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ASSESSMENT OF THE SITUATION REGARDING USED LUBRICATING OILS IN THE MEDITERRANEAN BASIN AND SUGGESTED PROGRESSIVE MEASURES FOR THEIR ELIMINATION AS MARINE POLLUTANTS

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TABLE OF CONTENTS

	<u>Page No.</u>
1. INTRODUCTION	1
2. USES AND COMPOSITION OF LUBRICATING OILS	2
3. ASSESSMENT OF POLLUTION BY USED LUBRICATING OILS IN THE MEDITERRANEAN	3
3.1 Sources and types of used lubricating oils reaching the Mediterranean Sea	3
3.1.1 Municipal wastewaters	4
3.1.2 Non-refinery industrial wastes	5
3.1.3 Urban runoff	9
3.1.4 Motor oils	10
3.1.5 Sale of lubricants and generation/regeneration of used oils in the Mediterranean	11
3.2. Inputs of used lubricating oils into the Mediterranean Sea	13
3.3. Levels of used lubricating oils in the Mediterranean	13
3.4 Fates of used lubricating oils in the marine environment	13
4. MEASURES TO PREVENT AND CONTROL POLLUTION BY USED LUBRICATING OILS IN THE MEDITERRANEAN	13
4.1 Alternative ways to use or dispose of used lubricating oils	13
4.2 Cost benefit analysis of used lubricating oils collection and re-utilization	14
4.3 Collection systems	16
4.4 Present National legal, administrative and technical measures relevant to the Mediterranean	17
4.4.1 Algeria	17
4.4.2 Cyprus	18
4.4.3 Egypt	19
4.4.4 France	20
4.4.5 Greece	21
4.4.6 Israel	23
4.4.7 Italy	24
4.4.8 Lebanon	25
4.4.9 Libya	26
4.4.10 Malta	26
4.4.11 Monaco	26
4.4.12 Morocco	27
4.4.13 Spain	27
4.4.14 Syria	28
4.4.15 Tunisia	29
4.4.16 Turkey	29
4.4.17 Yugoslavia	30
4.4.18 European Economic Community	30

TABLE OF CONTENTS (Continued)

	<u>Page No.</u>
4.5 Standardisation and marketing	31
4.6 Public awareness	32
5. SUGGESTED OUTLINE OF PROGRESSIVE NATIONAL MEASURES	33
5.1 Definition of used lubricating oils	33
5.2 Assessment of sources and levels of used lubricating oils	34
5.3 Controlling sources of used lubricating oils causing significant pollution	35
5.4 Industrial used oil policies	35
5.5 Controlling re-use and disposal of used lubricating oils	39
6. REFERENCES	39

1. INTRODUCTION

Article 5 of the Protocol for the protection of the Mediterranean Sea against pollution from land-based sources (UNEP, 1980) binds the Contracting Parties to eliminate pollution of the protocol area by substances listed in Annex I to the protocol, and to this end, to elaborate and implement, jointly or individually as appropriate, the necessary programmes and measures to this end, such programmes and measures to include, in particular, common emission standards and standards for use.

Item 6 in Annex I to the protocol consists of "used lubricating oils". In conformity with the decision of the Contracting Parties at their fourth ordinary meeting in Genoa in September 1985 (UNEP, 1985a) that substances in this annex should be accorded priority over Annex II Substances in the development of the necessary programmes and measures, preparations were commenced by the Secretariat for an assessment of the state of pollution of the Mediterranean Sea by used lubricating oils to be produced. This activity was agreed to by the meeting of experts on the technical implementation of the protocol in Athens from 9 to 13 December 1985 (UNEP, 1985b), and time-tabled for implementation during the 1986-1987 biennium. A questionnaire for the acquisition of relevant country information was discussed by the Working Group for scientific and technical cooperation for MED POL at their fourth meeting in Athens from 16 to 20 June 1986 (UNEP, 1986), and circulated.

The first report (UNEP/UNIDO, 1987) was submitted to the Working Group at their fifth meeting in Athens from 6 to 10 April 1987. This report which was based on material available at the time, including the response of a number of countries to the questionnaire, constituted an assessment of used lubricating oils, describing their nature, their origin, their fate after use and their effects on the marine environment. It also contained information on legal provisions presently existing in Mediterranean countries that apply, or could be applied to, pollution prevention and/or control for used lubricating oils, and what measures could be appropriately taken in terms of the Protocol for the Protection of the Mediterranean Sea against pollution from land-based sources, including recommendations to the Contracting Parties thereto.

After discussion, the Group agreed that the document, as well as the proposed definition of used lubricating oils contained in another document (UNEP/FAO/WHO/UNIDO, 1987) before the Group, required thorough revision and the inclusion of more up-to-date information regarding the situation in the various countries. In this regard, it was agreed that those countries not having already done so, would submit relevant information by 31 July 1987 to the Secretariat and that a revised version of the document incorporating such information would be submitted to the next meeting of the Working Group (UNEP, 1987).

In accordance with this decision, a revised version of the document (UNEP/UNIDO, 1988) was submitted to the First meeting of the Scientific and Technical Committee of the Mediterranean Action Plan, held in Athens from 23 to 27 May 1988. After deliberation, the Committee agreed that further updating was still necessary, and that a simplified questionnaire should be sent to countries with a view to obtaining such updated information for incorporation into a further revised version of the document (UNEP, 1988a).

The present version of the document, while retaining the same basic structure of the original, incorporates new information received by the Secretariat from countries in the form of replies to the questionnaires sent out in 1988. In addition, the document has been further revised and re-edited.

2. USES AND COMPOSITION OF LUBRICATING OILS

Lubricating oils are essential for many industrial and transportation purposes, as well as for a number of other uses:

1. Examples of industrial uses of lubricants are for hydraulic pumps, compressors, turbines and metalworking (e.g. cutting, grinding, drilling or machining of metal).
2. Transportation uses include oils for automobile engines (both gasoline and diesel), transmissions and gears; railroad and marine diesel engines; and airplane engines.
3. Other uses for oils are in electrical transformers, in rubber manufacturing processes, and in spinning and natural gas transmission equipment.

The lubricating oils from the refinery processes of crude oil are very complex mixtures of hydrocarbons: linear and branched paraffins; and cyclic alkanes and aromatic hydrocarbons ($>C_{15}$ with boiling points between 300 and 600°C. However, lubricating oils obtained from the residual fractions have some compounds with boiling points of up to 815°C. The technology used in the fabrication of the different lubricating oils is specific for each commercial company. Moreover, the type and quantity of additives are determined by future utilisation and by commercial patent. The normal production processes of lubricating base oils, after the refining processes, are: propane deasphalting; solvent extraction; hydrotreating; solvent dewaxing; acid treating and finishing.

The chemical composition of lubricating oils, as with all other petroleum products, varies with the crude-oil source, the refining process and the additives present. The fabrication process of lubricating oil has changed significantly in recent years in order to eliminate undesirable compounds, such as polyaromatic hydrocarbons (PAH). For this reason, two-thirds of the base oil produced in industrialised countries is solvent-refined.

Generally, aliphatic compounds represent between 73 and 80% of the total weight of the oil. This fraction is composed of alkanes and cycloalkanes of 1-6 rings. Monoaromatic hydrocarbons make up 11-15% of the weight, diaromatics 2-5% and polyaromatic and polar fractions 4-8%. The polar fraction is made up of aromatic compounds which contain sulphur, nitrogen or oxygen. In certain cases, probably when the oil has not been refined very well, the aromatic compounds can represent 37-50% of the oil. The fraction of aromatic hydrocarbons is composed of compounds with 1-5 aromatic rings.

Lubricating oils are characterised by their high additive content. During oil fabrication, and in order to improve its physical and chemical properties, several types of additive are employed. The additive content of

lubricating oils can be as much as 20%, the most important being detergents and dispersants at 2-15% of the weight of the oil. Of the oil additives, several compounds are known to be dangerous environmental contaminants. These include zinc diaryl or dialkyl dithiophosphates; molybdenum disulphide; zinc dithiophosphate; heavy-metal soaps and other organometallic compounds (Vasquez-Duhalt, 1988).

Several definitions of used lubricating oils have been adopted for various purposes. A possible definition in terms of Annex I to the Protocol for the Protection of the Mediterranean Sea against pollution from land-based sources, to serve as a basis for national measures, is given in section 5.1. of this document.

