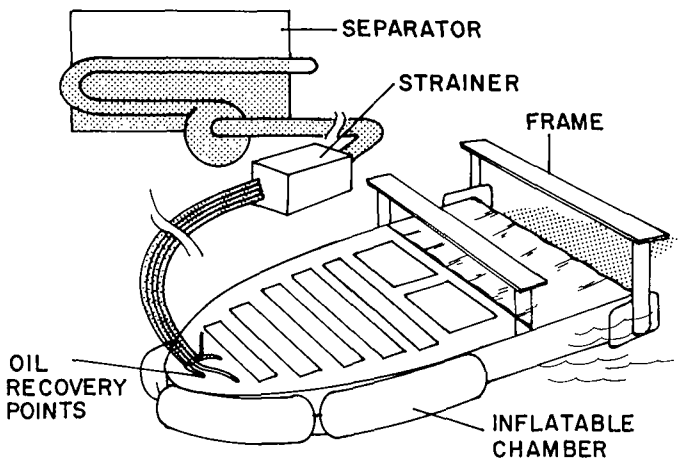
TRACOR MARINE
P.O. Box 13107
Port Everglades Station
Fort Lauderdale, FL 33316
USA

telephone (305) 463-1211
telex 510 955 9864

SOCK
((Shell) Spilled Oil
Containment Kit)
Price upon request

COLLECTION PRINCIPLE

Oil and water enter an open-bottom chamber which floats on the surface as a semi-ellipsoid shape. Product concentrating at the aft end is pumped to a remotely positioned separator for further water removal and the oil then transferred to storage. An in-line strainer removes debris.



PHYSICAL SPECIFICATIONS (1980 test kit)

Length (m)	8.84
Width (m)	2.44
Discharge Hose Diameter	three @ 7.6 cm each
Weight (skimmer only) (kg)	2 948
Materials of Construction	nylon reinforced nitrile rubber, aluminum frame
Air Tuggers	two @ 1 m x 1 m, each @ 90.7 kg
Tool House	2.1 m x 3.7 m @ 2 268 kg
Power Unit	60 HP air-cooled diesel engine
Pump	Tuthill positive displacement
Debris	fluids strainer/manifold, 1 m x 1 m @ 90.7 kg
Other Features	42 longitudinal, 32 transverse flotation cells

MODE OF OPERATION

The SOCK was designed for use in conjunction with an offshore vessel. The flexible chamber streams from a floating frame which is in turn towed alongside a vessel advancing through an uncontained slick. As originally conceived, launching apparatus as well as a diesel/hydraulic power source, pump, separator and auxiliary equipment comprise the skimming package. When not deployed, on-board storage of all skimming components is possible. Original installation of all equipment on a vessel may take 1 to 2 days, requires substantial lifting capacity, but is straightforward under good supervision.

PERFORMANCE

Offshore testing of the SOCK was sponsored by the U.S. Navy and conducted in April 1980 in the Atlantic Ocean off New Jersey. Results were recorded as follows for Larosa (Venezuelan) crude, API gravity 23.9°.

Wave Height (m)	Wave Period (s)	Direction to Sea	Forward Speed (kn)	Oil Recovery Rate (m^3/h)	Oil Content (%)	Oil Recovered vs Oil Encountered (%)
1.2	7	lead	1.0	10	44	55
0.9	5.5	lead	1.3	35	89	93
1.4	3.7	lead	1.3	12	39	47
1.0	4.3	follow	1.75	12	43	43
0.7	5.8	follow	2.1	2	26	18

The wave height and period indicated are 1/3 significant. Water temperature was constant at 6.7°C, with air temperatures varying between 8.3 and 11.1°C.

Highest recovery figures were measured at a relative wind-driven surface (oil) velocity of 1.5 kn in 1 m waves, 5 s peak to peak. About 35 m^3/h of a 2 mm slick were recovered. Performance was generally found to decline in rougher seas and at higher velocities. Loss mechanisms were attributed to shedding and entrainment, with vortices and turbulence generated by the system apparent at speeds greater than 1 kn. It was further determined that the capability of the mother ship to (a) maintain slow speeds with a steady heading and (b) otherwise manoeuver with a low-drag force device towed alongside was critical to machine performance.

OPTIMUM APPLICATION

Likely in light to medium viscosity oils at relative velocities of approximately 0.75 kn and lower; in concentrations of oil several millimetres thick and more; in debris-free conditions; in calm and moderate sea conditions including ocean swells.

ADDITIONAL PERFORMANCE INFORMATION

(1) Ayers, R.R., SOCK-An Oil Skimming Kit for Vessels of Convenience, 1977 Oil Spill Conference, American Petroleum Institute, New Orleans, LA, (March 8-10, 1977).

(2) Lichte, H.W., M. Borst and G.F. Smith, USNS Powhatan, SOCK Skimmer Offshore Tests, U.S. Environmental Protection Agency, Cincinnati, OH (in preparation).

(3) Lichte, H.W., M. Borst and G.F. Smith, USNS Powhatan, SOCK Skimmer Offshore Tests, Proceedings of the 1981 Oil Spill Technology Conference, American Petroleum Institute, Atlanta, GA, (March, 1981).

OTHER DATA

The SOCK was originally developed by Shell Development Company and later with the assistance of the Gulf of Alaska Clean-up Organization.

Shell Development Company,
E-1340 Westhollow Research Center,
P.O. Box 1380,
Houston, TX 77001
USA

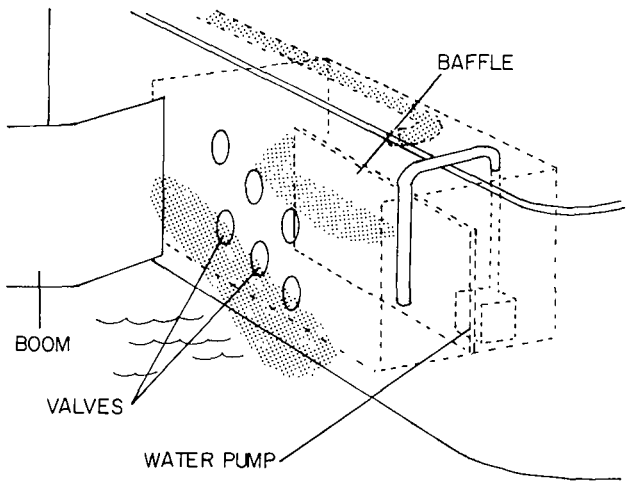
UNOCO
contact:
Oil Pollution Control R & D Program
NTNF
P.O. Box 70 Taasen
N-Olso 8, Norway

telephone (47)(02)14 35 90

SOOPRES SYSTEM
(Skuteng/Aker OOS)
Price upon request

COLLECTION PRINCIPLE

A series of six circular openings in a ship's side accept fluid as the system is advanced in conjunction with deflector boom. The liquid then flows into an on-board double tank and weir system where oil/water separation takes place. A gate valve controls the flow at each opening.



PHYSICAL SPECIFICATIONS

Diameter of Openings	400 mm
Number of Openings	six
Location of Openings	immediately below still waterline to 1.5 m above it
Distance Between Openings	1 170 mm (centre to centre)
Other Data	A main boom 30 m in length with a 1.5 m flotation element and 1.5 m skirt is fastened to the ship astern of the openings. It extends at an angle of about 20° to a float attached by a universal joint to an arm which in turn is affixed to the ship forward of the openings. The secondary boom then leads the oil into the main boom which deflects it into the openings. The system is duplicated on either side. The oil pathway consists of its entry through the openings into the first tank, travel around a dividing wall or baffle into a less turbulent area, and flow over a simple weir into a second tank where further settling occurs. Water is pumped from each of the tanks as separation proceeds.

MODE OF OPERATION

The UNOCO system has been designed as a three-vessel offshore skimming package. One ship incorporates one set of openings on each side midships in addition to the separation and storage tanks and the main booms and fittings. Two additional vessels each tow a length of secondary boom which in the vessel Skuteng/Aker OOS system presented a 150 m swath width. On-board storage of the booms is possible when in transit, with deployment quickly achieved once the spill site has been attained.

PERFORMANCE

Evaluation of a prototype system was undertaken in the North Sea in the vicinity of Alesund, Norway, in June 1980. Openings on one side of the fishing vessel MELOYVAER were tested on two separate occasions using an emulsion formed from an SAE 30 lubricating oil.

During the first set of trials, significant wave height was 2.7 m with an average period of 8 s. The bottom hole was closed, the next to bottom intake continuously regulated, and the remaining four holes kept open. Towing speed ranged from 0.8 to 2 kn. Of 15.3 m^3 of oil released as a 49% water-in-oil emulsion (total amount 25 m^3), 6.5 m^3 of oil was recovered as an emulsion containing 74% water (total amount 25 m^3). Thus, about 40% of the released emulsion having a viscosity of 11 000 mPa•s (measured at 1 rps) was recovered. Free water was pumped away at a rate of 300-500 m^3/h; the fluid transferred to the second tank contained about 50% free water.

In the second test, significant wave height was 1.8 m with an average period of 4.9 s and a wind speed of 9.6 m/s (19 kn). Towing speed ranged from 0.8 to 1.3 kn. Of 18.5 m^3 of a 63% water-in-oil emulsion (6.8 m^3 oil) released, about 70% or 4.9 m^3 of oil was recovered as a 78% water-in-oil mixture (viscosity 25 000 mPa•s). The significant increase in efficiency was believed to possibly have been the result of a more consistent towing speed (which was also lower than the first test run).

Oil losses were attributed to leak under the primary boom; recommendation was made to extend the front of the booms even with the ship's bow to minimize bow wave effects. Use of the secondary booms was judged to render the total system less manoeuverable. Other suggested improvements related to increasing the efficiency of the simple weir system separating the tanks and moving the attachment point of the boom closer to the intake holes. Separation of the emulsion occurred satisfactorily with 50-100 ppm oil measured in the water phase.

OPTIMUM APPLICATION

In light to heavy oils present as free-floating slicks; at consistently maintained speeds of about 1 kn; using only primary boom extended to ship's bow and attached immediately astern of the intake openings; will process debris; operable in wave heights of several metres.

ADDITIONAL PERFORMANCE INFORMATION

Langfeldt, J.N. and M. Wold, Full Scale Tests with Oil Recovery Systems Offshore Norway, June 1980, Oil Pollution Control Research and Development Program, Oslo, Norway, (June, 1981).

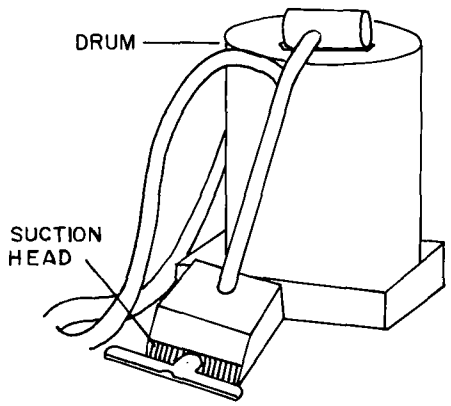
VAC-U-MAX
37 Rutgers Street
Belleville, NJ 07109
USA

telephone (201) 482-1000

VAC-U-MAX
Price upon request

COLLECTION PRINCIPLE

An air line is connected through an evacuating device to an empty drum which then is attached to a simple floating suction head through a hose/pipe arrangement. Oil is drawn through the skimming head and into the evacuated drum.



PHYSICAL SPECIFICATIONS

Evacuation Device	40 cm x 15 cm x 15 cm (approximately)
Suction Head	40 cm wide (approximately)
Flotation	40 cm x 40 cm x 15 cm (approximately)
Inlet Diameter	5.1 cm
Storage Capacity	connects to 208 L drum
Power Requirements	1.3 cm air line, pressure unspecified

MODE OF OPERATION

This small vacuum skimmer requires an air compressor for its operation. The device attaches to a drum which is placed on a working platform (shore, dock, vessel or other surface) adjacent to a contained spill. The suction head is then placed in the spilled oil which is conveyed to the drum. The system has been designed for the cleanup of minor amounts of material and is highly portable.

PREDICTED PERFORMANCE

No evaluation data are known for the Vac-U-Max Skimmer.

See also Scan Comb Ltd. Skimmini and Megator Corp. Puddle Mop.

The Vac-U-Max system is a portable suction device designed for application to small volumes of light oil in protected waterways, in processing plants, and in ditches and sumps. It operates in a manner similar to a household vacuum cleaner: namely, a suction head which is attached to a continuously evacuated chamber is used to remove unwanted material.

The skimmer likely functions best in stationary pools of concentrated oil contained by booms in calm, non-flowing, debris-free water. Short, breaking waves and thin slicks would probably lead to inefficient operation of the Vac-U-Max, particularly as concerns the collection of excessive amounts of water. It is not clear from the literature exactly what the configuration of the inlet is; a judgment therefore cannot be made on whether or not the uninterrupted ingress of liquid can occur. It is suggested that this aspect be investigated as well as the choice of materials and precise power requirements.

Like the Scan Comb Ltd. Skimmini, the hand-held manoeuverability, light weight and direction of the device from directly above the oil are all intriguing aspects. Operation from a dock or walking the suction head through shallow water would be required. Overall, the compactness and simplicity of design of the Vac-U-Max should combine to offer a useful, small-spill, skimming package.

PREDICTED OPTIMUM APPLICATION

In light oils contained as a slick 1 cm or more in thickness; in calm, stationary water that is free from debris; operated from a deck or shore as a hand-held unit.

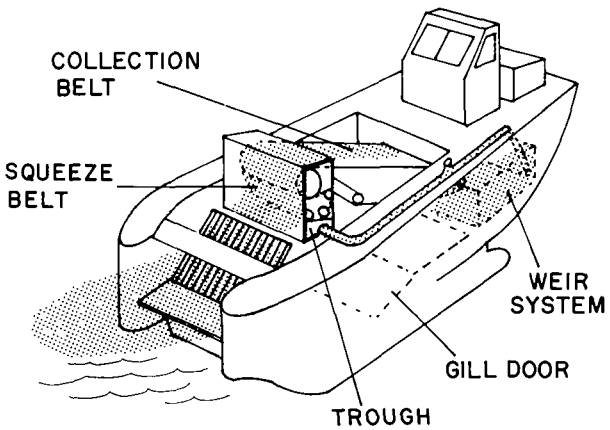
VERSATECH PRODUCTS INCORPORATED
60 Riverside Drive
North Vancouver, British Columbia
V7H 1T4
Canada

telephone (604) 929-5451
telex 043-52686 BENNPOLL VCR

BENNET SKIMMERS
Price (U.S.):
Mk 3 $150 000
Mk 6 $650 000
Mk 9 $1 300 000
Mk 10 $160 000
Mk 12 $300 000

COLLECTION PRINCIPLE

An endless sorption belt recovers oil in the interhull area of a catamaran. A second (squeeze) belt removes the oil, depositing it in a collection trough from which it is conveyed to storage. In some models, additional oil pickup is provided by a backup weir system or submersible pump. Water exits through one or two gill doors in the skimmer's underside.