3. ASSESSMENT OF POLLUTION BY USED LUBRICATING OILS IN THE MEDITERRANEAN

Specific information about used lubricating oils in the Mediterranean Sea is quite limited. However, estimates about the sources, kinds, levels, fates and effects of such oils can be derived from general information about marine oil pollution and about the uses of lubricating oils in the countries surrounding the Mediterranean. In addition, answers to the questionnaires sent in connection with this assessment provide further information which, even though only partial from the regional viewpoint, is useful in defining the scope of pollution caused by used lubricating oils and the policy measures appropriate to eliminating it.

3.1 Sources and types of used lubricating oils reaching the Mediterranean Sea

The kind of inventory undertaken in the pilot project on pollutants from land-based sources in the Mediterranean (MED POL X) (UNEP/ECE/UNIDO/FAO/UNESCO/WHO/IAEA, 1984) is what would be needed for an accurate estimate of the amounts of used lubricating oils entering the Mediterranean. As there are many industrial, transportation and other applications for lubricants, a starting point for this assessment is a list of the principal sources of used lubricants.

The industries that generate the most used oil are the primary metals, fabricated metal products, machinery, electrical equipment, transportation equipment, chemical products and rubber and plastics products industries. The types of used oils vary widely according to the specifications for particular applications. Metalworking oils, for example, range from 100% oil (so-called neat oil) to oil-water emulsions (called soluble oils) with a low percentage of oil. Both formulations require as many as half a dozen additives, e.g. to reduce wear on cutting and grinding tools. Quenching oils, used to cool hot metals, contain oxidation inhibiting additives (e.g. barium sulfonate, zinc compounds, sodium nitrate). Steel rolling and stamping oils vary but are often combinations of naphthenic mineral oils and tallow oils, with sulphur and phosphorous additives to reduce wear on the rollers. Hydraulic oils, used for example in die-casting, steel foundry operations and automobile production, usually consist of paraffinnic base stocks with only rust and oxidation inhibiting additives (e.g. a hindered phenol) and sometimes an antiwear additive (e.g. zinc dithiophosphate). Transformer oils are straight mineral oils with no additives. Turbines, either steam powered or gas-fired, generate electricity or run compressors in chemical plants or refineries, for example. Their lubricating oils are similar to hydraulic oils, although high temperature oxidation inhibiting additives are also needed.

Automobiles, trucks, buses and heavy machine equipment all use oil in their engines, gears, transmissions and hydraulic systems. Therefore, dealerships, service stations and garages all generate used oils. Amounts and types vary with the kind, age and size of the vehicles. New passenger cars produce a few gallons of drained motor oil (crankcase oil) every six months. Older cars must be serviced more frequently. Long distance trucks require up to eight gallons of gear oil in their axles. Some earthmovers need 35 gallons. Dump trucks, garbage trucks and loading vehicles generate transmission fluids from their hydraulic systems, in addition to transmission fluids from the transmissions of all vehicles. Diesel engine oils for large and small trucks (and automobiles) are another category of automotive lubricants. Several additives are contained in these lubricants, often making up more than 15% by volume. In used lubricating oils these additives are chemically changed, and the oil itself is contaminated with rust, soot, dirt, dust, lead (from gasoline), engine wear metal particles and water (condensed from vapour).

Both railroads and airplanes also use lubricants. Typically they are almost all collected at terminals and airports and recycled, and are thus unlikely components of pollution.

Other sources of used lubricating oils are refrigeration units and shock absorbers. These oils are usually made from naphthenic base stocks. Naphthenic base stocks are also used to make process oils used in rubber manufacturing. Air compressor oils are similar to turbine oils. They are made from paraffinic base stocks and have low levels of additives. Rock drill oils, used for jack hammers, air hammers and underground drills are similar to industrial gear oils. They contain additives to modify friction as well as antiwear and extreme pressure additives. Way oils are formulated to lubricate slides of machine tools, e.g. lathes, and are similar to hydraulic oils, with a friction modifier additive. Spindle oils lubricate spinning equipment in the textile industry. They are similar to hydraulic oils with rust and oxidation inhibiting additives.

Estimates of quantities of used lubricating oils reaching the sea would have to be based on detailed knowledge of the size, location and disposal practices of the sources, the number of motor vehicles registered in coastal areas, and the appropriate per capita urban runoff amount in different regions.

3.1.1 Municipal wastewaters

In 1979, Eganhouse and Kaplan analysed 38 samples of treated municipal wastewater from five major wastewater pollution control plants in Southern California as reported in 1980 by the Southern California Coastal Water Research Project (SCCWRP). Four of these discharges were used in making estimates for facilities serving approximately 9.8 million people in 1979 (National Academy Press, 1985; Eganhouse and Kaplan, 1981).

The wastewater samples were analysed for total extractable organics and for total hydrocarbons (THC). The results of these analyses were compared with reported concentrations of oil and grease from the routine monitoring done by the wastewater management agencies as reported by SCCWRP. Regression analysis indicates that THC accounts for approximately 38% of the oil and grease discharged from these treatment plants.

The total mass emission from the four discharges is estimated to be approximately 43 million metric tonnes per year in 1979, resulting in an overall contribution of oil and grease of about 12 grams per capita per day (g/cap/d). These results can be used to calculate the total per capita contribution of THC from the Southern California outfalls in 1979, which comes to 38% of 12 g/d or 4.5 g/d.

Although calculated for Southern California, the figure of 4.5 g/day per capita could be used for an approximate estimate of the municipal wastewater contribution of oil and grease discharge into the Mediterranean Sea from coastal areas. The Mediterranean coastal population has been estimated at approximately 133 million in 1985 during the course of the Blue Plan studies (UNEP, 1988b). On the basis of this population estimate, assuming that all wastewaters were discharged through municipal facilities, the municipal wastewater contribution to the total hydrocarbon pollution load of the Mediterranean Sea would be 4.5 g/day per capita x 133 x 10⁶ residents x 365 days, equivalent to just under 218,500 metric tonnes per year.

3.1.2 Non-refinery industrial wastes

A sizeable fraction of non-refinery industrial waste discharges into municipal wastewater systems and its petroleum hydrocarbon (PHC) content have been accounted for in the previous section. However, there is a quantity of PHC that goes more or less directly into the marine environment through coastal non-refinery effluent discharges. Extremely limited quantification of this source has been made, and even less information is published for reasons of confidentiality. Previous world estimates have been made by the NRC (1981) of 200,000 metric tonnes per year, and the Royal Commission of Environmental Pollution (1981) of 150,000 metric tonnes per year.

Table 3.1 presents quantities of lubricant imports for many countries bordering the Mediterranean. If data for all the countries were available, perhaps the total lubricant imported would be about 500,000 metric tons per year. These data do not include lubricants refined within the countries themselves. Using the 500,000 metric ton figure, an estimate of the used oil generated would be about 250,000 metric tons per year, based upon experience, approximately 50% of purchased oils end up as a collectible used oil.

An alternative method of estimating the amount of industrial used oils generated, is through calculating the number of employees in appropriate industries and utilising the standard estimate for used oil generation per capita on the basis of the Industrial Standards International Classification (ISIC) for each category of employee. Table 3.2 shows the estimate of used oil generated per employee for those ISIC categories using the majority of lubricating oils in industry. Table 3.3 lists the employment figures for countries bordering the Mediterranean for each of these ISIC categories. The results, obtained by multiplying the number of employees by the estimated per capita generation, are shown in Table 3.4. This gives a total value of 1,760 million litres of used oil generated which, assuming an average specific gravity of 0.925, can be expressed as 1.63 million metric tonnes per year.

The figure developed above is substantially higher than the used oil generated figure of 250,000 metric tonnes per year obtained from Table 3.1. The primary reason for this is that Table 3.1 does not account for all shipments of lubricants from all sources, principally those lubricants produced from refineries within the countries themselves.

Table 3.1

Imports of lubricants from OECD countries	
	<u>1000 Metric Tons</u>
Algeria	15
Cyprus	N.A
Egypt	28
France	133
Greece	44**
Israel	N.A
Italy	78**
Lebanon	N.A
Libya	41
Malta	N.A***
Monaco	N.A.
Morocco	N.A.
Spain	41
Syria	N.A
Tunisia	N.A
Turkey	5
Yugoslavia	N.A***

N.A. : Not available

* From O.E.C.D. (Organization for Economic Cooperation and Development) countries: Austria, Belgium, Canada, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, Japan, Finland, Australia, New Zealand and selectively Yugoslavia. 1982 data.