MARK IV

PHYSICAL SPECIFICATIONS (MARK 4)

	3F	4	6D	6E	9A	10	11	12
Length (m)	7.32	12.27	12.8	13.3	16.4	11.3	7.62	8.33
Beam (m)	2.38	3.63	4.27	4.14	6.40	3.63	3.76	3.02
Height (m)	0.91	3.20	1.5	2.43	4.80	--	2.59	--
Draught (m)	1.01	2.41	1.01	1.22	1.22	0.43	0.60	0.43
Weight (t)	4.03	15.4	17.23	13.4	46.4	--	5.79	--
Storage Capacity (m^3)	1.89	6.36	9.46	9.46	16.2	--	4.55	--
Materials	polyester/natural fibre belt, nylon squeeze belt; Mk 12 hull is fibreglass, others aluminum							
Power Unit	S.M.*	twin GM 6 V 53	Caterpillar diesel	Perkins T6.354	diesel	diesel	S.M.*	twin Detroit 4-53
Power Requirement (HP)	70	240	190	160	174	100	102	156
Speed (kn)	5	7	7	10	5	5	5	20
Pump	Moyno progressing cavity pumps; also submersible Stanley pump in models 3F and 10							
Debris	a grill is provided in all skimmers							
Other Data*	S.M. = Stabilimenti Meccanici V.M. diesel; propulsion includes Mercury stern drive legs, Schottel (360°) drive on the Mk 4, portable power pack on the Mk 11 (Arctic Skimmer)							

MODE OF OPERATION

The Bennett skimmers feature a rotating belt designed to create a zero relative velocity between the oil and the skimmer. As such, the line of non-propelled and self-propelled machines are either manoeuvered through

slicks or anchored in streaming oil slicks. Crane launching is required and air transport possible with some models. Use of the skimmers is intended for harbours and near-coastal waters.

PERFORMANCE

The Mk 4 was field-tested by Environment Canada in July 1975 and May 1976 off Canada's west coast. Of 21 test runs, 11 resulted in 90-100% oil collected versus oil presented, 7 runs produced 80-89% efficiencies, and 3 were recorded at less than 80%. In the tests conducted in calm water using Canadian Western Crude, oil content exceeded 80% in 7 of 11 test runs at speeds of 1 and 2 kn. Offshore, in conditions of 0 to 3 on the Beaufort wind and wave scale, oil content generally ranged from 48 to 61%. Crude, diesel and, in one instance, a bunker/crude blend were used. At OHMSETT, the Mk 6E was evaluated in October 1977 and the Mk 11 (Arctic Skimmer) examined in October 1979. "Peak performance" for the Mk 11 is reported for calm water tests:

	Oil Recovered vs Oil Encountered (%)	Oil Content (%)	Oil Recovery Rate (m^3/h)
Heavy Oil 21.00 cm^2/s	96.3 (@ 2 kn)	85.0 (@ 0 kn)	20 (@ 0 kn)
Light Oil 0.35 cm^2/s	99.4 (@ 1 kn)	97.4 (@ 0 kn)	19.4 (@ 0 kn)

The Mk 11 also underwent sea trials in the Atlantic Ocean in April 1980 while a Mk 3 skimmer was tested in situ in October 1980. Both programs were supervised by Environment Canada. All tests highlighted the importance of optimum gill door and bow ramp settings for various forward velocities, with the openings decreasing with increasing speed. The belt angle was also determined to be critical to performance and related more to oil type and its physical properties. Plunging water jets have also been found to assist the machine in the collection process. In recent models, the skimmers have been improved with the introduction of a tracking mechanism for the squeeze belt and graduated scales for the gill and bow door openings so that reproducible settings are possible. In several instances, the hydraulic system has required simple modification to allow proper cooling in warmer climates.

Overall, a large data base has been collected through various test programs that show the Bennett oil collection principle to be effective. Because of the relative complexity of the machines (vis-a-vis smaller skimmers), a regular schedule of maintenance would be required to ensure peak performance.

OPTIMUM APPLICATION

In light to heavy oils in thicknesses of several millimetres and more; at speeds to 2 kn; in calm to moderate sea conditions (swells, 1 m waves); will process some debris.

ADDITIONAL PERFORMANCE INFORMATION

(1) Lichte, H.W. et al., Performance Testing of Four Skimming Systems, U.S. Environmental Protection Agency, Cincinnati, OH, (1980).

(2) Solsberg, L.B., W.G. Wallace and M.A. Dunne, Field Evaluation of Oil Spill Recovery Devices: Phase Two, Report EPS 4-EC-77-14, Environment Canada, Ottawa, Ontario, (1977).

(3) Urban, R.W. and D.J. Graham, Performance Tests of Four Selected Oil Spill Skimmers, EPA 600/2-78-204, U.S. Environmental Protection Agency, Cincinnati, OH, (1978).

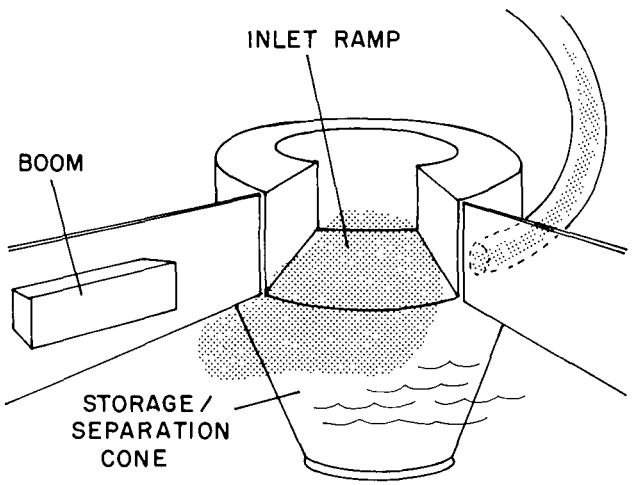
VERSATECH PRODUCTS INCORPORATED
60 Riverside Drive
North Vancouver, British Columbia
V7H 1T4
Canada

telephone (604) 929-5451
telex 043-52686 BENNPOLL VCR

SEA HAWK
Price: $3 000 (U.S.)
(effective 11-3-81)

COLLECTION PRINCIPLE

Oil and water overflow an upward sloping ramp into a circular floating chamber. The chamber extends below the water's surface as a flexible cone providing an oil/water separation area. Concentrated product is pumped to storage.



PHYSICAL SPECIFICATIONS (production model)

Diameter (cm)	117
Height (cm)	61
Discharge Hose Diameter (cm)	5.1
Weight (kg)	43
Storage Capacity (L)	380
Materials of Construction	fibreglass/plastic floating chamber, PVC-coated polyester cone
Other Data	equipped with cleats, quick-disconnect fittings, boom attachment points

MODE OF OPERATION

The Sea Hawk is used in conjunction with an external pump and containment booms which attach to either side of the oil inlet. It is then positioned in a current to accept product or, in stationary conditions, a water jet is used to herd oil towards it. The oil-water mixture accumulates in the cone, with separation taking place there by gravity. Water flows out the bottom. Intermittent off-loading is possible with the freeboard preadjusted by ballasting. Launching requires three or four persons because of the configuration of the system rather than due to its weight. The Sea Hawk is intended for application in rivers, lakes and harbours or other protected bodies of water. It can also be used exclusively as an oil/water separation and intermediate collection unit.

PERFORMANCE

Evaluation of the Sea Hawk was undertaken in Canada and the U.S. in 1976. The Canadian program was comprised of in situ trials in the St. Lawrence River in currents of 0.19-0.41 m/s (0.4-0.8 kn), water

temperatures of 8-14°C and air temperatures of 5-16°C. A prototype skimmer was used in conjunction with two lengths of 46 cm boom and a 7.6 cm Spate pump. Test media included an Iranian Crude (reported as API Gravity 30°-43°), a diesel blend (S.G. 0.8-0.9; viscosity 0.02-0.043 cm^2/s at 15°C) and a water-in-crude emulsion (properties unspecified).

For the crude and diesel tests, 5-22% of a thin slick (1 mm) was recovered in calm conditions with a peak of 22% obtained in 15 cm waves. In thicker (10 mm) slicks, 60-85% of the oil discharged was recovered in conditions ranging from calm to wave heights greater than 30 cm. Emulsion was recovered on one of three test runs in which it was used (only when the unit was trimmed to significantly alter the weir angle). Oil content reached a maximum of 20% for all tests, a low value which the test team attributed to the minor volumes of test oil used relative to the capacity of the holding/separation chamber. In U.S. tank tests conducted at OHMSETT, oil recovery rate was recorded between 0.03 and 1.5 m^3/h, with inconsistent results caused by ballasting and weir positioning difficulties. Oil content and pickup efficiency numbers also reflect continuous adjustment to the device.

The Sea Hawk was successfully used in the St. Lawrence River program exclusively as an oil/water separator when receiving collected liquid from other low-flow skimmers. (Higher volumes resulted in carry-through of oil.) Recommendations based on the Canadian experience with the prototype included reinforcement of the discharge hose fitting, recessing ballast vents, adding grip handles, and the provision of an adjustable weir and debris grill. Manual deployment was found to be somewhat awkward but, overall, the Sea Hawk was well constructed with smooth edges, quick disconnect fittings and good boom connectors. It skimmed well, with the major loss mechanism due to vortex formation at the boom junctions and resultant oil underflow.

OPTIMUM APPLICATION

In light to medium viscosity oils deflected by boom connected to skimmer; in calm conditions to 30 cm waves; in slicks 1 cm thick and more travelling at a relative velocity of about 0.25-0.5 kn; in debris-free water.

ADDITIONAL PERFORMANCE INFORMATION

(1) Solsberg, L.B., W.G. Wallace and M.A. Dunne, Field Evaluation of Oil Spill Recovery Devices: Phase Two, Technology Development Report EPS 4-EC-77-14, Environment Canada, Ottawa, Ontario, (December, 1977).

(2) Widawsky, A., Performance Tests of Three Skimmers and One Boom at OHMSETT, TM-60P-76-11, U.S. Naval Civil Engineering Laboratory, Port Hueneme, CA, (1976).

OTHER DATA

In August 1977, Environment Canada supervised the in situ evaluation of a larger version of the skimmer called the Super Seahawk (diameter 3.05 m, weight 1 200 kg). Because oil entrainment through vortex formation became pronounced at speeds of 1-2 kn, testing was halted. Refer to Environment Canada's Technology Development Report No. EPS 4-EC-78-2, "Field Evaluation of the Super Seahawk and Marco Class V Oil Skimmers", (May, 1978).

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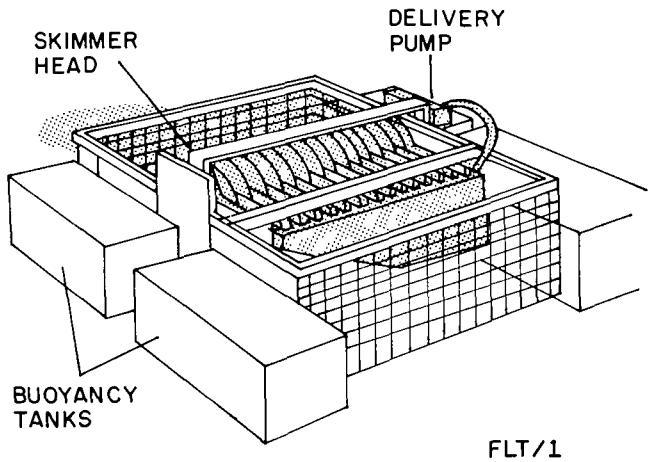
Littleton House
Littleton Road
Ashford, Middlesex TW15 1UQ
England

telephone Ashford (44)(07842) 45011
telex 887767 VIKINT G

KEBAB
(FLT, FX, 600)
Price upon request

COLLECTION PRINCIPLE

A series of discs attached to a straight axle rotate through a layer of oil which adheres to the discs. The oil is scraped off and transferred to storage.



FLT/1

PHYSICAL SPECIFICATIONS (three models are marketed)

	600	Floating (FLT)	Fixed (FX)
Overall Length (m)	0.65	2.65	1.52
Overall Width (m)	0.44	2.47	0.78
Overall Height (m)	0.37	1.00	0.88
Draught (cm)	11	30	about 30
Discharge Hose Diameter (cm)	3.8	--	--
Weight (kg)	12	500	variable
Number of Discs	5	14	14
Disc Diameter (cm)	28	61	61
Materials of Construction	coated marine grade aluminum body; stainless steel discs	coated marine grade aluminium body; marine grade aluminum discs (optional stainless steel)	coated steel frame; marine grade aluminum discs
Power Unit	12 V DC 0.03 HP disc drive, Danfoss OMP80 PVB hydraulic piston pump		
Drive Unit	requires 2 A, 12 V source	5.5 kW Brook Crompton Parkinson motor/ 300 kg power pack	suitable 3-phase electric motor/ 300 kg power pack
Pump	2.26 kg double-diaphragm hand pump 3.8 cm (optional 12 V single-diaphragm and 240 V positive displacement units)	175 ND rotor unit/ Sperry Vickers drive	gravity-fed outlet

MODE OF OPERATION

The Kebab 600 was designed as a small, portable skimmer suitable for minor spills. The Fixed and Floating Skimmers were conceived as permanent installation oil removal devices available as 1 m modules. All skimmers require a remote source of power. The 600 is connected to an external pump, the Floating model incorporates its own transfer system and the Fixed platform discharges collected product by gravity flow.

PREDICTED PERFORMANCE

No evaluation data are known for this model series of skimmer.

See also Vikoma International Ltd., Komara Miniskimmer, Lockheed Missiles and Space Co. Clean Sweep, and Morris Industries Ltd. MI-2 and MI-30 entries.

The straight-line configuration of discs appears to be ideally suited for oil removal as a permanent installation unit. The system can be operated unattended using readily available power sources. The inclusion of a rotor pumping unit in the Floating Kebab seems to be a practical choice while the lack of a powered transfer system in the Fixed Kebab suggests applications where light to medium viscosity oils must be removed from an effluent and conveyed by gravity or other means to remote collection points.

Best performance might be expected where a relative velocity of 0.5 kn or less exists between the oil and the discs, detrimental wind-herding effects are minimized, and optimum disc speed has been precisely determined.

The Kebab 600 skimmer should provide a highly portable oil recovery system for very minor spills that have been contained in calm conditions. Effective performance will largely hinge on the recovery of product that flows from the scrapers through the discharge hose under the suction of the off-loading pump. The friction-fit hose might be susceptible to disconnection but the skimmer appears to be otherwise robust and well outfitted with tethering and lifting hardware.

PREDICTED OPTIMUM APPLICATION

In calm conditions; in light to medium viscosity oils that have been contained by a boom or are floating in a sump.

Kebab FLT and FX - as permanent installations
Kebab 600 - as a portable unit for minor amounts of contained oil.

VIKOMA INTERNATIONAL, LTD.
Littleton House
Littleton Road
Ashford, Middlesex TW15 1UQ
England

telephone Ashford (44)(07842) 45011
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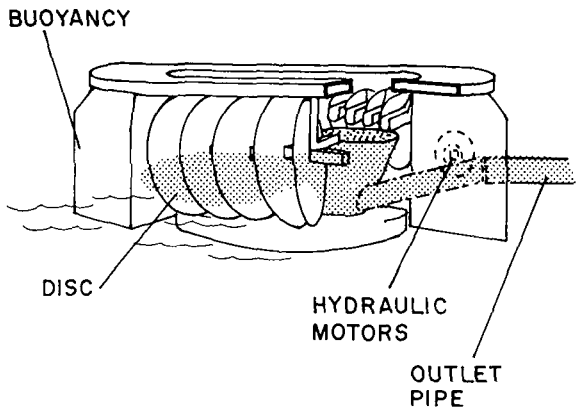
KOMARA MINISKIMMER
(Komara 12K Skimmer)
Price: $21 950 (U.S.)
(effective 1-3-81)

COLLECTION PRINCIPLE

Thirty-two plastic discs rotate along the periphery of a circular floating head to take up floating oil. The product is scraped from the discs and enters a central sump from which it is pumped to storage by a remotely located transfer unit.



PHYSICAL SPECIFICATIONS

Maximum Width (m)	1.16
Overall Height (cm)	46
Draught (cm)	19
Discharge Hose Diameter (cm)	7.6
Weight (kg)	54.4
Disc Diameter (cm)	28
Materials of Construction	plastic, foam-filled buoyancy chambers
Power & Transfer Unit	diesel/hydraulic pump package includes single cylinder Petter engine, Spate induced-flow 7.6 cm pump, hydraulic pump, controls; weight 182.3 kg

MODE OF OPERATION

The skimmer is deployed into a contained slick; disc speed and pumping are controlled through the remotely placed power pack. Launching can be readily accomplished by two persons with operation taking place from a wharf, shoreline, vessel or other suitable working platform. Storage for collected product must be prearranged.

PERFORMANCE

The Komara was evaluated in situ in October 1976 under the direction of Environment Canada and in tank trials at OHMSETT in June 1975 and May 1976.

Air Temp. (°C)	Water Temp. (°C)	Wave Height (cm)	Test Medium	Disc Speed (rpm)	Slick Thickness (mm)	Oil Recovery Rate (m^3/h)	Oil Content (%)
Optimum U.S. Test Results							
24	26	0	No. 2 Fuel	--	25.4	2.4	99+
--	--	0	Light Oil	139	23	0.59	43.1
--	--	0	Light Oil	58.9	5.3	0.25	71.9
No. 2 Fuel: 0.18 cm^2/s @ 26°C							
Light Oil: 0.10 cm^2/s @ 38°C							
Optimum Canadian Test Results							
5	8.5	0	Crude Oil	--	10	2.2	84
4	8.5	0	Diesel	--	10	0.96	98

Crude Oil: Iranian, API Gravity 30°-43°

Diesel: blend, 0.024-0.043 cm^2/s at 15°C

The Komara has been determined to perform consistently well in test programs. The skimmer will tolerate moderate size waves (10-20 cm) and generally collects oil with a lower water content at relatively lower disc speeds. Pickup rate tends to increase with increasing slick thickness and viscosity although heavier oils cannot be processed by the disc/scraper system and remote pump.

Environment Canada noted the Komara to be a lightweight, easily handled system that was capable of "pulling in" product with consistently high oil content. Modifying features secondary to the main collection component were cited as offering further improvement including the use of rigid hose material, quick-disconnect fittings, more durable body and improved wiper contact.

OPTIMUM APPLICATION

In calm to very moderate sea conditions; in light and medium viscosity oils contained in thicknesses of several millimetres and more; will process some debris; optimally operated at less than maximum disc rpm.

ADDITIONAL PERFORMANCE INFORMATION

(1) McCracken, W.E., Performance Testing of Selected Inland Oil Spill Control Equipment, EPA 600-2-77-150, U.S. Environmental Protection Agency, Cincinnati, OH, (August, 1977).

(2) Solsberg, L.B., W.G. Wallace and M.A. Dunne, Field Evaluation of Oil Spill Recovery Devices: Phase Two, Technology Development Report EPS 4-EC-77-14, Environment Canada, Ottawa, Ontario, (December, 1977).

(3) Widawsky, A., Performance Tests of Three Skimmers and One Boom at OHMSETT, TM-60P-76-11, U.S. Naval Civil Engineering Laboratory, (1976).

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England

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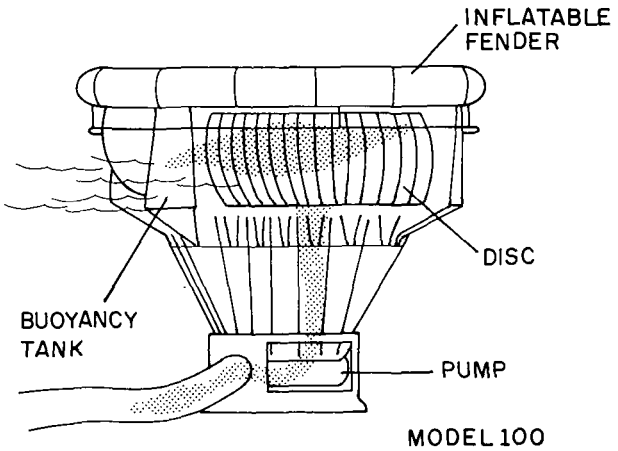
SEASKIMMER
(50, 100)
Price upon request

COLLECTION PRINCIPLE

A series of discs are rotated through an oil layer to pick up product and then are scraped by wiper blades. A built-in transfer pump removes the collected oil from a central sump to a remote storage point.



PHYSICAL SPECIFICATIONS

		50	100
Skimmer Head	Length (m)	2.26	3.37 (outside diameter)
	Width (m)	2.26	--
	Height (m)	1.40	2.54
	Working Draught (m)	0.36-0.42	approx. 2.0
	Empty Weight (kg)	700	1 000
	Number of Discs	44	84
	Disc Diameter (cm)	81	61
	Suction Pump	Selwood 10.2 cm helical rotor	centrifugal unit
Power Pack		53 HP diesel; 64 L/min main hydraulic pump; weight: 780 kg	70 HP (@ 2 500 rpm) diesel; 0.16 m^3/min air compressor 246 kg/cm^2; 68 L/min hydraulic pump, weight: 2 785 kg (with pallet and lifting jib)
Materials of Construction		aluminum alloy skimmer head, discs; PVC fenders, scrapers; steel frame power pack	fibreglass-reinforced plastic body; neoprene/nylon fender with steel; PVC discs; coated steel frame power pack

MODE OF OPERATION

The Seaskimmer systems are intended for use in coastal and offshore situations. The skimming head is placed in a stationary, concentrated slick and operated via the power pack from an attendant vessel with adequate storage capacity. The model 50 can also function where shallow draft requirements must be met. Crane launching is required with continuous tethering to the boom arm allowing repositioning and quick retrieval as necessary.

PREDICTED PERFORMANCE

No evaluation data are known for the Seaskimmer systems.

See also Vikoma International Ltd. Komara Miniskimmer and Frank Mohn Fusa A/S Framo ACW-400.

The Seaskimmers should function optimally in medium viscosity oils contained as slicks 1 cm and greater. Disc speed selection will likely determine best results, with an rpm chosen that will yield a high collection rate yet pick up a product low in water content. At excessive rotational speeds, higher percentages of water in the recovered liquid can be expected.

Both models of Seaskimmer should function better in longer period waves rather than shorter, breaking chop since splash against the skimmer body might result in the latter case. The model 50 skimmer with its straight-line disc configuration might offer some advantages over the torroidal arrangement of discs in the 100 unit as concerns repair and disc replacement in the field. The Seaskimmer 50 shallow draught also adds to its range of applications.

The lifting jib assembly that comprises a component of the 100 package provides for self-contained deployment. While it allows freedom of movement of the skimming head on the water, it does not offer the positive control of a directly attached hydraulic arm with built-in wave compensation. This could be a concern in significant swells or higher sea states.

Overall, the disc concept has proved to be an effective and efficient means of recovering contained oil and, barring mechanical problems, the Vikoma Seaskimmers with sump-incorporated pumps and remote power pack should provide for relatively high capacity recovery operations.

PREDICTED OPTIMUM APPLICATION

In light to medium viscosity oils contained as 1 cm slicks and greater; in calm to moderate conditions; will process some debris; operated at selected disc speeds.

OTHER DATA

The Seaskimmer 50 model is a relatively recent development and typifies the strong engineering background of the company and its continuing efforts to research and improve its products.

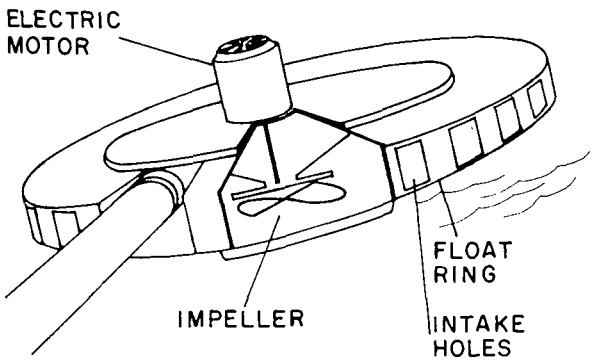
WATERMASTER PUMPS & POLLUTION EQUIPMENT
P.O. Box 5332
London, Ontario
Canada

telephone, telex unavailable

WATERMASTER
Price not applicable

COLLECTION PRINCIPLE

Product is drawn through openings in a circular float ring over a weir and directly into a pump impeller located central to the unit. A discharge hose carries the collected product to a remote storage point.



PHYSICAL SPECIFICATIONS (Model 706-1 1/2 XPE only - several models sold)

Overall Diameter (cm)	122
Weir Diameter (cm)	76
Overall Height (cm)	45
Discharge Hose Diameter (cm)	15.2
Weight (kg)	32
Materials of Construction	fibreglass body and floating urethane impeller, aluminum transmission
Drive Unit	1 1/2 HP (4 kW) explosion-proof electric motor, 60 Hz, rated at 3 450 rpm, 230 V, single-phase, 10 A
Impeller Diameter (cm)	24
Other Data	various models feature 7.6 cm and 15.2 cm discharge hoses with gas, air and electric drives in 1-5 HP

MODE OF OPERATION

Two persons can easily deploy this motorized skimmer head into a slick contained by oil barriers. An external source of power is required for the electric and pneumatic models with use intended for harbours and other protected waterways. Storage/separation facilities should be prearranged. Supplementary flotation attachments are available to increase stability.

PERFORMANCE

In situ evaluation of the Watermaster 706-1 1/2 XPE was undertaken on behalf of Environment Canada in October 1976 in the St. Lawrence River. Diesel oil and an Iranian Crude (API Gravity 30°-43°) were presented as 1-2 cm slicks in water at 7°C in small waves 0-4 cm in height. Performance peaked at 9 L/min of diesel collected, with significant water recovery reported. Total liquid pumped by the impeller reached approximately 420 L/min.

Comments by test personnel indicated the unit to have adequate lifting hardware but the 15.2 cm hose was judged awkward to handle. Although oil content and oil recovery rates were found to be relatively low in the tests, users report substantially higher efficiencies in thicknesses of light oil greater than 1-2 cm. It would then become a matter of ensuring that the intake openings were at an appropriate height to accept oil flowing into them. Too high a position of the perforations accounts in large measure for the low Environment Canada oil recovery rates.

Overall, the Watermaster was found to be lightweight and easy to deploy and retrieve.

OPTIMUM APPLICATION

In light oils contained in significant thicknesses greater than 2 or 3 cm; in debris-free, calm conditions; with external power source (with electric and pneumatic models) and storage/separation facilities.

ADDITIONAL PERFORMANCE INFORMATION

Solsberg, L.B., W.G. Wallace and M.A. Dunne, Field Evaluation of Oil Spill Recovery Devices: Phase Two, Technology Development Report EPS 4-EC-77-14, Environment Canada, Ottawa, Ontario, (December, 1977).

OTHER DATA

Current company contact information was not obtained and availability of the Watermaster is not known.

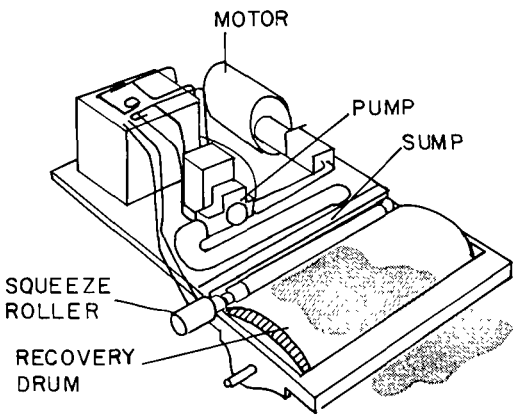
WELLES PRODUCTS CORPORATION
11765 Main Street
Roscoe, IL 61073
USA

telephone (815) 623-2111
telex 257-452

RECLAM-ATOR
Price not applicable

COLLECTION PRINCIPLE

Oil adheres to a rotating sorbent drum which is then squeezed by a roller arrangement. The recovered product flows into a sump from which it is pumped to remotely located storage.



PHYSICAL SPECIFICATIONS

Overall Length (m)	3.7
Overall Height (m)	1.5
Overall Beam (m)	2.3 and 3.0
Draught (cm)	25
Drum Length (cm)	63.5 and 127
Discharge Hose Diameter (cm)	3.8
Weight (cm)	227
Materials of Construction	aluminum, foam-covered drum (No. 10 & 20 pore sizes)
Power Requirements	5 HP at 1 800 rpm to 15 HP at 3 600 rpm; air-cooled Wankel rotary engine with underwater exhaust available
Debris	screens are optional
Additional Information	several units have been marketed, including the FR-40P (a self-propelled catamaran) and the smaller, non-propelled FR-40S skimmer

MODE OF OPERATION

The skimmer can be launched directly from a trailer (via ramp) or by crane. It is designed for both stationary and advancing modes. In the latter case, towing or pushing is required (in the non-propelled models). Off-loading facilities must be planned. Drive is hydraulic, variable electric, or mechanical constant electric. Intended application is in sheltered water, including API gravity separators in the case of smaller models.

PREDICTED PERFORMANCE

No performance data for the Reclam-ator were obtained.

See also Clear Seas Atlantic Ltd. OSCAR entry.

The rotating drum concept has been investigated by Environment Canada as an oil recovery principle (note above entry for references). The difference between the Reclam-ator and other machines incorporating a drum, namely those marketed by Bodan-Werft and Surface Separator Systems, Inc., is that the Welles Products device utilizes a foam-covered cylinder to both absorb and adsorb the oil.

Based on flume studies, it is still probable, however, that several operating parameters influence the recovery process. These would include the rotational speed, submergence depth and forward speed of advance of the drum in the oil. A range for each of these parameters likely exists over which optimum performance would be realized. Otherwise, oil entrainment could be expected, a problem which should be further compounded by wave forms which disrupt the oil layer before it can make contact with the drum. Satisfactory operation in a wide range of oils should be possible, although more viscous products skimmed at lower temperatures may present some difficulties as concerns removal by the roller mechanism. Sub-freezing temperatures and various debris forms might also interfere with the functionality of the sorbent material. Water entering the intercellular structure might freeze at lower temperatures thus rendering it non-sorbent; tearing or material degeneration could occur upon prolonged exposure in debris.

Overall, the Reclam-ator incorporates a simple design that when properly applied produces satisfactory results.

PREDICTED OPTIMUM APPLICATION

In calm, debris-free water; in light to heavy oil several millimetres or more in thickness; at optimum settings of drum rotational speed, drum submergence depth and relative velocity (likely less than 0.5 kn).

OTHER DATA

The Reclam-ator has been marketed in the past by Peabody Welles, Inc., also known as Welles Corporation (a subsidiary of Peabody Galion Corporation) of the U.S. In Canada, Napier Reid Ltd. has represented the product line. Inquiries made in August 1981 produced a reply indicating Welles Products Corp. was no longer making oil spill recovery equipment.

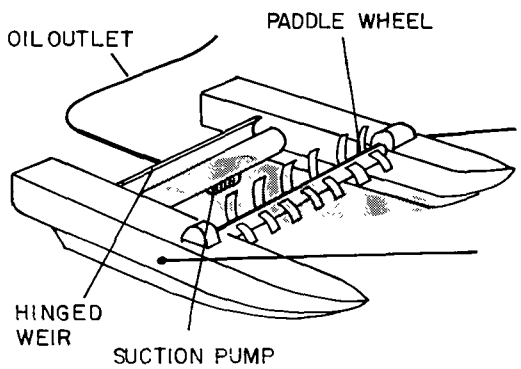
W.R. BISHOP & ASSOCIATES
Wharfside Building, Suite 474
680 Beach Street
San Francisco, CA 94109
USA

telephone (415) 775-5920

BISHOP OIL REMOVAL & RECOVERY SYSTEM
Price upon request

COLLECTION PRINCIPLE

A floating hinged weir held between two pontoons self-adjusts to accept an incoming layer of product which is then transferred to storage by a pump located in the collection sump. A paddle wheel assembly has been incorporated for wave and vortex dampening.