** Data also includes imports from other (non-O.E.C.D.) countries.

*** Combined total for Malta, Yugoslavia and Gibraltar reported as 17.000 mt.

Source: Annual oil and gas statistics, 1981 and 1982. International Energy Agency, O.E.C.D., Paris, 1984 (Tables 125, 155 and 170).

Table 3.2

Used oil generated per employee by ISIC category (litres)

Description	ISIC Code	Litres per annum per employee standard
Chemical and allied products	351, 352	327
Rubber and plastic products	355	234
Primary metals	371	161
Fabricated metals	381	328
Machines, except electrical	382	80
Electrical equipment	383	167
Transportation equipment	384	338

Sources: Derived from Yates, et al., Used oil recycling in Illinois: Data book 1978 and Maltezos, 1976. The Table presents average figures developed from data obtained in the New York Metropolitan Area and the State of Illinois, USA.

Table 3.3
Employment in Mediterranean countries by ISIC Category

DESCRIPTION	ISIC CODE	LIBYAN		SYRIAN		ARAB JAM-		ARAB		TURKEY	YUGOSLAVIA	TOTAL							
		1984	1984	1982	1984	1982	1984	1982	1984										
Chemical and allied products	351,352	7,985	1,600	72,840	317,000	25,608	13,929	237,000	***	1,054	490	***	14,846	135,000	14,600	13,608	47,340	103,000	1,005,900
Rubber and plastic products	355	1,138	256	6,608	92,000	3,679	4,099	59,000	***	0	1,031	***	3,280	41,000	2,400	869	10,905	36,000	262,265
Primary metals	371	50,944	0	46,248	214,000	8,912	4,086	222,000	***	0	0	***	867	129,000	0	5,210	58,430	125,000	864,697
Fabricated metals	381	37,898	2,461	33,916	234,000	40,098	41,202	189,000	***	681	1,657	***	16,687	218,000	11,700	13,938	42,760	249,000	1,132,998
Machines, except electrical	382	17,098	1,284	23,626	533,000	15,529	9,523	278,000	***	0	810	***	4,679	139,000	3,200	461	54,036	214,000	1,314,246
Electrical equipment	383	17,098	535	21,034	481,000	23,787	32,740	301,000	***	0	2,107	***	7,703	160,000	2,600	6,163	35,332	182,000	1,273,099
Transportation equipment	384	29,252	455	38,464	602,000	36,421	21,078	383,000	***	0	922	***	8,371	241,000	1,100	5,867	53,437	181,000	1,602,367
TOTAL		161,413	6,591	242,736	2,493,000	194,034	126,657	1,669,000	***	1,735	7,017	***	56,433	1,063,000	35,600	46,116	302,240	1,090,000	7,455,572

*** Data unavailable

Note: ISIC categories listed are those producing most of the used oils generated by the manufacturing industry.

Table 3.4
Estimated used oil generated by ISIC Category per country (million litres)

DESCRIPTION	ISIC CODE	LIBYAN		SYRIAN		ARAB REPUBLIC OF EGYPT		FRANCE		GREECE		ISRAEL		ITALY		LEBANON		AHRIYA		MALTA		MOROCCO		SPAIN		TUNISIA		TURKEY		YUGOSLAVIA		TOTAL	
		1984	1984	1984	1984	1982	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984		
Chemical and allied products	351,352	2.61	.523	23.8	104	0.37	4.55	77.5	***	.345	.160	***	4.85	44.1	4.77	4.45	15.5	33.7	329														
Rubber and plastic products	355	.266	.0599	1.55	21.5	.861	.959	13.8	***	0.00	.241	***	.768	9.59	.562	.203	2.55	8.42	61														
Primary metals	371	8.20	0.00	7.45	34.5	1.43	.658	35.7	***	0.00	0.00	***	.139	20.8	0.00	.839	9.41	20.1	139														
Fabricated metals	381	12.4	.807	11.1	76.7	13.1	13.5	62.0	***	.223	.543	***	5.47	71.5	3.84	4.57	14.0	81.7	371														
Machines, except electrical	382	1.37	.103	1.89	44.2	1.24	.762	22.2	***	0.00	.0648	***	.374	11.1	.256	.0369	4.32	17.1	105														
Electrical equipment	383	2.86	.0893	3.51	80.3	3.97	5.47	50.3	***	0.00	.352	***	1.29	26.7	.434	1.03	5.90	30.4	213														
Transportation equipment	384	9.89	.154	13.0	203	12.3	7.12	129	***	0.00	.312	***	2.83	81.5	.372	1.98	18.1	61.2	542														
TOTAL		37.6	1.74	62.3	564	41.2	33.0	391	***	.568	1.67	***	15.7	265	10.2	13.1	69.7	253	1760														

*** Data unavailable

Source: Figures in the Table above were obtained by multiplying the used oil per employee per ISIC Category in Table 3.2 times the total employment in Table 3.3.

3.1.3 Urban runoff

The global input of petroleum hydrocarbons (PHC) to coastal waters from urban runoff was estimated by NRC (1975) to be 300,000 metric tonnes per year. The value was based in part on the assumption that urban runoff contributed about half the amount of PHC contributed by municipal and non-refinery wastewaters. The crudeness of this estimate was unavoidable because of the lack of measurements of PHC in urban runoff. The situation ten years later is only slightly better because most of the studies undertaken in the intervening years have focused on analytical methods of characterizing the PHC fractions rather than on mass contributions of PHC. Part of this dilemma may be due to the difficulty of representative sampling of the runoff. Other problems are the determination of mean PHC concentrations and the volume of runoff, which permit accurate estimation of mass PHC contributions. Estimates of PHC in runoff should be based on factors such as runoff area, watershed characteristics, PHC usage and population density. Recognizing the difficulties in quantifying the mass of PHC contributed and considering hydrological, physical and land use variations in urban areas (as well as the definition of urban), the authors of Oil in the Sea concluded that the best estimate of urban PHC runoff must be based on estimates of per capita contributions. Population is one of the principal generating factors of urban PHC runoff for a given petroleum consumption level. Table 3.5 shows data for per capita estimates of PHC contributions from a number of non-Mediterranean locations.

Despite the gross variation in per capita PHC contribution, it is believed to be the most accurate basis for current estimation of urban PHC runoff. A per capita PHC contribution of 1.0 g/cap/d is probably the most reliable estimate that can be made from present information.

Employing the unit per capita contribution of 1.0 g/cap/d per day and a coastal population of about 133 million, one can estimate the urban runoff contribution of the Mediterranean Coastal Area to be about 48,500 t/a.

Table 3.5

Per capita estimates of PHC contributions in urban runoff

Location	Unit PHC contribution (g/cap/d)	Reference
Philadelphia and Trenton	0.03	Whipple and Hunter (1979)
Narragansett Bay	2.7	Hoffman <u>et al.</u> , (1982)
Los Angeles (a)	1.9	Eganhouse and Kaplan (1981)
Seattle	0.3	Wakeham (1977)
Sweden (b)	0.3	NRC (1975)

(a) Single storm extrapolated to annual runoff.

(b) Typical urban area (0.2 parking, 0.3 multi-family and 0.6 single family).

Source: Oil in the Sea (National Academy Press, 1985)

3.1.4 Motor oil

A major contributor to urban runoff and river contamination with oils is oils released to the environment from vehicle operation and maintenance. This results from oils spilt on roads, oils dumped by persons changing their own oils (50% in many areas), and centralized depositories improperly disposing of oils. An attempt is made below to quantify the used oils generated from vehicles.

In the absence of comprehensive data from all Mediterranean countries, quantities of used motor oils generated have to be estimated indirectly. Table 3.6 gives the total number of vehicles registered in all Mediterranean States for 1982. These figures represent country totals, not actual coastal areas, and most of them must therefore be treated with a certain amount of reserve from a purely Mediterranean viewpoint.