PHYSICAL SPECIFICATIONS

Various models are planned from 1.2 m to 6 m in width, with exact overall dimensions unspecified.

For standard models:

Weir Diameter (m)	1
Paddle Wheel Diameter (m)	1
Paddle Wheel Drive	30 HP hydraulic motor
Pump	vane-type centrifugal unit hydraulically powered
Oil/Water Separator	optional

MODE OF OPERATION

The Bishop System is designed to be towed alongside or pushed ahead of a suitable vessel so that it is manoeuvered through uncontained slicks. Power and control is achieved by a diesel/hydraulic package positioned on board the attendant vessel which also provides product storage. A baffled heat treatment oil/water separation system is also available to receive the oil/water mixture from the skimming head. Manufacturer-suggested applications include harbour, coastal, and offshore spills. Crane launching would be required.

PREDICTED PERFORMANCE

No independent evaluation data are known for the Bishop Oil Removal and Recovery System.

See also Skim-Pak entry under Douglas Engineering.

The sales literature indicates that a prototype unit was constructed in 1968 and subsequently (1971) applied to a spill in the U.S. The skimmer features a hinged weir which should function well to accept an incoming oil layer. Because it self-adjusts to some wave-induced motion, oil content, typically 5-40% depending on slick

thickness and oil properties and assuming calm conditions, will be as high as that of any hydro-adjustable weir device. The Bishop Skimmer should operate best in substantial thicknesses of 1 cm and greater. In thinner slicks, excessive water uptake could reasonably be expected.

Performance will likely be affected further by one other factor, namely relative velocity between the skimmer and the oil. At too high a speed of advance, entrainment is a probable occurrence as the oil might dive beneath the inlet before it has the opportunity to enter the system. Even if the pump-off rate were to be matched to a theoretical encounter rate, this hydraulic effect would likely become pronounced at some forward speed due to the vertical plane presented by the collection component.

It is also interesting to note that a much less complex advancing weir concept incorporated on a pontoon support structure has been evaluated in the U.S. (see M.G. Johnson High Speed Skimmer). While the two devices may outwardly appear to be similar, the Johnson Skimmer "encourages" the oil to submerge and in doing so to enter a simple slot lacking the hinged weir (which requires overflow). This feature largely eliminates the entrainment problem.

Overall, the Bishop Skimmer was one of the first "vessel of opportunity" devices and pioneered the work in advancing, hydro-adjustable weirs.

PREDICTED OPTIMUM APPLICATION

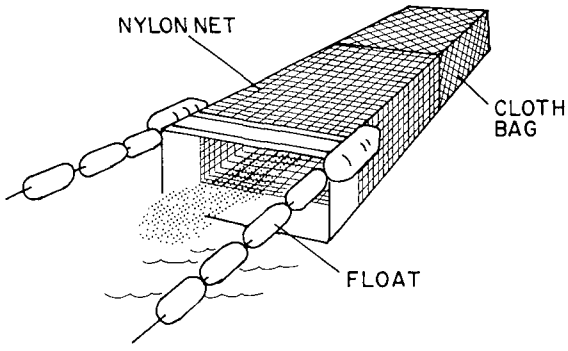
In light to medium viscosity oils available as slicks 1 cm or greater in thickness; in debris-free, calm conditions; at relative velocities likely about 0.75 kn and less.

OTHER DATA

Verification of the availability of this device should be made if it is of further interest.

Ajinomoto Co. Inc. and Sea Sweeper M-07
Morishita Chemical Industry Co. Ltd.
Japan

Sea Sweeper M-07

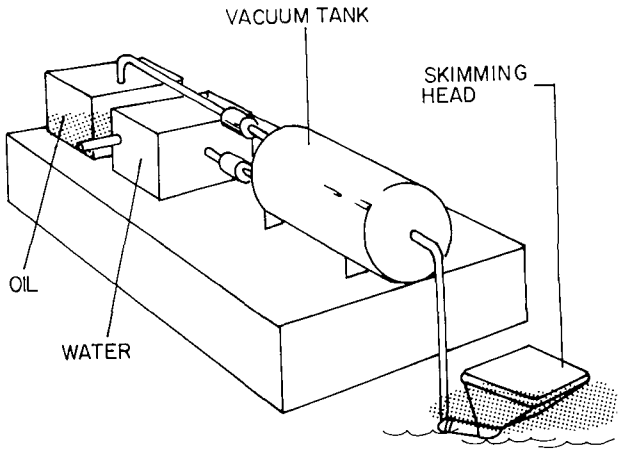


The Sea Sweeper M-07 is comprised of three parts, namely two sweeping booms, a netted central section, and a rear collection bag. Each of the sweeps is 20 m in length and leads into a 2 m long nylon body which in turn ends in a 3 m long cloth collection bag. The netting serves to maintain the integrity of the 2 m wide inlet to the rear section and is supported and reinforced by plastic piping. Floats on either side allow product to funnel into the device in a variety of wave conditions. The device was designed primarily for the collection of viscous products and oil-containing sorbent. Two towing vessels take up ropes attached to the end of the sweeps with a third craft trailing as the off-loading platform. Sales literature on the system has been distributed; commercial availability should be verified.

Alexander Cardew Limited
2, 3 & 5 Studio Place
Kinnerton Street
Knightsbridge
London, United Kingdom
SWIX 8EP

The firm has represented Gabbiano Skimmers manufactured by Industrie Meccaniche Ing. A. Scardellato (see main entry for further details).

Allweiler AG
West Germany

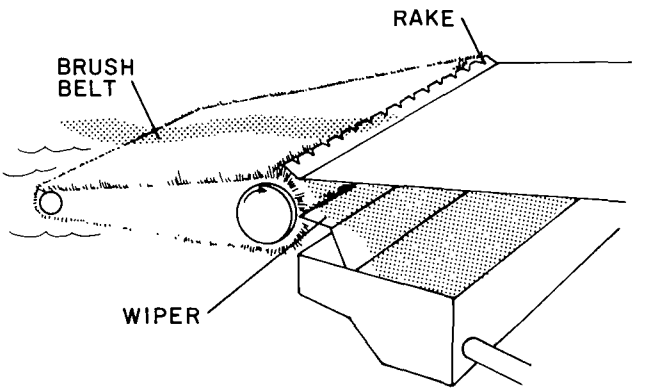


This well-known pump manufacturer designed an offshore skimmer that features a hydro-adjustable weir system 2 m x 1 m. Recovered product flows into a 10 m^3 tank maintained under a low vacuum where oil/water separation occurs. The two phases are then pumped to two tanks for further concentration, with water pumped into one tank and oil withdrawn from the primary receival unit into the other tank. Oil transfer to an attendant vessel then takes place. The system has been conceived for operation from a barge or supply ship. Reported in Ocean Industry, October, 1978, p. 121.

ABBREVIATED ENTRIES

American Oil Co.
Research and Development Division
Whiting, IN
USA

Absorption Oil Skimmer & Brush Belt Oil Retriever



The Absorption Oil Skimmer uses a flexible belt fabricated from open-celled polyurethane foam which rotates on a drum to pick up spilled oil which is then squeezed from the foam by rollers.

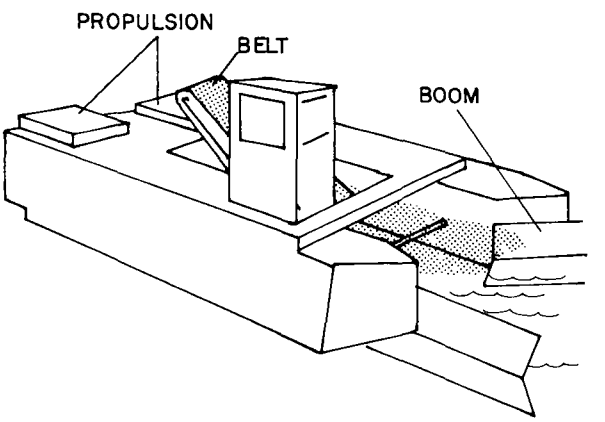
The Brush Belt device features a belt comprised of polypropylene bristles mounted on an inclined conveyor. A rake removes collected debris while oil is scraped by a wiper bar.

Reported in Petroleum Engineer, April, 1972, p. 59.

Annand Steel
Truro, Nova Scotia
Canada

telephone (902) 895-4458
telex 014-49558

Oil Cat



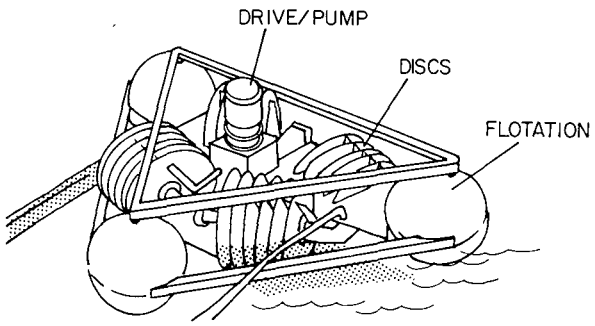
The Oil Cat is a 10 m long craft with 3.7 m beam and 41 cm draught which incorporates the Slicklicker oil recovery apparatus (see main entry under R.B.H. Cybernetics (1970) Ltd.). Power for this self-propelled vessel is supplied by twin 53 HP air-cooled Volkswagen engines which drive 30 cm Jacuzzi jet pumps. Construction is of zinc/epoxy coated steel (5 440 kg) or aluminum (3 630 kg). Optional accessories include deflector screens, oil transfer pumps and trailer, with operator cab and sling lifting lugs standard.

Atlantic Research Marine Systems
A Division of the Susquehanna Corporation
3333 Harbor Boulevard
Costa Mesa, CA 92626
USA

telephone (714) 546-8030
telex 910-595-1527

Oil Spill Reaction System

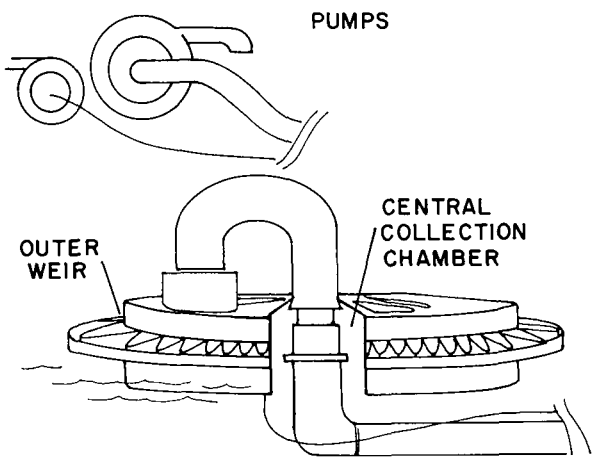
The Oil Spill Reaction System is similar in design to other disc skimmers with the exception of the very large disc diameter of 2.1 m. It is held at the apex of two deflecting booms which are used to convey product to the unit. Scrapers remove oil adhering to the discs to a central sump from which it is removed by an on-board pump to a trailing vessel. The sales literature refers to an available model with two rows each containing the discs.



B. Cellini
Florence
Italy

Perseus Skimmer

Oil and water overflow a circular outer weir lip and enter a central separation chamber where water is removed by one pump while oil is transferred by a second pumping system, both remotely located. Back-washing is possible to clear debris from the intake. This neoprene skimmer with 316 steel intake is 180 cm in diameter, 20 cm in height and weighs 141 kg. Flotation is provided by cellular polyurethane; the pumps are centrifugal, self-priming units powered by a 6 HP diesel engine.



A detailed brochure describing the skimmer was received by Environment Canada; however, a complete address was unavailable.

Biggs Wall Fabricators Ltd.
Hampden House
Hitchin Road
Arlesey, Bedfordshire
UK

telephone (44)0462-731133
telex 826113 BIWACO G

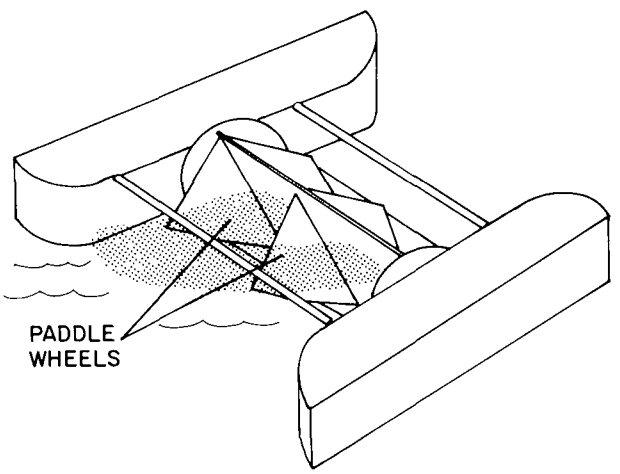
Springsweep System

Biggs Wall has participated in the development of the Springsweep System under the direction of Warren Spring Laboratory (see also separate entry for Warren Spring). The company has provided equipment associated with the oil suction device. Components include a 30 HP diesel power pack, air compressor and 15 cm intake line with suction head. The package is used in conjunction with the Trelleborg AB Troilboom as an "over-the-side" advancing skimmer.

Boss Industry
Kristiansand
Norway

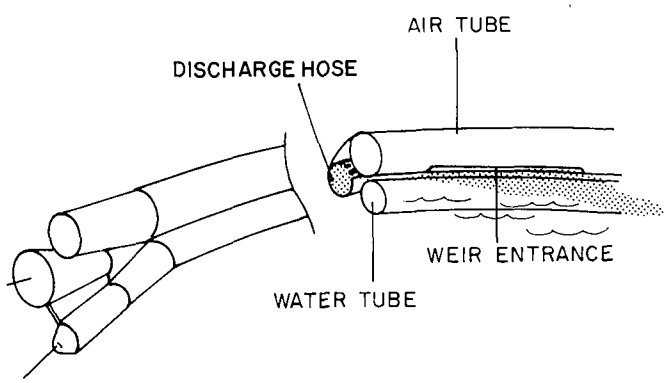
A prototype oil skimmer was developed comprised of a rotating funnel-shaped paddle wheel driven by a hydraulic motor and supported between pontoons. Overall width is 5.5 m and paddle wheel diameter is 2 m.' Control is achieved via a power pack positioned on a mother ship.

Commercial availability is not known.



British Petroleum Company Limited
Research Centre
Sunbury-on-Thames
Middlesex, England
TW16 7LN

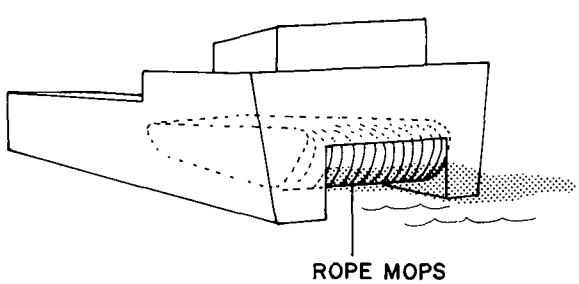
Weir Boom System



British Petroleum, with the support of the Norwegian and British governments, has developed a weir boom system. Work has proceeded slowly and deliberately on the project which began August 1977 with a full-scale prototype evaluated in November 1979 at the Ixtoc-1 well blowout in Mexico followed by testing of the skimming component at OHMSETT in October 1981 under a private user's agreement.