Table 3.6

Vehicle registrations in Mediterranean countries for 1982

Country	Cars	Trucks and buses	Total vehicles
Algeria	580,000	300,000	880,000
Cyprus	97,958	29,195	127,153
Egypt	461,277	221,018	682,295
France	20,420,000	2,689,500	23,109,500
Greece	999,315	526,593	1,525,908
Israel	518,858	115,299	634,157
Italy	19,616,106	1,641,706	21,257,812
Lebanon	***	***	***
Libyan Arab Jamahiriya	415,509	334,405	749,914
Malta	74,773	17,871	92,644
Monaco	13,897	3,109	17,006
Morocco	460,515	190,180	650,695
Spain	8,353,944	1,505,542	9,859,486
Syrian Arab Republic	26,000	10,961	36,961
Tunisia	141,185	147,571	288,756
Turkey	826,756	233,377	1,060,133
Yugoslavia	2,698,605	454,850	3,153,455
TOTAL:-	55,704,698	8,421,177	64,125,875

*** Data unavailable

* Source: World Motor Vehicle Data 1984-85 Edition.

Pages 40-42.

More updated figures are available from seven countries (France, Israel, Italy, Malta, Monaco, Spain and Tunisia) through replies to the two questionnaires submitted. These figures are shown in Table 3.7, and are more accurate in that, in the case of France, Italy and Spain, they refer specifically to Mediterranean coastal areas.

Table 3.7
Vehicle registration in seven Mediterranean countries,
1985-1988

Country	Cars (1)	Trucks and buses (2)	Motorcycles	Total (1 + 2)
France	2,140,000	283,230	N/A	2,423,230
Israel	696,712	140,352	33,814	837,064
Italy	1,650,000	153,700	222,102	1,803,700
Malta	79,700	10,794	9,590	90,494
Monaco	15,709	3,260	2,103	18,969
Spain	235,736	51,259	22,138	286,995
Tunisia	145,000	115,000	N/A	260,000

It is not easy to amalgamate the figures in Tables 3.6 and 3.7, but adjustment of those in the former for countries other than those listed in the latter, and application of tentative correction factors (a) for coastal areas as against entire countries, and (b) for increases in motor registrations since 1982, would indicate that the total number of vehicles (cars, buses and trucks) registered in the coastal areas of the Mediterranean is, at a conservative estimate, of the general order of 15 million (12 million cars and 3 million buses and trucks). This very tentative estimate excludes motorcycles and mobile machinery (tractors, bulldozers, etc.). From information supplied by a number of countries on both amounts of lubricating oils generated and number of registered vehicles, the average amount of used lubricating oils per vehicle per year varies between 20 and 30 litres. Taking 25 as an average, and assuming a total of 15 million vehicles in coastal areas, the total amount of used lubricating motor oils generated in Mediterranean coastal areas would be of the order of 375,000 metric tonnes per year.

3.1.5 Sale of lubricants and generation/regeneration of used oils in the Mediterranean

Direct and updated data on amounts of lubricating oils sold, generated and thereafter regenerated or otherwise disposed of is limited to the seven countries which either replied to one or both of the 1986 and 1988 questionnaires, or for which information could be obtained from other sources such as the 1986 Spanish study on used lubricating oils in Spain and other EEC member states (Auxini, 1986). This data is given in Table 3.8.

Table 3.8

Sales, generation/regeneration and collection/disposal of used lubricating oils in seven Mediterranean countries for 1985-1988 (in metric tonnes/year)

	France	Greece	Israel	Italy	Malta	Spain	Tunisia
Lubricants sold:							
- automotive	507,000	N/A	33,400	367,000	N/A	N/A	N/A
- industrial	338,200	N/A	17,200	220,000	N/A	N/A	N/A
- other	46,500	N/A	3,000	76,000	N/A	N/A	N/A
Total:	891,700	100,000	53,600	663,000	2,270	320,000	39,600
Total used oils generated	369,874	50,000	N/A	300,000	2,162	100,000	N/A
Oils collected	92,047	N/A	12,000	N/A	2,162	36,000	N/A
Oils re-refined	91,826	25,000	6,000	90,000	216	36,000	5,000
Oils re-used as lower-grade lubricants	13,961	N/A	N/A	N/A	432	N/A	N/A
Oils burnt	125,000	N/A	N/A	100,000	866	N.A	2,000
Oils re-utilised for various purposes	N/A	N/A	N/A	N/A	540	N/A	1,350
Oils otherwise disposed of	N/A	N/A	N/A	N/A	108	N/A	N/A

Even this data is incomplete. Moreover, the figures refer to countries as a whole, not to activities in the Mediterranean coastal zone. There is a large variation from country to country in the proportion of lubricants sold to used oil generated. In the four Mediterranean member states of the EEC, the capacity for regeneration of used lubricating oils is estimated at well in excess of actual output.

3.2 Inputs of used lubricating oils into the Mediterranean Sea

While the material presented in Section 3.1 above can be utilised to provide very tentative estimates of used lubricating oils generated in the Mediterranean region or to calculate the potential amount of either total hydrocarbons or petroleum hydrocarbons reaching the sea from various sources, it is not possible to arrive at any realistic estimate of the input of used lubricating oils into the Mediterranean Sea in the absence of more detailed country information.

3.3 Levels of used lubricating oils in the Mediterranean Sea

There is some reported data about levels of petroleum hydrocarbons in the Mediterranean Sea in general (UNEP/IMO/IOC, 1987), but little about what proportion might be attributed to used lubricating oils. It is not therefore possible, on the basis of the present state of knowledge, to provide any tentative specific estimate of levels of used lubricating oils or their by-products in the Mediterranean marine environment.

3.4 Fates of used lubricating oils in the marine environment

Chronic discharges of oil constitute a much greater pollutant input into the sea than oil spills (National Academy Press, 1985), but the oils from the former source are more dispersed and less concentrated than those from the latter. The fates of oil on its introduction into the marine environment (i.e. the physical, chemical and biological transformations that occur) have been studied and reported on mainly regarding spills, although they do not differ essentially from the fates of chronically discharged oils, including used lubricating oils. Specific fates of course depend on the specific properties of the oils discharged, that is, on their density, viscosity, solubility, etc., and these properties change over time as the physical, chemical and biological processes have their effects.

The physical and chemical fates of oil compounds in the marine environment, as well as their effects on marine ecosystems, are well covered by current literature dealing with petroleum hydrocarbons in general.

4. MEASURES TO PREVENT AND CONTROL POLLUTION BY USED LUBRICATING OILS IN THE MEDITERRANEAN

4.1 Alternative ways to use or dispose of used lubricating oils

Used lubricating oils may be either re-used or disposed of. They may be re-used as lubricants and as fuels or fuel supplements and for miscellaneous other purposes. Disposal possibilities range from indiscriminate dumping to hazardous waste treatment.

Re-use as a lubricant may involve re-refining the oil to remove impurities and adding new additives to make the re-refined oils suitable for specified purposes, or it may simply involve a less demanding application of the used oil to consume the remaining lubricant properties. Re-use as a fuel may occur in public solid waste or sewage treatment plant sludge incinerators. Used lubricating oils may be blended with fuel oils as a fuel supplement, after they have been treated to remove water, volatile components and suspended solids (usually called "reprocessing"), and then burned in electric power plant steam boilers or cement kilns or other industrial process or used to heat greenhouses, warehouses, etc. Used lubricating oils may also be used as a component in making asphalt, spread to keep down dust on parking lots or roads, or painted on concrete forms or timbers.

Disposal may be into the garbage or a landfill, onto an unused lot of land, into a sewer, by open burning, or in accordance with hazardous waste treatment requirements, e.g. high temperature incineration or special landfilling. Land treatment is also possible, i.e. spreading the used oil over the ground in controlled quantities and cultivating the ground so that the oil may be biodegraded.

4.2 Cost-benefit analysis of used lubricating oils collection and re-utilization

Whether and how used lubricating oils are re-used or disposed of is, absent any government regulation or incentives or public services, entirely a matter of the costs of collecting and preparing the oils for re-use and the prices paid for the alternative uses. Although the specific costs and prices are determined by supply and demand in relatively localized markets, they ultimately depend on the world oil economy. Generally, when the price of crude petroleum is high, there is more demand for used oil and better prices can be obtained for products made from it. When the price of crude petroleum is low, however, products made from virgin oil are less expensive and there is correspondingly less demand for products from used oil and, hence, less used oil collected for re-use.