The device is based on the Oceanpack marketed by Vikoma International Limited. It is a boom fabricated from Butaclor-coated nylon material and is comprised of two main chambers: a 0.68 m air tube and a lower 0.56 m water chamber. In the weir system, a third 0.3 m compartment carries hydraulic lines and provides additional buoyancy for the weir pumps and hydraulics. Ten weir openings each 1.2 m long by 75 mm high are spaced at 6 m intervals in a boom 120 m in total length. A plastic vane pump conveys product from each weir (there are ten pumps in total); the pump has been designed to process debris 15 mm in diameter and is protected by a stainless steel grill which prevents larger items from entering. Each pump assembly weighs 30 kg and is mounted in a protective aluminum casing. Total pumping capacity is rated at 625 m^3/h. Other gear consists of a 85 kW diesel power pack, two 15 cm centrifugal pumps for on-deck recovery, deflector booms and couplings, and a hydraulic dump valve to relieve pressure in the discharge tube. Reported in the Proceedings of the 1981 Oil Spill Conference, pp. 643-648, American Petroleum Institute, Atlanta, GA, March 2-5, 1981.

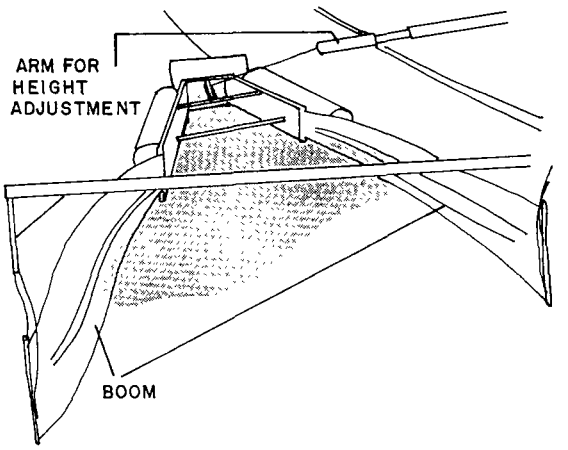
C. Hoyer
Lyngby, Denmark
Lindo Shipyard
Odense, Denmark



The development of a prototype skimmer was announced by Lindo Shipyard ultimately to be a 4 000 tonne, 80 m x 30 m catamaran incorporating an oil mop sorbent system between its hulls. Cost was estimated at 120 million DKR in 1978; this vessel was designed for the cleanup of spills in coastal waters as well as for fire fighting, supply transfer, and workshop/offshore installation activities. Reported in Scanshore, January/February, 1978, p. 18.

Clean Atlantic Associates
contact:
Haliburton Services
P.O. Box 1431
Duncan, OK 73533
USA

Fast Response Open Sea Skimming System
(Don Wilson Skimmer)



Several models of the Fast Response System have been evaluated, including examination via both in situ trials and tank tests at OHMSETT. The basic unit consists of a V-shaped boom which forms a 10 m wide swath at the side of a single support vessel. At the boom apex, oil is taken up by a suction head which remains buoyant at high speeds due to pontoon-type floats which support it. These can be adjusted in height to optimize the position of the skimmer. The system has been designed for relative velocities to 2-3 kn. In the U.S. tank trials, performance was evaluated at speeds to 2.25 kn with heavy (6.52 cm^2/s) oil and to 3.5 kn using medium (1.66 cm^2/s) oil in harbour chop waves to 0.63 m significant wave height. Details of the evaluations should be requested through Clean Atlantic Associates.

Reported in:

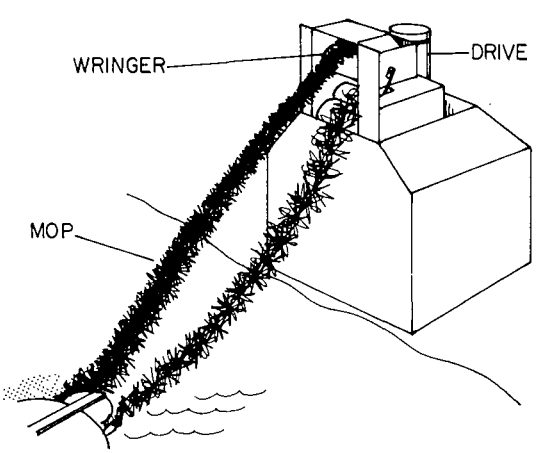
(1) Proceedings of the 1979 Oil Spill Conference, pp. 229-236, American Petroleum Institute, Los Angeles, CA, March 19-22, 1979.

(2) Proceedings of the 1981 Oil Spill Conference, pp. 661-666, American Petroleum Institute, Atlanta, GA, March 2-5, 1981.

Containment Systems Corp.
P.O. Box 1390
Cocoa, FL 32922
USA

telephone (305) 632-5640
telex 566-535

Mop-Wringer



Containment Systems Corp. markets an oleophilic rope skimmer. It is available in several models with a number of optional features, and includes a motorized drive/wringer assembly with sump, endless fibre rope and return pulley. For information on the performance of a similar device, see main entry Oil Mop, Inc.

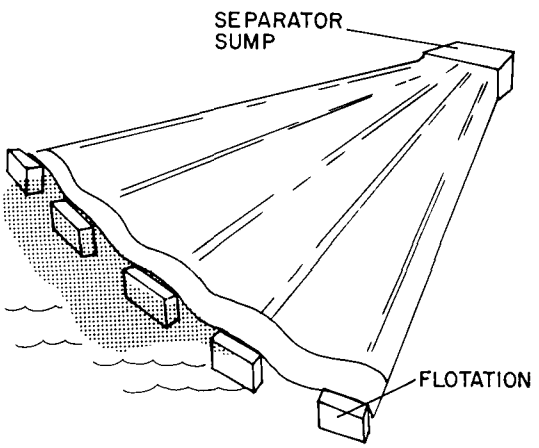
Core Laboratories
7501 Stemmons Freeway
Dallas, TX 75027
USA

telephone (214) 631-8270

Core Skimmer

(Sea Sweep, Inc.)

This triangular device is a unitized boom/skimmer which utilizes a series of long funneling corridors to direct product into a rear separator/sump. The basic sump unit measures 1.2 m by 4.6 m, with a maximum sweep width of 18.3 m. Draught of the empty system is 1.8 m. Two 350 HP towing vessels are required to manoeuver the skimmer through a slick. A "Presser" pump with 10.2 cm discharge hose is included.



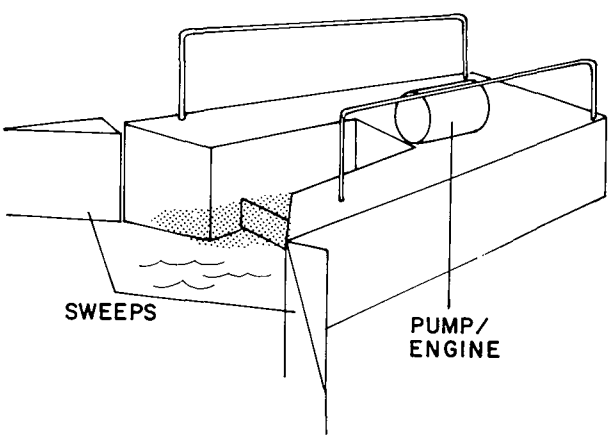
Reports indicate the use of a Core Skimmer with a 4 m wide inlet in Lake Maracaibo. The skimmer was also associated with Sea Sweep, Inc. For performance data on similar concepts, consult main entries Nylands Verksted and Fiskeredskap A/S.

Crisafulli Pump Co., Inc.
P.O. Box 1051
Glendine, MT 59330
USA

telephone (406) 365-3393

Crisafulli Aqua-Sweeper

This well-known pump manufacturer designed a 3.1 tonne self-propelled weir skimmer. Overall vessel dimensions are: length, 4.88 m; beam, 2.18 m; hull height, 1.52 m; draught, 1.57 m; power supplied by a gasoline engine (31 HP rated at 3 000 rpm). The catamaran-type craft is trailerable and includes a 10.2 cm Crisafulli centrifugal pump with 453 L storage sump. Crane-deployable or self-launching from a tilt-bed trailer, the unit incorporates sweep arms with a 2.7 m swath capability; it was designed for the recovery of lighter oils in sheltered waterways where a current exists between the oil and vessel.



De Smithske A/S **Destroil**
Tagholm 1
Dk 9400 Norresundby
Denmark

telephone (45)(08)17 81 11
telex 69620 DESMI DK

The company has been associated with the Destroil Skimmer and holds Canadian and U.S. patents on the device. See main entry under Gustaf Terling AB for information on the Destroil.

Eimbcke Oilskimmer GmbH
2000 Hamburg 1
West Germany

telephone (49)(040)33 351
telex 02 161 725 A EICD

The company has constructed catamaran vessels which feature a collecting channel, separation tanks, and oil and water pumps. Models are designated EOS T followed by the approximate length to include 3 m, 8 m, 15 m and 30 m craft. The smallest vessel requires an external power supply and can store 2 100 L of product; the largest skimmer is designed for coastal waters, stores 135 000 tonnes of product, and is powered by twin Caterpillar D353 marine diesel engines. The 8 m and 15 m harbour vessels hold 10 000 and 20 000 L, respectively, and are also self-propelled.

Euro-Matic Ltd.
May Crete House
Boston Manor Rd.
Brentford 1
Middlesex
UK

telephone (44)(01)560 6372

A request for information failed to produce a response. It is not known whether the firm manufactures/markets skimmers although its name appears on such lists.

Far East Levingston Shipbuilding Ltd.
31 Shipyard Road
Jurong Town
Singapore 22

telephone Singapore 652144
telex RS 21513

A request for information produced no response. The firm has been listed as a manufacturer/supplier of spill equipment.

Frank Ayles & Associates Ltd.
27-28 Mitre Street
London EC3A 5BU
UK

telephone (44) 01 247 1926
telex 886089

The company is a firm of export managers which markets equipment for Biggs Wall Fabricators Ltd. and others. Although sometimes listed as an equipment producer, Frank Ayles is only known through the course of this study to represent the manufacturers of spill technology.

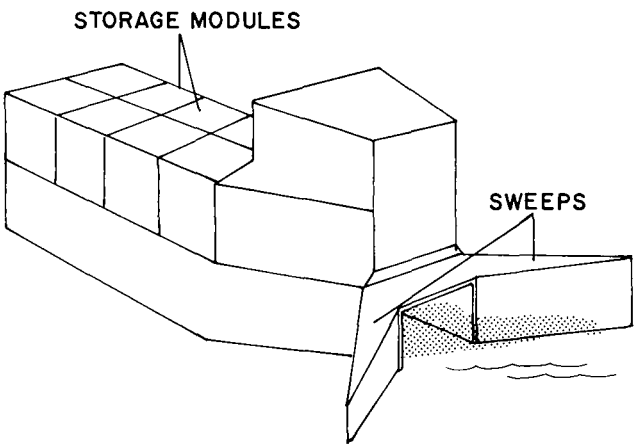
Frimokar Anstaly **Frimokar**
Zollstrasse 225
Im Malarsch 4
F1-9494
Schann
West Germany

telephone (49)(075)23348
telex 77945

No information was received from Frimokar on skimmers manufactured by the company.

Gotaverken-Finnboda
Svenska Varv
Sweden
contact: Mr. C. Belfrage

A self-propelled barge has as its distinguishing feature 40 stainless steel tank containers 6.1 m in length arranged on deck. When filled, they can be exchanged for empty modules or the contents pumped to small tankers. Total capacity is 800 tonnes; the unloaded draught is 1.5 m. The skimming component positioned between sweeps at the bow is unspecified. The 1978 cost estimate for this multi-purpose vessel was 15-16 million SEK. Development of the concept to the commercial stage is not known.



Reported in Scanshore, January/February, 1978, p. 40.

Gustav Trellenberg K.G.
Technische Ausrustung
Vogelsang 126
Postfach 1166
2070 Ahrensburg
West Germany

telephone (49)(04102)5.12.59
telex: 2 189 840

No information was obtained for G. Trellenberg. The name has appeared as a manufacturer/supplier of skimming equipment.

Harding Pollution Control
5719 Kirby Drive
Houston, TX 77005
USA

telephone (713) 524-9445

also

Kirkland, Washington
USA

The company sold a self-propelled weir/polyurethane belt skimmer mounted on a catamaran. Design was based on early conventional mechanical belt skimmers developed by Bennett Pollution Control Ltd. of North Vancouver, British Columbia.

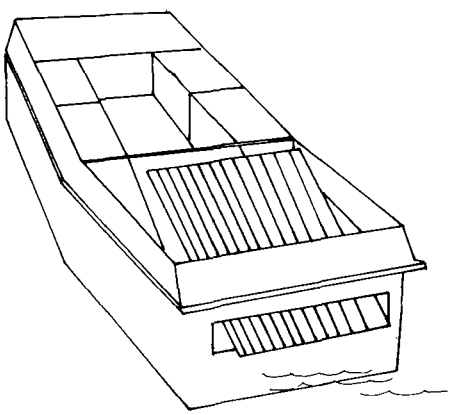
Twin 353-GM diesel engines were used to drive a 12 m long vessel with a 3.7 m beam and weighing 21 tonnes.

Current availability of the system is uncertain.

Harmstorf Limited
65 Cannon Street
London-EC4
UK

telephone (44)(01)236 2576

Harmstorf Corporation of 446 West 34th Street, New York, NY 10001 USA, patented and marketed a self-propelled oil recovery vessel consisting of a steel boat, belt skimmer, collection tank and transfer pump (eccentric screw type). A 22 HP diesel engine was used to power three hydraulic drives (propeller, belt roller and pump). Various models were available including shore-mounted belt systems. Inquiries produced a response from Spearin, Preston & Burrows, Inc. of New York indicating the availability of the Harmstorf (UK) Pneumatic Barrier only.

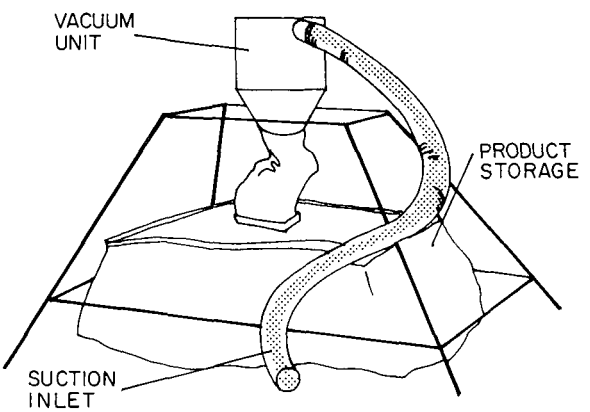


Harrier Marine Limited
Pilsworth Road
Bury BL9 8RL
Lancashire, England

telephone (44)(061)796 8703
telex 666754 AB HARPEX G

Oil Master High Vacuum Series

Harrier Marine markets a series of air-driven vacuum units in five sizes including the smallest HV2 system up to the largest HV9 model. The lower-capacity machines are mounted on a frame so that product, picked up by a simple suction hose, drops into a hopper and flexible compartment arrangement. A diesel powered screw compressor can be trailer- or vessel-mounted for fast response capability. The larger units have a design capacity of 86 m^3/h and can be applied to lightering operations.

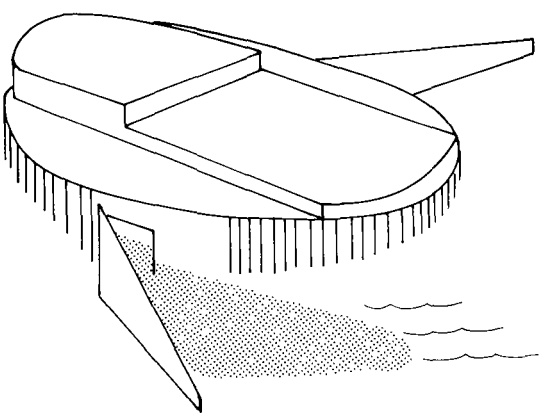


Harrier Marine also have developed a catamaran recovery vessel called the Oilmaster Belt Skimmer for the collection of a range of oils including viscous products.

Houlder Offshore Ltd.
Norway

contact: Mr. Thor Haavie

This patented offshore spill device consists of a circular vessel 6 000-7 000 tonnes in displacement (30 000 dwt loaded) and 45.7 m in diameter. Wings 22.9 m in length open out on either side to direct oil into openings at the base of the wings. A slowly rotating paddle within the vessel would assist in drawing in oil, with 22 700 L/min pumps removing oil. With 10 000 HP, the craft was designed to operate with a draught of 18.3 m and have a transit draught of 3.7 m. Cost in 1977 was estimated at $35 million (U.S.). It is not known whether the skimmer was developed beyond the conceptual stage. Reported in Ocean Industry, August, 1977.



Hyde Products, Inc. **Destroil**
810 Sharon Drive
Cleveland, OH 44145
USA

telephone (216) 871-4885

Hyde Products is the U.S. distributor of products developed by Gustaf Terling AB of Sweden (see main entries under the latter's name).

Industrial Plastics Canada Ltd.
P.O. Box 93
Fort Erie, Ontario L2A 5M6
Canada

telephone (416) 871-0412

IPCL is the Canadian distributor of products manufactured by Slickbar, Inc. of the U.S. See main entries for Slickbar.

Intermar Corp. S.A.
Case Postale 218
CH-3963 Crans
Switzerland

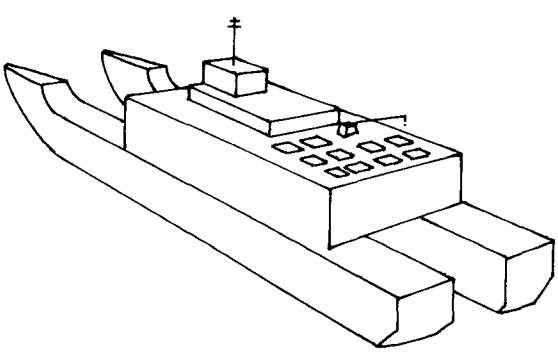
telephone (41)(27)432907
telex 38562 KASA CH

This company has been an international distributor of equipment manufactured and sold by Costruzione Batelli Disinquinanti (Co. Ba. Di.) S.p.A.

Kaldnes Mekaniske Verksted A/S **Oil Catcher**
P.O. Box 420
N-3101
Tonsberg
Norway

telephone: Tonsberg (47)11640
telex: 11561

The company devised a system called the Oil Catcher which utilizes a 104 m, 10 000 dwt catamaran vessel as the mother ship. A weir-type skimmer accepts product concentrated by large booms. The ship is designed for other purposes. Reported in Ocean Industry, October, 1978, p. 118. It is not known if development beyond the conceptual stage has taken place.



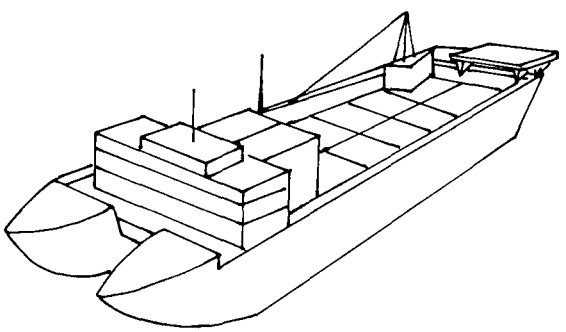
Kepner Plastics Fabricators Inc.
3131 Lomita Boulevard
Torrance, CA 90505
USA

telephone (213) 325-3162
telex 691646

Kepner markets a skimming system that includes a SLURP Skimmer, diaphragm pump, oil/water separator, storage bag and other accessories. For information on the skimmer, see main entry under Seaward International, Inc.

Kristiansand Mechaniske Versksted
Norway

Sea Vac Recovery System



A group of companies has designed a skimmer that functions between the hulls of a 10 000-20 000 dwt ship where wave activity is dampened. In addition to Kristiansand, others involved include the Institute for Continental Shelf Research, the Parley Augustsson Shipping Group, NEBB A/S, Promaco A/S and Scandinavia Maritime A/S, with the latter heading the project. Work started in 1976 and was aimed at a recovery vessel with a maximum speed of 15 kn. Commercial availability is not known.

Reported in Ocean Industry, October, 1978, pp. 120-121.

Krupp Reederei und Brennstoffhandel
Ruhrurter Schiffswerft
Homburger Strasse 50

P.O. Box 130580
4100 Druisberg 13
West Germany

telephone (49)(0203)89077
telex 855774

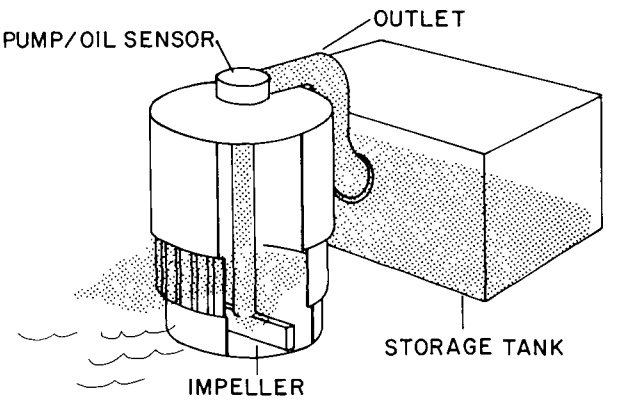
No information was available from the company although written requests for data were sent.

Lisep Ltd.
866 Second Avenue
New York, NY 10017
USA

telephone (212) 421-6407

Lisep System

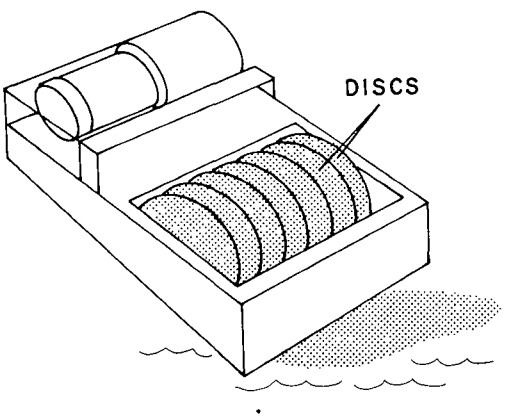
Lisep Ltd. has developed a unique skimming concept taken to the prototype stage and evaluated at OHMSETT in 1981. Oil and water enter a circular separation chamber through slots. The action of an impeller creates a central core of the oil which, once sensed by oil discriminating apparatus, is then pumped through a central conduit to on-board storage.



Tank testing has shown the device to have some promise; however, mechanical difficulties related to off-the-shelf hardware were encountered. Further development work is likely.

Lowe Engineering Company
Lincoln Park, NJ
USA

This skimmer features 46 cm plastic discs that rotate within a coated carbon steel or stainless steel frame to recover floating oil. Power is provided by an explosion-proof motor through a gear reduction and chain drive. Pontoons, trash guard and heated hood are listed as optional.



Reported in Chemical Engineering, March 4, 1974, p. 90.

Marine Equipment Ltd.
309 Cooper Street
Suite 312 A/B
Ottawa, Ontario K2P 0G5
Canada

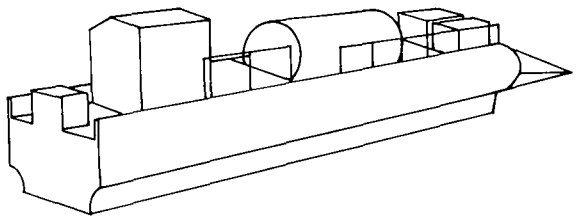
telephone (613) 232-3701
telex 053-3758

Marine Equipment Ltd. markets in Canada products manufactured by Vikoma International Ltd. of the UK (see main entries under this name).

Marine Pollution Control Corporation
9010 Roselawn Avenue
Detroit, MI 48204
USA

telephone (313) 931-1035

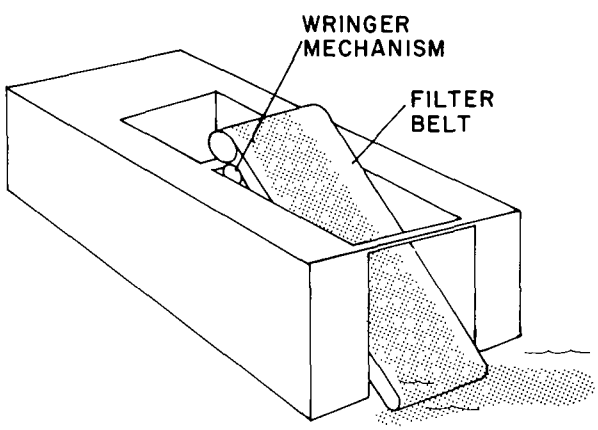
Buda II



An Anti-Pollution Barge was developed by Marine Pollution Control Corporation as a multi-purpose, self-propelled vessel. Debris removal and oil skimming are listed as two of its intended functions. The skimming component consists of 5.1 cm flexible intake hoses connected to a vacuum system with "skimming adapters" included on the suction end to accommodate wave motion. A hoist further controls the level at which skimming takes place. Holding capacity is comprised of four tanks with a combined volume of 24 225 L. A water pump and manifold arrangement accesses all tanks for removal of settled water.

The vessel is 12.2 m in length, with a 3.2 m beam and a hull depth of 107 cm. It is constructed of 0.64 cm steel plate and weighs 13.2 tonnes, including 1 tonne cargo hoist. Twin 86 HP diesels have two functions: one provides propulsion while the other drives a 25 kW generator (for deck power requirements). The Buda II is capable to 7 kn unloaded and 5.2 kn loaded. Four pad eyes allow crane or boom bridle lifting with transport by air, land or water possible. It has been designed for semi-protected waterways such as lakes, bays and harbours.

Martin Marietta Corporation
P.O. Box 179
Denver, CO 80201
USA



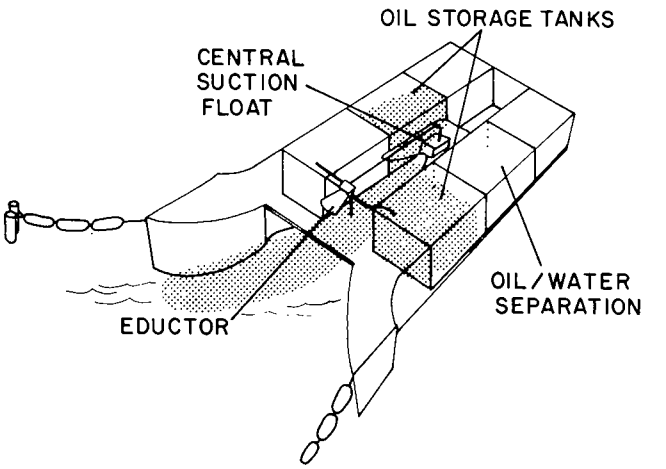
An endless, rotating filter belt operates between the hulls of a catamaran to pick up both oil and debris. A prototype unit 10.7 m long, 3 m in the beam, with a 76 cm draught was marketed. The unit featured a 1 m belt and oil transfer system driven by a 30 HP engine. For the performance summary of a similar recovery concept, see Marco Pollution Control entries.

Mitsubishi Heavy Industries Ltd.
Nagasaki Shipyard & Engine Works
1-1 Akunoura-machi, Nagasaki 850-91
Japan

telephone Tokyo (81)(212)3111
telex 22282

Oil Spill Recovery Ship

Mitsubishi designed a self-propelled, twin-hull craft 9.6 m long with a 4.1 m beam and 1.4 m deep for oil skimming. The vessel features an eductor-driven oil suction that floats freely so that wave motion is accommodated. The recovery system includes a series of steps designed to maximize oil content in the collected phase and water content in the discharged liquid.



Once skimmed by the floating suction head, the first concentrating phase for the recovered fluid consists of two settling tanks (one in each hull). The oil phase is pumped into a second separating tank (again there are two) while the water phase is recirculated to the eductor. The oil is then stored in twin tanks; the water from the separating tank passes through a final oil adsorber tank before being discharged.

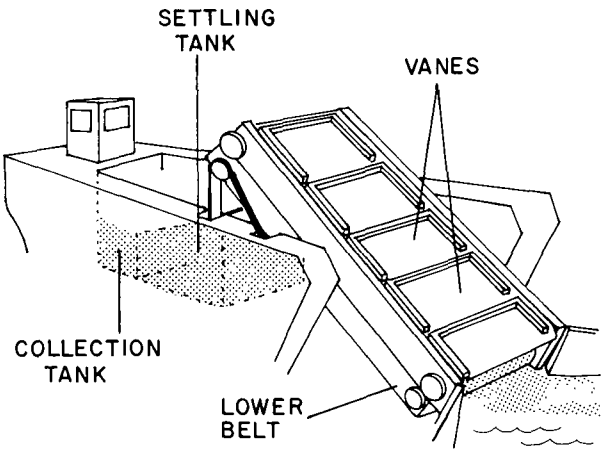
The prototype ship includes a 80 HP four-cycle diesel engine as a prime mover. It is water-cooled and drives twin variable speed (0.5-6 kn at 200-1 200 rpm) propellers, eductor, twin water discharge centrifugal pumps and two oil transfer pumps. The settling, separator and storage tanks are each 1 m^3 in capacity, with the polypropylene oil adsorbing tanks each 0.2 m^3 in volume. Mitsubishi originally constructed the skimmer as an experimental ship; its commercial availability would have to be confirmed.

Refer to:

Uchida, S., H. Takeshita and Y. Seike, Development of Oil Spill Recovery Ship, Proceedings of the 1977 Oil Spill Conference, pp. 367-374, New Orleans, LA, March 8-10, 1977.

Mount Royal Marine Repairs Ltd. **Unimop**
P.O. Box 250
Station C
Montreal, Quebec H2L 4K1
Canada

telephone (514) 844-1071



The Unimop anti-pollution barge and conveyor assembly was conceived for the removal of oil and debris primarily in harbours but also for a range of applications. The recovery component consists of two rotating endless belts both inclined at an angle and arranged so that one is positioned immediately above the other. The top conveyor includes fixed horizontal vanes and rotates down into an incoming layer of oil so that the vanes form individual pockets against the smooth surface of the lower belt rotating in the opposite direction but at the same speed as the upper belt. Thus oil is conveyed up between the belts and is discharged into an open top settling tank, finally collecting in a second adjacent compartment where it is stored. Debris is collected in a similar manner. Both belts are driven by a chain and sprocket arrangement with drive components unspecified. Although the concept is patented, standard model sizes are not defined in the literature; the engineering details of the drive arrangement, hydraulic adjustments and ballasting are provided. It is uncertain whether or not the concept has been taken beyond the construction of a small-scale, tank model.

MSE Engineering Systems Ltd.
265 Canarctic Drive
Downsview, Ontario M3J 2N7
Canada

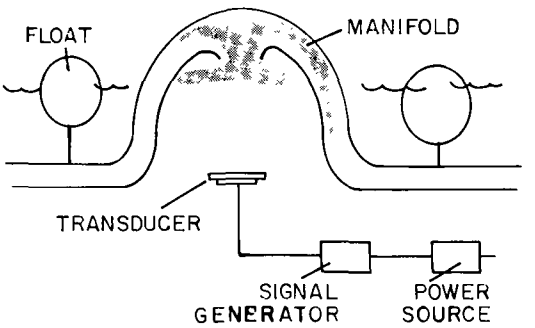
telephone (416) 661-5646
telex 065-2398

MSE is the distributor in Canada of skimming equipment manufactured by Megator Corporation of the U.S. (see main entries).