Uncounted in the costs and prices upon which decisions about whether and how to collect, re-use and dispose of used oils by private firms and persons are based, are the costs to the public, i.e. to society, of environmental damage resulting from these decisions. Environmental damages also have costs, although they are often not quantified. If used lubricating oils are disposed of by dumping them on land, for example, the costs may be loss of arable soil, contamination of ground water that serves as a source of drinking water and pollution of surface fresh and marine waters and harm to the living organisms in them. Similarly, used oil burned as a fuel or fuel supplement with little or no effort to remove contaminants either before or after burning causes pollution of the air from emissions of these contaminants or their by-products, e.g. lead, with consequences to public health. How high the costs of environmental damage are depends on how much oil is involved, what contaminants it contains, how it is re-used or disposed of, and where it happens. These costs too, will vary with local circumstances. To prevent or limit them, as well as to conserve the oil resource itself, are the principal purposes of government intervention by imposing regulations or by providing public services or incentives in order to influence private decisions about used oil collection, re-use and disposal.

The costs of collecting used lubricating oils depend on how much oil is generated in an area and of what quality, how many collection points exist, how big the truck (or other means of transportation) is that is used to collect the oil, what the costs of operating the truck and the company that owns it are and how often it is collected. If the demand for used lubricating oils is high the collector might be willing to go further to collect them or incur the additional cost of paying the generator for the used oil on the grounds that the prices that can be obtained from selling it exceed the total costs, leaving it profitable to collect the oil even with those payments. If the demand for used oils is low, however, a collector may charge for his services. This may encourage the generator to dispose of (or use) the oil in ways that cost less than these charges. Low demand (or highly contaminated oil) may also make it difficult for the collector to sell the used oils and give him an incentive to dispose of inexpensively what he has collected. In part to avoid environmentally damaging disposal, many governments regulate collectors, thus adding the costs of compliance with the regulations to the costs of collection.

Assuming the collector is independent, i.e. not owned by a business that prepared used oils for re-use, where he sells his oil depends on what prices he is offered for it by those competing to obtain it for alternative re-uses. If virgin fuel oil in a locale is expensive, a person who inexpensively reprocesses used oils to sell them in turn as fuel supplements may be able to bid higher for the used oils than a person whose higher costs to re-refine the oils into new lubricants prevent him from paying as much as the reprocessor for the feedstocks because he would not be able to sell his re-refined product at a profit.

Unlike used automotive lubricating oils, used industrial lubricants tend to vary in composition, with the result that collectors are less willing to collect them and the industries are more inclined to segregate and collect their own oils for one kind or another of re-use or disposal.

Whether used oil is reprocessed for burning or re-refined for lubricants or disposed of again, absent any government intervention, depends on whether it is profitable to prepare the oil for re-use. Re-refining, for example, incurs costs for labour, chemicals, energy, plant maintenance, waste disposal, taxes, insurance, and for the used lubricating oils as feedstocks. These costs vary with the re-refining process employed. Although filtering and heating used oils to prepare them for sale as a fuel supplement is less expensive than re-refining, whether a firm purchases them depends in turn on calculations by the firm of whether the increased costs of maintenance of burning equipment and of pretreatment or air pollution control exceed the savings of not buying the relatively small percentage of virgin fuel oil for which the reprocessed used oils would substitute. In some circumstances a collector may find he is offered the highest price for used oils by those who want to re-use them, without incurring any preparation costs, to suppress road dust or stabilize sandy soils.

To go beyond this general discussion of the trade-offs involved in used lubricating oil collection, re-use and disposal requires detailed data about environmental damages (and their costs), the costs of collection and preparation and the prices offered for various products made from used oil or charged for different ways of disposal in particular regions and at specific times (USEPA, 1980).

4.3 Collection systems

In the circumstances just described, i.e. where collection of used lubricating oils is not provided as a public service or encouraged by fiscal incentives (e.g. subsidies or tax measures) or required by regulation, small independent oil collectors will flourish where and when demand for used oils is high and decline under contrary conditions. These opportunistic entrepreneurs compete with longer-established collection businesses, also often small, that respond to service calls, or enter into contracts to provide regular pickup or delivery services, or visit generators who usually have considerable quantities of used oils.

As a means of stabilizing their supplies of feedstocks, some re-refining and re-processing enterprises have established their own collection services.

Unlike used automotive lubricants, which by the nature of their sources are both dispersed and mixed with one another (although not with other wastes), used lubricants from industrial sources are more concentrated and more susceptible to segregation. Collection of different industrial lubricants and ease of recycling them are both promoted by establishing in-plant collection areas for each kind as well as separate sewers for process wastes, sanitary wastes and storm runoff wastes. In existing plants where separate sewers may not be practical, traps can be established to catch most of the used lubricants before they mix with other wastes.

Various special arrangements may be made by sources that regularly generate large quantities. Industrial firms often segregate, collect and ship their used oil in a closed loop arrangement with a particular re-refiner who returns a product that meets agreed-upon specifications. Collection services may be provided by the re-refiner or the firm may transport the used oil itself. Transport is usually least expensive by truck, but sometimes it occurs by rail or barge. Occasionally the oil is carried by pipeline, e.g. where land treatment is the disposal method.

A special problem is presented by individuals who prefer to change the oil in their cars themselves. It is usually inconvenient for the person to take the crankcase drainings to a service station or garage and often people who do make that effort are not welcome. Both voluntary and government-sponsored programmes to enlist the cooperation of such places in serving as collection centres and to publicize their locations have been undertaken as one response to the phenomenon of self-changers, which is an increasing phenomenon in some areas.

Because the adequacy of collection is both vulnerable to changing economic conditions and essential to preventing environmental damage and waste of resources caused by improper disposal, many governments have decided to provide or support collection systems. Regular household pickup, similar to newspaper or garbage collection, is one form of such public service, and establishment and maintenance of central collection points is another. Some governments enter into contracts obligating the contractors to pick up all or minimum quantities of used oils within specified districts so long as they do not contain specified kinds or levels of contaminants (sometimes these contracts specify where the contractor must take what he collects). Waste exchanges are operated by some governments as a means of promoting the sale of materials, often from industrial production processes, from firms that regard

them as wastes to those that view them as resources, thus preventing entry of the materials into the waste stream. A few governments arrange for special boats that can pump out oil bilges at harbours and ports.

4.4 Present national legal, administrative and technical measures relevant to the Mediterranean

Several surveys have been published of legislation in nations bordering the Mediterranean that is relevant to land-based sources of pollution in general. The questionnaire prepared in connection with this assessment has requested copies of laws, regulations and directives that apply, or could be applied, to define used lubricating oils and to control their generation, collection, storage, transport, disposal or re-use in order to have complete and up-to-date information specific to the subject. Such laws could relate to air and water pollution control, waste management, regulation of industrial plants or transportation service facilities, soil or ground water protection, coastal zone or marine environment protection, fire prevention or general public health, in addition to used lubricating oils themselves. The following summaries of the legal authorities or administrative measures of each nation are based on the existing surveys cited, except where other noted, e.g. where copies of existing legislation or information about experience under it are available.

4.4.1 Algeria

Law No. 83-03 of 5 February 1983 on environmental protection requires that establishments used for industrial, commercial purposes be operated to comply with provisions made to avoid atmospheric pollution in a decree.

It also authorizes decrees determining the conditions for regulation or prohibition of direct or indirect discharges, runoff, disposal or dumping of water or of materials and any act liable to adversely affect the quality of surface waters, any groundwater or coastal waters. It authorizes decrees determining the conditions for the regulation of the placing on sale and distribution of certain products liable to give rise to discharges prohibited or regulated in accordance with the decrees described in the preceding sentence or liable to increase the harmfulness caused by such discharges.

The law states that it is prohibited to discharge, dump, or incinerate at sea materials that are liable to be prejudiced to public health and to biological resources, to hinder maritime activities, including fishing, to adversely affect the quality of seawater, from the standpoint of its use, or to harm the amenity value of the sea. A list of such materials shall, if necessary, be laid down by regulatory texts. The Minister for Environmental Protection may, after public inquiry, authorize such discharges, dumping, or incineration under conditions guaranteed to be harmless and entail no nuisances, and shall determine the time limit within which the prohibition shall apply to existing intentional discharges or dumping operations.