Ocean Ecology Ltd.
10th Floor, 549 Howe Street
Vancouver, British Columbia
V6C 2C6
Canada

telephone (604) 685-8241

Ultrasonic Skimmer



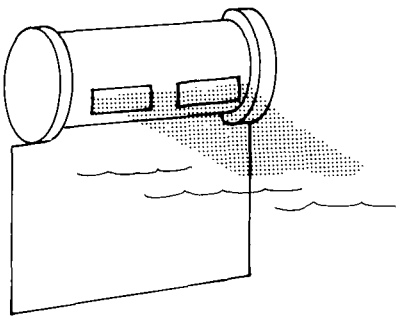
Mr. John Koblanski, associated with Ocean Ecology Ltd., has investigated and developed ultrasonics to the test tank model stage as a means of recovering oil. The technique centres around a vibrating transducer which emits energy that is directed from below the water's surface toward the air/water interface. There, the large impendance mismatch between the two fluids results in a reflection of energy. If floating oil is located at the interface, it is deflected into the air as a vertical column and can then be collected by a manifold. The advantages of the approach include the variations in intensity of the energy used (power level) so that different viscosity oils can be affected; the range in possibilities of focussing the energy to achieve the effect at specific locations; and the manner in which the signal seeks out the reflecting surface even if constantly changing position (i.e. the phenomenon should work in limited wave conditions). Smaller models have been constructed which have also demonstrated that it is possible to atomize lighter oils, such as diesel, using a sound transducer and combust it in a single step. A program of preliminary investigations into transducer types, emission frequencies, power levels and oil collection rates and combustion was overseen by Environment Canada in 1978 through 1980, with a report submitted in June 1980.

Contact: Environmental Emergency Branch, Environment Canada, Ottawa, Ontario K1A 1C8, Canada.

Oil Gulp
P.O. Box 340
Flora, IL
USA

Oil Gulp

This containment and recovery device (skimming barrier) exists in sections 11.6 m long and in three heights, 35.6 cm to 81.3 cm.



Water is pumped through the barrier so that it carries oil (that has entered through openings along its length) to a recovery vessel.

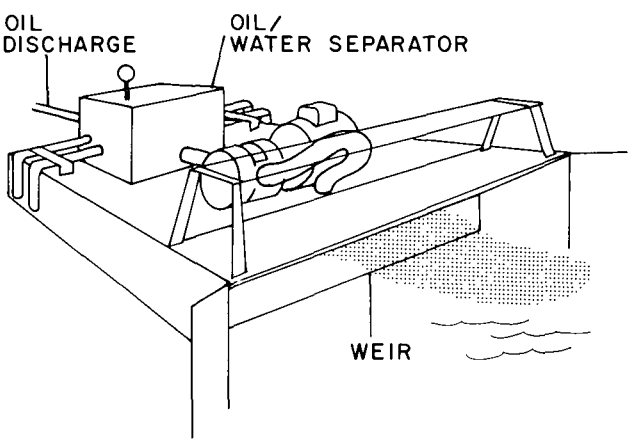
Reported in Oil and Gas Journal, January 8, 1979, p. 117.

Oil Sweeper Corporation of Canada Ltd.
St. Andrews West, Ontario
Canada

Lalonde Oil Sweeper

Developer: Mr. H.J.M. Lalonde

telephone (613) 933-4015



One of the first commercially available oil skimmers in Canada, this device is comprised of two components, namely a skimming head and an oil/water separator. The suction head consists of a simple overflow weir and sump. The latter incorporates discharge ports through which water exits during the collection process. Product is then pumped into a baffled tank so that concentrated oil can be drawn off the top while water discharges through a bottom valve arrangement. Provision for the recycling of the water phase is also included. The skimmer was constructed as a non-propelled vessel designed to be advanced through a slick in protected waters. Standard sizes are not indicated in the sales literature. Recent brochures were not obtained and the status of the skimmer as a commercial entity was not determined.

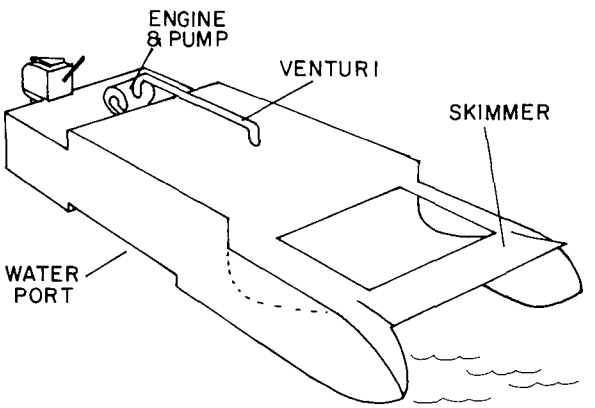
Philip C. Speer and Associates, Inc.
4 Weed Circle
Stamford, CT 06902
USA

Water Pollution Controls, Inc.
2035 Lemoine Avenue
Fort Lee, NJ 07024
USA

telephone (201) 224-8182

Slick-Sled

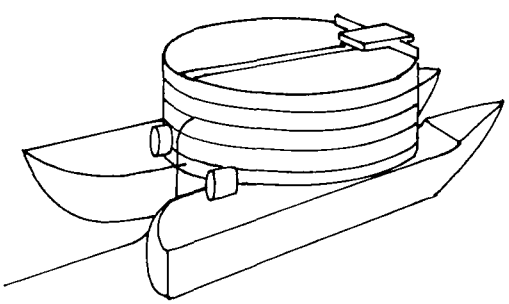
The Slick-Sled is a self-propelled catamaran vessel which supports an open-bottom chamber between the pontoons. An inclined bow ramp submerges product which then rises into the collection chamber. From there, accumulated oil is removed to attendant vessels supplying storage capacity.



The skimmer incorporates a venturi system which initially raises the water level in the collection chamber so that oil will rise through a maximum vertical distance thereby displacing the water. The venturi can also be used for deballasting the pontoons. A 4.3 m prototype called Model V25 was designed with additional sizing available upon request. For performance data on a similar collection concept, see main entry Global Oil Recovery Systems Inc. DiPerna Sweeper.

Ragnar Blesvik
Norway

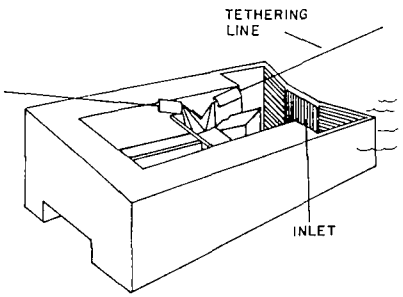
Two tanker hulls, each of 7 000-10 000 dwt, are employed in this design concept as the supporting bases for a central cylindrical mid-body. The round superstructure would be used to store 3 000 m of boom, with the whole system kept on standby at the offshore oil field. Independent floating skimming heads would then be deployed within the contained area. This approach differs from most other larger vessel recovery schemes in that an oil collection component is not incorporated between the hulls. See also C. Luhring Schiffswerft GmbH & Co. KG (main entry). Reported in Ocean Industry, October, 1978, p. 121.



Raumfahrttechynik GmbH
West Germany

ERNO Oil Skimmer

This skimmer has been researched in Germany. No details on the system were obtained but recent information suggests that it is a concept being pursued.

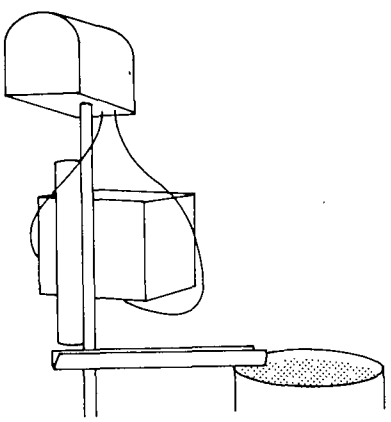


Reported at 1981 Arctic Marine Oil Spill Program Conference, Edmonton, Alberta, June 16-18, 1981 (does not appear in proceedings).

R.E. Wright Associates, Inc.
3240 Schoolhouse Road
Middletown, PA 17057
USA

telephone (717) 944-5501

Automatic Oil Bailer

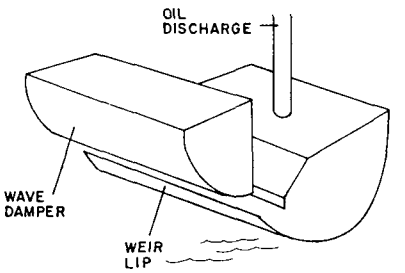


This relatively small automatic system was designed for the unattended recovery of light oil or gasoline from wells a minimum of 10 cm in diameter. It can be used in conjunction with a well drawdown pump so that product migration is either minimized or prevented. Adjustment to a range of depths is possible with timer-controlled pumping frequency. The equipment consists of a mechanical bailer 8.9 cm in diameter (3 L capacity) operated by a self-reversing motor-driven winch. It is driven by a 1/3 HP, 115 V, single-phase reversing motor mounted in a NEMA 7 explosion-proof enclosure. Installation space required is 2.4 m x 0.6 m x 1.2 m.

Lt. Cdr. R.G. Teasdale-Developer
Royal Navy
Assistant Captain of the Port
HM Naval Base
Portsmouth
UK

Oleanic Skimmer

A wave suppressor held between the hulls of a catamaran assists in presenting an incoming layer of oil to an adjustable weir lip positioned at the craft's centre of buoyancy. The oil flows into a pump-evacuated chamber. A prototype vessel was constructed but commercial availability is uncertain.



RNG Equipment Ltd.
32 Stoffel Drive
Rexdale, Ontario M9W 1A8
Canada

telephone (416) 249-7383

RNG is the Canadian distributor of equipment manufactured by Oil Recovery Systems, Inc. of the U.S. (see main entry).

Rotork Marine Ltd.
51B High Street
Reigate, RH2 9AE
Surrey
UK

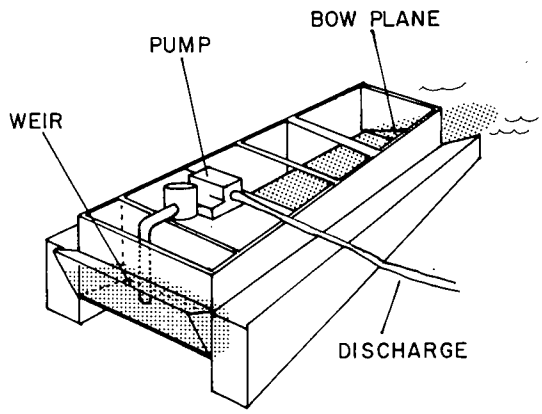
telephone (44)(07372)21121
telex 946744

No information on a separate and distinct oil skimming machine manufactured by Rotork was obtained. The company is known for its Sea Trucks which have been used in conjunction with OMI Limited equipment. Rotork has appeared, however, on several lists of skimmer manufacturers.

Seaward International, Inc.
6269 Leesburg Pike
Falls Church, VA 22044
USA

telephone (703) 534-3500
telex 899-455

Huskey Offshore Skimmer



Seaward International, Inc. manufactures a commercially available, non-propelled 12 m catamaran skimmer designed for offshore use. Oil collection takes place between the hulls of the vessel: product initially flows over an adjustable bow plane and then along a main compartment which incorporates a floor or ramp sloping downward toward the stern. The ramp ends in an adjustable weir and sump which accepts the surface layer of oil trapped between the hulls. An on-board pump transfers oil to attendant storage while water discharges through a slot in the skimmer's bottom end at a point immediately in front of and below the weir. The vessel operates with a 91 cm draught, has a 4.9 m beam and weighs 13 520 kg. It is designed for use in conjunction with two lengths of diverting boom.

Skim Inc.
1532 South Sunol Drive
Los Angeles, CA 90023
USA

telephone (213) 263-3829

Although Skim Inc. appears on lists of skimmer manufacturers, requests for information elicited no response.

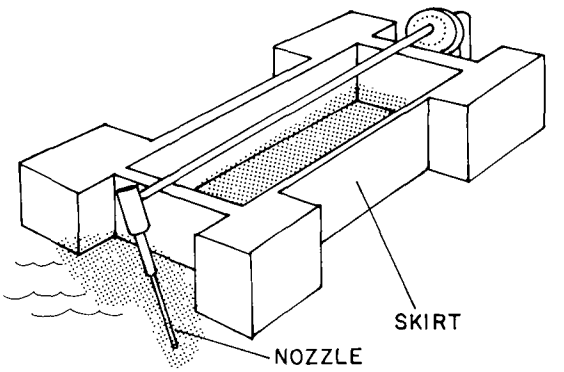
Skimovex B.V.
P.O. Box 1406
135, Binckhorstlaan
The Hague 2077
Holland

telephone (31)(070)83 04 25
telex 32135

Skimjet

The Skimjet oil recovery system has been designed in a variety of forms and has been used in spill cleanup. The system consists of a floating rigid fence arranged in a square configuration. A nozzle positioned at an angle on one side of the enclosure but exterior to it directs a jet of water onto a surface layer of oil. The "vortex" created draws the oil beneath the skirt and it rises up inside the enclosed area. An oil collecting funnel accepts oil upon its accumulation; transfer by gravity or pump to an oil collecting tank follows. The Skimjet has been designed as a 5.7 m oil recovery craft (model 3900 Harbour and River Unit), as a 1.3 m, 60 kg portable unit (Mini-Skimjet MS 1000) and as a system for placement in fixed facilities such as API gravity separator or offshore drill shafts.

MINI-SKIMJET



The 3900 model incorporates three 6.4 cm diameter jets, a collecting reservoir 2.4 m x 3.0 m, is constructed of normal carbon steel (zinc and epoxy coated) and weighs 6.5 tonnes. It is propelled by two 20-25 HP Volvo Penta YP 250 EL outboard motors with a 13-27 HP Hatz Z-790 diesel which drives a positive displacement star pump US 3100. The non-propelled Mini-Skimjet as a 1 m^2 reservoir, single nozzle and is of aluminum construction.

In Canada, the Skimjet system has been marketed by:

Control and Metering
A Division of McNamara Corporation Limited
711 Kipling Avenue
Toronto, Ontario M8Z 4G4
Canada

telephone (416) 259-8411
telex 06-967647

Skuteng A/S
Pottemakervn 8
Postboks 124
Vietnet
Oslo 5, Norway

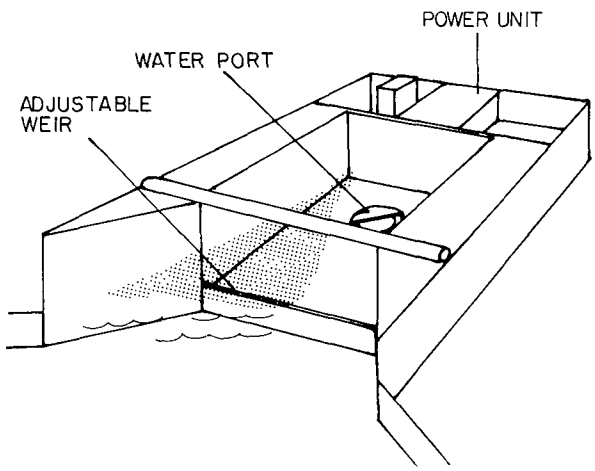
Skuteng A/S of Oslo has been involved with the development of the Ocean Pollution Recovery System or Soopres System. It consists of a number of ports in a ship's side which accept oil diverted to them by deflector booms. The concept is discussed under the main entry UNOCO (also known as the Skuteng/Aker approach). The company has also participated in the examination of oil skimming packages in concert with Gotaverken of Sweden.