Factories, workshops or other installations that may cause hazards to or adverse effects on the amenity value of the neighbourhood, health, safety or public hygiene, agriculture, the protection of nature and the environment, or the conservation of sites and monuments shall be defined in a List of Classified Installations which shall be laid down by decree. The decree shall subject the installations to licensure or notification depending on the seriousness of the hazards or adverse effects entailed by their operation.

The decree applies automatically to new installations and shall specify the time limits within which it shall apply to existing installations and the conditions governing such application. Licenses may be granted, after public inquiry, only if hazards or adverse effects are eliminated or prevented by measures specified in the order made by the Minister for Environmental Protection. The Minister may inspect all classified installations except those under the jurisdiction of the Minister of National Defense.

Any person who produces or possesses wastes, defined as all residues from a process of production, conversion, or use of any substance, material, or product, under conditions that produce harmful effects on the soil, flora and fauna, cause deterioration of sites or the countryside, pollute air or water, cause noise or odours and, in general, adversely affect human health and the environment, shall be required to dispose of or arrange for the disposal of the wastes in a way that avoids these effects. Disposal of wastes includes the collection, transport, storage, sorting and treatment necessary for the recovery of energy or of reusable elements and materials, and the dumping in or discharge into the natural environment of all other products under conditions suitable for preventing the nuisances mentioned. Producers or importers must establish that wastes derived at any stage from the products they produce or import may be disposed of under the conditions specified in the law, and the Ministers for Environmental Protection is authorized to obtain information on procedures for disposal and the consequences of utilization of products. Manufacture, possession for sale, placing on sale, sale, and supply to the consumer of products that generate wastes may be regulated to facilitate the disposal of the wastes, or prohibited. Producers, importers and distributors of such products, or of materials used in their production, shall be required to provide for or contribute to the disposal of wastes produced. Persons possessing wastes from such products shall be required to convey them to establishments or services specified by the Minister for Environmental Protection. Waste disposal installations are subject to the provisions applicable to classified installations summarized above. Waste disposal practices, in the stages set forth in section 90, must be carried out under conditions that facilitate the recovery of materials or of reusable forms of energy.

Under Title II of Decree No. 81-267 of 1 October 1981 the chairman of the communal people's assembly is responsible for arranging for wastewater treatment and eliminating pollution.

4.4.2 Cyprus

The Foreshore Protection Law of 7 December 1934, as amended in 1961 and 1964, authorizes the District Officer to prohibit or limit dumping of engine oils or any other fluid lubricating oil (as well as liquid ballast) on any specified part of the foreshore, into the sea within a specified distance from the low water mark, or from any pier, wharf, quay, etc.

Section 5 of the Public Rivers Protection Law of 19 May 1930, Ch.82 of the Laws of Cyprus, authorizes the District Officer to prohibit or impose conditions on the dumping of any refuse in the bed or on the banks of any river.

Section 8B of regulations dated 22 July 1971 under the Fisheries Law of 15 May 1931, Ch.135 of the Laws of Cyprus, prohibit the contamination of maritime or surface waters by substances that may have a direct or indirect adverse effect on the development or survival of fish.

Under the Municipal Corporations Law of 10 June 1930, Ch.240 of the Laws of Cyprus, municipalities may take legal proceedings against a person who pollutes so as to create a health hazard.

4.4.3 Egypt

Section 1 of Law No.13 of 28 August 1904 on troublesome, unhealthy and dangerous establishments provides that activities considered unhealthy require a license from the Ministry of Public Health.

The order of the Cairo Governorate of 13 October 1924 restricts dumping of wastewater and garbage into the zones of the Nile or on its banks.

Section 2 of Law No.196 of 30 April 1953, as amended by Law No.33 of 1954, requires a license for the discharge of industrial and certain categories of domestic wastes into the Nile, other water courses, canals, drains, ponds or marshes.

The Oil Pollution Regulations impose obligations on port refineries, including a requirement that they report any accident that has caused serious pollution in harbours and territorial waters.

Order No.56 of 11 January 1962 provides for protection of harbour and territorial waters from oil pollution, though perhaps only from ships.

Law No.35 of 1946, as amended by Law No.645 of 1954, applies to discharges of industrial wastewaters into public sewers.

Chapter I of Law No.93 of 1962 on the discharge of liquid wastes, as implemented by regulations contained in Decree No.649 of 1967, requires a license for the discharge into public sewers from public places and from industrial or other establishments specified by the Minister of Housing and Utilities upon his determination that the establishment observes applicable health regulations. The license specifies wastewater characteristics in accordance with standards of the Ministers of Housing and Utilities and of Health. The sewage authority may require elimination of the cause of the discharge that causes a public health or similar hazard.

Chapter II of Law No.93 governs discharges into watercourses of public sewage and from private buildings and industrial establishments. Local authorities representing the Ministries of Health, Public Works and Industry must approve the discharges, after consulting the sewage authority. The sewage authority may issue a license if the wastewaters can be assimilated by the watercourse. Wastewater characteristics are specified for discharges into watercourses as they are for those into public sewers.

The regulations in Decree No.649, mentioned above, require the construction of traps in industrial establishments and garages for oil. They also authorize the sewage authority to require pretreatment of wastes that would be harmful to the sewage system. The decree also specifies standards for wastewaters discharged into different classifications of watercourses and into public sewers: industrial wastewaters discharged into the Nile (Class A) or drainage canals (Class B) may not contain more than 10 mg/l of oil and grease. For Class A waters, the discharges may not contain any materials that may adversely affect fish or other aquatic organisms or which may adversely affect the quality of water for drinking or other domestic purposes. For

Class B waters, discharges must not exceed standards for several metals, including lead. Seas and lakes are Class C waters. Discharges into Class C waters may not contain matter that may adversely affect beaches, marine installations, shellfish breeding areas, fish or other aquatic organisms. Wastewaters discharged into public sewers may not contain more than 100 mg/l of oil and grease, or any substances liable to be harmful to fish, or any materials with a flash point lower than 85 °C.

Section 9 of Law No.74 of 1971 on irrigation and drainage prohibits dumping of any substances harmful to health into any watercourse used for irrigation and drainage.

4.4.4 France

France is a nation with a long history of preferring the re-refining of used lubricating oils. Most recently, as a member of the European Economic Community, France has complied with the requirements of Council Directive 75/439/EEC (vide paragraph 4.4.18) of 16 June 1975 on the disposal of waste oils by Decree No.79-981 of 21 November 1979, modified by Decree No 85-387 of 29 March 1985, although the definition of used oils excludes oil-water emulsions and tank residues, which are regulated under other waste management laws. Used oil generators are required to collect used oils, store them so as to avoid their contamination, and give them to approved collectors or, with prior authorization, to approved disposal facilities. Approvals, in the form of agreements, are issued by the Ministry of the Environment that include requirements for environmental protection and for what must be done with the used oils collected. By decision of 29 March 1985, a departmental commission for approval of the collection of used lubricating oils was established. Also with prior authorization, a generator may dispose of used oils on its own. France requires that used oils be re-refined into a lubricant where economically feasible. Special permission is required for burning used oils that are unsuitable for re-refining as a fuel, although unauthorized burning as a fuel is reported to be substantial. Up to the present time, France has assigned one licensed collector exclusively to each department. The collector assigned may subcontract collection of up to 30% of the volume in his department. Some large collection companies have franchises for collection in several departments (in industrial areas there are some unauthorized collectors). All amounts over 200 litres must be collected within 15 days of notice and they must be given as directed by ANRED, the national agency for recovery and disposal of wastes, almost always to one of the nearly forty re-refiners. Under new regulations expected to come into force in the near future, each department will be able to assign more collectors, instead of only one.

Until March 1985, prices for motor oils, compressor oils and gearbox oils were fixed by decree on a sliding scale, depending on amounts to be collected, and the market set prices for transformer, turbine and transmission oils. This system was abandoned when the European Court of Justice held the French prohibition on export of used oils inconsistent with the Treaty of Rome establishing the Common Market (quite a bit of used oil generated in France had been exported to places where its use as a fuel was not so restricted and it brought higher prices than had been established. The only imports were from enterprises in Luxembourg under contract (60)). Now it is only required that prices for collection transactions be published.