Slickbar
250 Pequot Avenue
P.O. Box 139
Southport, CT 06490
USA

telephone (203) 255-2601

Clean Channel Skimmer

The Clean Channel Skimmer is a 6.4 m long steel catamaran with a 2.4 m beam powered by a 4-cycle diesel engine and 50 HP single screw. It was developed over a period of about seven years, first as a prototype and then modified upon subsequent use. An adjustable weir at the bow skims a surface layer of product which then overflows into a central collection area between the hulls. Entrapped water settles and exits through a central port in the bottom. The craft weighs 2 040 kg, holds 1 330 L, includes lifting eyes and pads, and operates with a 46 cm draught.



The Clean Channel Skimmer is a commercially available machine that has undergone comprehensive development work.

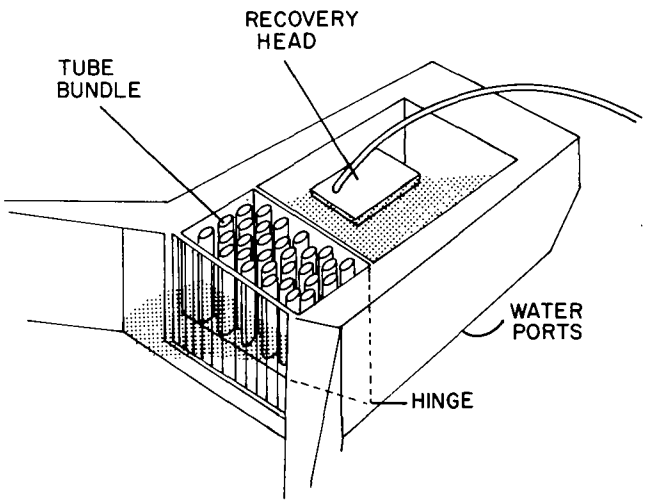
Spiltrol
A Division of Oceaneering International, Inc.
9219 Katz Freeway
Houston, TX 77024
USA

telephone (713) 461-4477

Seaward International
6269 Leesburg Pike
Falls Church, VA 22044
USA

telephone (703) 534-3500
telex 899-455

Inshore Sweep Skimmer
(Spiltrol Harbor Skimmer)



This skimming principle was developed by Shell Oil Company, and the device was manufactured by at least two firms, the most recent being Seaward International. The skimmer consists of a 7.6 m long catamaran vessel with a 3 m beam powered by a GM 3-53 diesel and inboard/outboard drive.

The collection component is housed between the pontoons. Oil passes through a debris screen; its flow is then slowed by a series of vertical tubes. The tubes form a bundle which is hinged at its lower, aft end so that it articulates with incoming waves. The oil then pools on the surface behind the tube bundle while water flows out the bottom of the device through submerged baffles. These are placed at a progression of angles so that water discharge occurs over the entire baffled area. A chevron-shaped recovery head effects the initial transfer of product from the collection area in the vessel. An "inverted funnel" weir suction head is also available for the off-loading of more viscous oils.

The Spiltrol is sold in aluminum (5 000 kg) or steel (6 250 kg), has a storage capacity of 4.45 m^3, and operates in the loaded condition with a draught of 85 cm. It includes a 7.6 cm self-priming diaphragm pump that is hydraulically driven. With its 6 m wide sweep provided by diverter booms, it was designed to be advanced through uncontained slicks in sheltered waterways such as harbours. It is a commercially available machine.

Tampa Drydock Company
Tampa, FL
USA

The company announced the planned construction of a 7.3 m catamaran which incorporates a rotating magnetic drum near its stern. A layer of ferromagnetic "polyfoam" is broadcast into oil and then funnelled back to the recovery drum where the oil-laden sorbent is picked up and squeezed through a wringing mechanism. On-board storage consists of two 1 893 L tanks. Development of the product as a commercial entity is unknown.

Reported in Ocean Industry, October, 1976, p. 77.

Tetradyne Corporation
1681 S. Broadway
Carrollton, TX 75006
USA

telephone (214) 242-1512

Tetradyne Air Jet Skimmer

The prototype device was comprised of an air stream generator which directed air 45° to the water's surface and of a low-current chamber into which the oil was deflected for subsequent recovery. Testing of the concept was conducted at OHMSETT May 3-23, 1976, at speeds to 6 kn using No. 2 Fuel Oil, naphtha, and two lube oils. Oil recovery rates varied between 0.025 and 0.56 m^3/h, while oil recovered versus oil encountered peaked at 28.4% but was generally much lower. The higer viscosity fluids were generally recovered more efficiently.

Lower performance was attributed to the inadequate supply of air to maintain a uniform nozzle velocity greater than 12 m/s; inadequate measuring instrumentation and control of air flow; and inadequate oil distribution and collection to provide accurate measurement.

It was determined that higher air velocities produced air bubble and oil entrainment at faster speeds which, it was suggested, might possibly be overcome by directing the air jet more parallel to the water's surface. Testing also showed that in slick thicknesses less than 0.2 mm, performance improved significantly; this was also the case at lower speeds (less than 3 kn) in calm water. A specific gravity of less than 0.85 was also felt to be necessary to avoid excessive oil entrainment.

ADDITIONAL PERFORMANCE INFORMATION

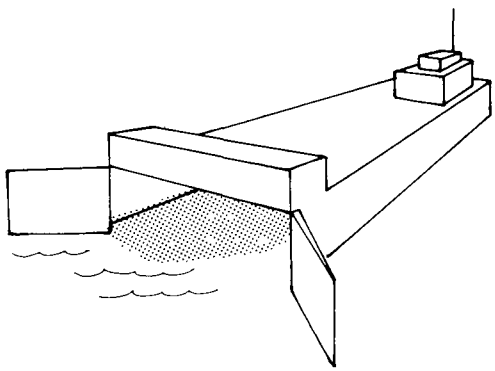
McCracken, W.E. and J.H. Schwartz, Performance Testing of the Tetradyne High Speed Air Jet Skimmer, EPA-600/2-78-187, U.S. Environmental Protection Agency, Cincinnati, OH, (1978).

OTHER DATA

It is not known whether further development work has taken place.

Trygne Thune A/S
Munchsgt 5
Oslo 1
Norway

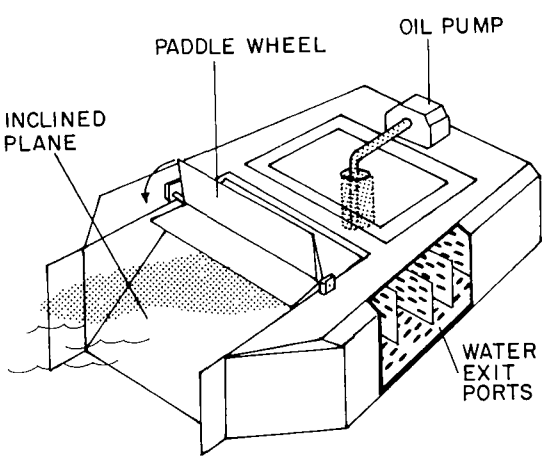
Ocean Oil Scooper



Trygne Thune designed a 31 m square bow vessel for use in offshore spills. Two doors at the bow open to offer a 15 m wide inlet to an incoming slick. Separation then occurs in a 600 m^3 holding tank which incorporates nine lateral and two longitudinal baffles. These are perforated so that wave dampening and the settling of water can take place. A self-trimming device maintains the ship at a constant draught of 4 m when skimming. The craft weighs 80-90 tonnes and is powered by a 700 HP diesel engine allowing it to proceed at 6 kt with the doors closed. Development to the commercial stage is not known. Reported in Ocean Industry, May, 1976, pp. 151-153.

Trygne Thune A/S
Munchsgt 5
Oslo 1
Norway

TT Oil Recovery System



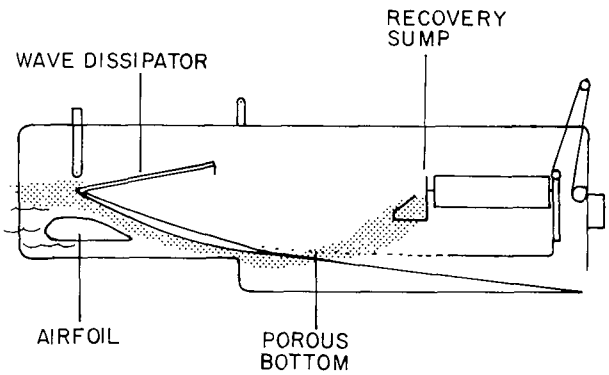
The 5.5 m long prototype skimmer features a paddle wheel which draws oil up an inclined ramp and into a chamber subdivided into sections by perforated baffles. Oil accumulates in the seven compartments and is drawn off by a pump while water exits through openings in the bottom. The skimmer was primarily designed for application to contained slicks in harbours; it features a diesel/hydraulic package which powers both the paddle wheel and pump. Sweeping is also noted as a possible operational mode upon the attachment of an outboard motor to the stern to provide propulsion.

Tulagi Inc. **Cyclonet System**
7600 Lakeshore Drive
New Orleans, LA 70124
USA

telephone (504) 282-2662
telex 504-584179

Tulagi has been associated with the U.S. marketing of products manufactured by Alsthom Atlantique. Refer to the main entry under that name for further information.

Ultrasystems, Incorporated **Oil Boom/Skimmer**
2400 Michelson Drive
Irvine, CA 92715
USA



The slotted hydrofoil with attached sump has been tested as a high-current skimmer on two occasions at OHMSETT. The first evaluation program was conducted in November 1975 and produced "oil collected versus oil encountered" values of 40-72% at 6 kn in 1 mm thick slicks of 1.50 cm^2/s oil. It was concluded that sump preload does not affect product flow over the weir and oil content. This is more a function of slick thickness. (A sump oil volume of 0.11 m^3 or more always produced oil content in the collected liquid of over 50%.) At 3 kn, the boom was found to hold 0.28 m^3 before losing 15% of the volume deposited. Losses reached 80-85% at 6 kn. Testing of the system resumed in September 1976; more comprehensive results were reported, including water tests at 4 kn during which 91% of the encountered lube oil was collected.

The device is one of the few machines that has been extensively designed to take into account basic hydrodynamic principles. The bow shape was determined by considering the production of a smooth bow wave achieved after a relatively large flow rate passes over a streamlined shape. The slotted hydrofoil reduces the high flow rate by drawing off a portion of the flow while the hydro-adjustable weir reduces water uptake. An array of surface-piercing rods serve as energy dissipators by introducing drag while an inclined porous plate further dissipates mechanical energy. In the tank tests, a porous sump bottom was found to reduce oil losses by increasing the effective depth of the sump, decreasing average sump velocity and reducing turbulence and head wave failure. Overall, the Ultrasystems Skimmer is a very interesting concept to consider because of the many design criteria which it incorporates based on hydrodynamic theory.

(1) Folsom, B.A., Development of a High Current Oil Boom/Skimmer, EPA 600/2-80-140, U.S. Environmental Protection Agency, Cincinnati, OH, (1980).

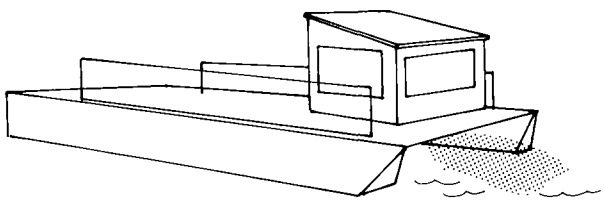
(2) Folsom, B.A. and C. Johnson, Development of a High Current Streamlined Boom/Skimmer for Inland Waterways, Proceedings of the 1977 Oil Spill Conference, pp. 328-337, American Petroleum Institute, New Orleans, LA, March 8-10, (1977).

Warren Spring Laboratory **Springsweep System**
Box 20, Gunnels Wood Road
Stevenage, Hertfordshire
England
SG1 2BX

Warren Spring has conducted a significant amount of investigative work on the use of a single vessel of opportunity to support an "over-the-side" skimmer. A portion of this study has involved the Troilboom manufactured by Trelleborg AB of Sweden and the Destroil Skimmer developed by Gustaf Terling AB. (Refer to the latter entry for additional details.) More recently, Warren Spring has examined alternative floating suction heads within the pocket of oil which forms in the boom. The purpose of the equipment is to chase down uncontained slicks at sea.

Worthington Corporation **Mop-Cat**
Marine Division
401 Worthington Avenue
Harrison, NJ 07029
USA

telephone (201) 227-9240



The standard Mop-Cat is a 10 m catamaran with a 3.7 m beam which incorporates a foam-covered rotating drum between the hulls as its oil collection component. Power is supplied by a Wankel or Kohler air-cooled 2-cycle gasoline engine with twin vertical propulsion drives. The drum collects oil in the stationary or advancing modes; off-loading is accomplished through a Worthington positive displacement, self-primining rotary pump. Articulated bow wings result in a swath width of 4.6 m; the 4 170 kg craft operates with a 48 cm draught when empty. Deployment has been designed for helicopter, crane or davitt suspension, with trailer also optional.

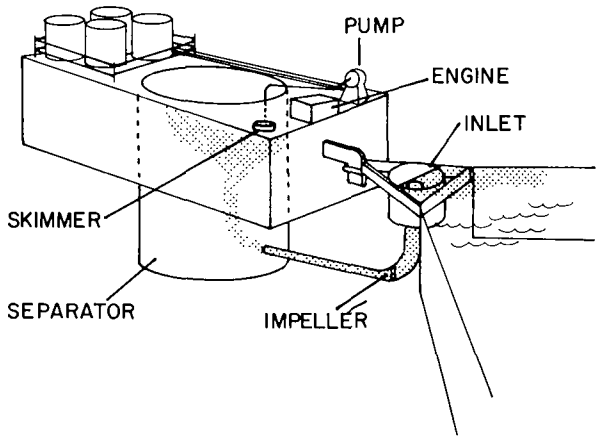
A slightly smaller model, WTKW Mark 1-29-12, is 8.8 m in length, weighs 2 085 kg, and is constructed of aluminum alloy 5086. It also operates with a sweep width of 4.6 m but can do so at a more shallow draught of 23 cm.

See Clear Seas Atlantic Ltd. OSCAR main entry for evaluation data on a double drum collection principle. Refer also to Bodan-Werft main entry.

Wylie Oil Spill Recovery System
P.O. Box 271
Summerland, British Columbia
Canada

telephone (604) 494-1024

Wylie Skimmer



A prototype of the Wylie Oil Recovery System was constructed and tested at OHMSETT in October 1980. The evaluation program served to indicate that a number of modifications would contribute to improved performance.

The machine, as presented for testing, consisted of a small barge, skimming bridle component and separator. An open-top cylinder, held vertically, accepts liquid which overflows into it. The fluid is then conveyed by an impeller positioned in a tube that connects the skimming weir to a cylindrical separating chamber. The latter is 2.4 m in diameter and extends an equal distance below the waterline. It has been designed to achieve oil/water separation based on an oil globule rise velocity of 0.1 m/s. A scow-like craft, with flotation provided by buoyancy tanks, supports the separating chamber, power source, controls, pumping equipment and drums into which the collected oil phase is transferred. It also supports a floating bridle assembly at its bow which attaches to a boom towed in a U-configuration so that the inlet tube skims liquid at the apex.

The Wylie Skimmer is intended for use in harbours and near-coastal waters. The prototype device was trailerable; the unique separation chamber could be raised for road mobility and lowered once in the water. Propulsion by outboard motors has been listed as optional.