Collectors must report monthly to the Ministry on volumes collected, supplies, costs and amounts delivered to disposal facilities and must give receipts to generators from whom they collect. Disposal facilities must keep records on dates of receipt, amounts, origins and characteristics of used oils received, and dates, amounts and characteristics of re-refined oils produced, and their destinations. From July 1, 1979 to December 31, 1981, France levied a tax on new and re-refined oils placed on the market that financed grants to used oil generators, collectors and disposal facilities for investment in storage, collection and treatment facilities (61). This decree also abolished tax preferences for re-refined products. Re-refiners also received a subsidy for each ton re-refined during this period. A subsidy to re-refiners was restored on a temporary basis in 1985 in order that they could compete for used oils that were being purchased for use as fuels. Increased efforts to enforce the prohibition on burning were also announced. France also spent 2.2 million francs for public education in 1980.

France also has legislation specifically prohibiting discharges of used (and new) oils into waters and limiting emissions of air pollutants from used oil burning. Disposal of process wastes, sludges and emulsions must be in accordance with Law No.75-633 of 15 July 1975 on waste disposal and with the Law of 19 July 1976 on classified installations. The former law defines wastes in Article 1 as all residues of an operation involving manufacturing, processing or use of any substance, material, product, or all abandoned goods or goods that their holder intends to abandon. Article 2 imposes an obligation that everyone who produces or holds waste is required to ensure that it is disposed of under proper conditions and to avoid (harmful) effects. Certain industrial wastes, including those containing used lubricating oils and polychlorinated biphenyls, must be disposed of by approved treatment installations. Industries that generate such wastes may be required to keep records and file reports on them and to complete a declaration when they are transported on how they will be disposed of.

Industrial discharges into public sewers must be authorized by the community and may be subject to pretreatment requirements (Decree No 77-974 of 19 August 1977). Discharges to watercourses require a permit under the Law No.64-1245 of 16 December 1964: All direct or indirect discharges, flows or deposits of water or matter generally liable to alter the quality of surface waters, groundwaters, or the water of the seas within territorial limits are subject to authorization. Article 2 of this law prohibits discharges or deposits into the waters of the sea or any kind, particularly industrial and atomic wastes liable to result in damage to public health, as well as the underwater flora and fauna, and to endanger the economic and tourist development of the coastal regions. Authorizations to discharge are granted where the substances involved can be guaranteed to be harmless, under conditions concerning amount of waste, flow, receiving water characteristics, etc. Again, the Decree of 8 March 1977 prohibits the discharge of used oils and lubricants into watercourses and sea waters.

4.4.5 Greece

Law No.743 of 13 October 1977 applies to pollution of ports, coasts and territorial waters of Greece by installations, vessels or tankers. Installations are defined to include oil refineries, oil installations, shipyards, ship repairing units, industries and plants of any kind, situated near the coast or using the coast for their functional needs or having an important and direct effect on the marine environment. Discharge of any waste

or sewage that may cause pollution is prohibited in ports, and coastal and territorial waters. "Pollution" is defined as presence in the sea of any substance which alters the natural condition of sea water or renders it harmful to human health or fauna and flora of the sea or, in general, is inconsistent with its intended uses. "Discharge" is defined as runoff or release, "waste" as solid or semi-liquid wastes of any nature discharged from ships, tankers and land-based installations, and "sewage" as liquid wastes of installations or industries whether or not they contain residues of substances used or produced by them. Discharges into the sea require a permit, which is granted "if there is no danger of pollution". Installations where oil is transferred or ships are repaired must have reception facilities adequate to receive oils, oil mixtures and other pollutants without delay and must take all necessary measures to avoid pollution. Terms and conditions for the approval of shore reception facilities, i.e. installations to receive and dispose of residues, oil mixtures, toxic substances and sewage from vessels and tankers, are fixed by joint decision of the Ministers of Industry and Power and of Merchant Marine (with the cooperation of Public Works and Social Services if land-generated liquid or solid waste and sewage are involved). Reception facilities must have the same permit as is required for industrial plants (69).

Sanitary Regulations Elb/221/1965 of 22 January 1965 establish water quality standards in Section 4 based on the intended uses of classes of surface waters and sea waters. A standard common to surface and sea water classes 1-4 is no toxic or otherwise harmful wastes or oily wastes which either alone or in combination could render the waters unsuitable for their intended uses. Class 5 surface waters may not contain oils in quantities that cause nuisance, contamination or other damage. Another common standard is that there must be no oils from sewage or industrial wastes. Section 5 of the Regulations provides that discharges of sewage or industrial wastes must have a permit, and be treated so that receiving waters are not made unsuitable for their intended uses. Section 2 requires that all necessary steps have been taken to prevent hazards to public health, interference with natural self-purification, and economic losses in general. The prefects decide whether applications for permits are granted, upon the recommendation of a committee of affected communities and responsible authorities. Sections 7 and 8 require licenses for disposal of sewage and industrial wastes onto or into the ground. They prohibit such discharges into wells or onto ground with fissures or holes, and authorize them if the ground is porous at a specified distance from the disposal point to any waters. Private waste disposal systems are governed by Section 9, which includes provisions for grease interceptors.

Sanitary regulations G1/18464/1969 of 4/29 September 1969 elaborates on the 1965 regulations summarized above with respect to protection of the Athens water supply. Direct or indirect discharges of oil upstream of water supply treatment plants are prohibited by Section 2, and discharges of sewage or industrial wastes are prohibited by Section 3 into two artificial lakes, Marathon and Iliki, or streams that flow into them. Drinking water quality in general is governed by Sanitary Regulations G3a/761/1968 of 6 March/10 April 1968. Article 5 of these regulations specifies limits on levels of substances and compounds in drinking water.

The sanitary Regulation Elb/301 of 10 February 1964 concerning collection, transportation and disposal of refuse, i.e. solid waste, semi-solid materials, liquid wastes of dwellings, institutions, factories and other installations that are disposed of on land, provides that it must be collected by means that avoid unhealthy situations or nuisance (an obligation of the municipalities) and stored in special containers until carried away. No controls specific to waste oils exist.

4.4.6 Israel

The Oil in Navigable Waters Ordinance of 1936, as amended in 1977, proscribes discharges of oil from installations on land, and establishes a Sea Pollution Prevention Fund.

The Ports (Prevention of Pollution) Rules of 1935, in Section 2, prohibit depositing of polluting substances into ports other than Haifa and Ashod. These two ports are covered by the Ports Authority Law of 1961. That law invokes the authority of the Minister of Transport to issue regulations under the Ports Ordinance to prohibit pollution of port waters or any place on land from which pollution may spread to a port, waterway or navigable river. Section 172 of the Port Regulations of 1971, as amended, prohibits the flow of drainage water into a port or place from which it may reach the port. Any other substance that might pollute sea water may only be allowed by the harbour master under conditions he sets.

Sewage outfall pipes into the Mediterranean are regulated by the Territorial Waters Committee under the Building and Planning Law of 1965. Other provisions concerning sewage are contained in the Local Authorities (Sewage) Law of 1962, as amended.

Industrial discharges are controlled via the Water (Use of Water in Industry). Regulations of 1964 that require all industries that use more than 5,000 cubic metres/year and all whose effluents are polluting a water source to submit a plan for effluent discharge control for approval by the Water Commissioner. The Licensing of Businesses Law of 1968, as amended, requires businesses designated by order to have a license in order to ensure environmental quality. An approved plan for waste removal and treatment is a condition of obtaining a license. The Model Bye-Law for Local Authorities (the discharge of industrial wastes into the sewage system), 1981, forbids discharge into sewage systems of industrial wastewater containing more than 20 mg/litre of mineral oil or oils with a mineral base for cutting machines known as soluble oil, or any kind of oil that is not biodegradable, or any other distillates containing oil products (this bye-law has already been adopted by about 30 local authorities in Israel).

Water pollution is controlled under the Water Law of 1959, as amended. It covers discharges that may cause pollution (i.e. change in water properties) from industrial establishments, buildings, sewage treatment plants, machines or means of transportation. It authorizes regulations concerning the location and establishment of specific sources of pollution, the use of certain substances or methods in production processes and the manufacture, import, distribution and marketing of certain substances and products. The Water Commissioner may require submissions of and approve a binding plan for disposal of wastes by sources of pollution.

The prevention of Seawater Pollution by oil Ordinance (New version, 1980) and its regulations forbid discharge of oil or oily waters containing more than 15 ppm of oil into Israel's territorial and inland waters by any shore installation or vessel. The prevention of Seawater Pollution (Dumping of waste) Law of 1983 forbids dumping of any material containing more than 10 mg/kg of (n-hexane soluble) hydrocarbons derived from crude oil into territorial and inland waters, and into the Mediterranean Sea area as defined in the dumping Protocol to the Barcelona Convention.

4.4.7 Italy

Italy implements the relevant EEC Directives under the authority of Law 42 of 9 February 1982 delegating implementation of such directives to the government, although it too prefers that lubricating oils be re-refined. Presidential Decree No.691 of 23 August 1982 requires generators either to have a permit to use used oils as a fuel or to provide them to a disposal consortium. Generators must store oils so as to avoid contamination. Authority exists to establish levels of contamination by water and other substances above which the generator would have to treat the oils or pay for their treatment. The consortium must give priority to re-refining to produce base lubricants unless that is not technically possible or economically reasonable. Second priority is disposal methods allowing greatest recovery of energy. The consortium consists of all enterprises involved in producing re-refined or new lubricating oils and is responsible for organizing collection and disposal of used oils throughout the country. Article 2 of DPR No.691 requires disposal to conform to requirements of other legislation concerning protection of surface and ground waters, coastal waters, drainage systems, soils and air. All re-refiners must be licensed under the Petroleum Law. Chronological records must be kept on the volume, origin and location of oils by those who generate, collect or dispose of more than 500 litres a year. Uncovered costs of collection and disposal of used oils are to be financed by charges levied by the consortium on its members in proportion to the volumes of new and used lubricating oils imported or marketed. The tax advantage for products made from used oil was abolished in 1982.

Discharges of any kind, public or private, direct and indirect, into surface waters (inland and marine) and groundwaters, into sewers, onto land and into subsoils, are controlled under Law 319 of 1976 and Law 650 of 24 December 1979. Manufacturing establishments, narrowly defined, and civil installations (including agricultural enterprises) must meet different limitations on discharges, and discharges (and enlargements of sources) must be authorized. Discharges into public sewers by manufacturing and civil installations must conform to limits established in regulations issued by the communities of consortia that operate sewage treatment facilities. Discharges of mineral oils into surface waters from new manufacturing installations may not exceed 5 mg/l. Existing manufacturing installations were to have met this limit by 1985. From 1979 until then a limit of 20 mg/l applied. The limit of 10 mg/l also applies to discharges into public sewers by manufacturing installations during the period before sewage treatment plants are constructed. No similar limit applies to civil installation discharges during this period. Article 9 of Law 319 of 1976 provides that these limits may not be met by diluting the effluent with water extracted for that purpose. These and other limits do not apply to the contents of solid matters in sludge from treatment plants, but discharges of such sludge into coastal or territorial waters must conform to requirements set by the head of the Maritime Department

and may not alter the marine environment so as to change its ecological structure or biological productivity, or endanger fishing, cause the spread of pathogens, damage aesthetics or possibilities for tourism, or inconvenience marine traffic.

The location of disposal of effluents on land or into subsoils is controlled by communities or consortia for industrial waste disposal. The limit of 5 mg/l set forth above for discharges containing oil into surface waters applies to discharges onto land, until local rules are promulgated, and in addition the discharges may not contain substances which alter the structure of the soil or its permeability, aeration or capacity for biodegradation. Discharges of sludges from manufacturing or treatment processes onto land may likewise not alter the chemical and physical structure of the soil, and must be treated to make them suitable for being deposited. Technical provisions of 4 February 1977 set forth parameters for assessing the amounts of oils and hydrocarbons in the sludge in relation to the characteristics of the land. Subsoil disposal is not permitted if it may damage groundwater.

Law No.366 of 20 March 1941 governs disposal of solid wastes generated in public areas and in homes and offices and includes provisions for recycling of usable industrial wastes. Rules for community collection in the law are supplemented by instructions from the Ministry of Health.

Article 71 of the Navigational Code prohibits discharges of any kind into port waters, while Article 76 requires managers of industrial installations or storage facilities located in wharves, quays or navigable canals to avoid fouling waters in accordance with orders of the head of the Maritime Department. Article 82 of the implementing regulations, DPR 328 of 15 February 1952, incorporates these provisions and extends them to waters beyond quaysides for cleaning operations that are to be conducted by whoever loads or unloads in port.

Article 15(e) of Law 963 of 1965 concerning fishing in marine waters, a criminal provision, prohibits discharges of substances which injure aquatic organisms or cause alteration of the environment in a way harmful to them. It has been applied to discharges of industrial process wastes, e.g. in Scarlino.

Italy and Yugoslavia have a 1977 agreement that provides for a joint commission to protect the Adriatic Sea and its coastal areas by studying problems of pollution and making recommendations for research and other provisions. Law 405 of 29 July 1981 provided financing for studies under this agreement. Italy, France and Monaco also have an agreement for the protection of Mediterranean waters in the Tyrrhenian Sea which came into force on March 1, 1981.

4.4.8 Lebanon

Decree Law 2775 of 28 September 1928 concerning marine fisheries prohibits discharges of pollutants into public waters and seas and regulations under this law govern construction of factories along the coast whose discharges might affect fisheries.

Decree No.2761 of 19 December 1933 contains provisions governing industrial wastewater and sewage disposal. Section 12 requires authorization of public health and agriculture authorities for treated sewage to be discharged into surface waters or used for agricultural purposes.

4.4.9 Libya

The Water Law of 28 September 1965 contains a general prohibition on pollution.

Section 3 of Petroleum Regulation No.8 of 1968 requires holders of concessions to drill for petroleum to take all reasonable precautions to avoid hazard or damage to natural resources.

Section 18 of Law No.130 of 26 September 1972 invests municipalities with the responsibility for sewage disposal.

Section 21 of the Health Law of 13 December 1973 prohibits any action that may lead to environmental pollution and requires all necessary steps to ensure purity of water. Regulations governing wastewater and refuse disposal are also authorized.

4.4.10 Malta

The Marine Pollution (Prevention and Control) Act of 1977 has as its objective to give effect to the provisions of international and regional conventions and protocols relating to the protection of the marine environment. It contains provisions for controlling land-based pollution.

Section 210 of Chapter 13 of the Code of Police Laws, as amended in 1972, imposes penalties on any person who allows petroleum or other oil or mixture of them to run into inland or territorial waters or harbours from any land-based installation. Section 209 proscribes leaving anything that may cause injury to public health or nuisance in any harbour or on any wharf. Section 104 requires the owner of a building to take necessary measures to prevent flow from drains or pipes. Section 138 imposes a duty on all persons to avoid negligent pollution of public water supplies.

Section 31 of the Port Regulations of 1966 contains a prohibition on discharges of oil that may apply to land-based sources.

The Sewage Matter Removal Regulations of 1911 apply to that subject.

4.4.11 Monaco

Section 1 of Law No.954 of 19 April 1974 prohibits dumping, spilling, depositing, or direct or indirect discharge of materials or substances into inland maritime waters, territorial seas, surface waters or groundwater that may cause deterioration of water quality, jeopardize natural functions of marine flora or fauna, harm public health or jeopardize economic development or tourism. Section 3 authorizes ordinances controlling or prohibiting the import, manufacture, distribution, sale or use of products liable to cause pollution and governing the operation of establishments which may be sources of pollution.

Similar authority is contained in Sovereign Ordinance No.4884 of 7 March 1972. Section 1 prohibits direct or indirect dumping or discharge of materials or objects into inland waters or territorial seas or any other activity that may cause or increase deterioration in water quality. Section 3 requires new installations intending to withdraw sea water or discharge into it to submit treatment plans for approval and obtain authorization to operate.

An agreement signed on May 10, 1976 by Monaco, France and Italy establishes a commission to bring about collaboration to control water pollution along the coast between St. Raphael, France and Genoa, Italy.

4.4.12 Morocco

The Vizierial Order of 26 May 1916 on the protection of municipal water supplies prohibits garbage disposal, construction and other activities in or near waters contained in aquaducts, reservoirs, wells and other sources or conveyances of water supplies.

The Dahir of 1 August 1925 contains provisions prohibiting dumping into watercourses of any substances harmful to public health or animals.

4.4.13 Spain

The Order of 27 May 1967 prohibits discharge into the sea of all petroleum products or residues containing such products by industries. Permits for discharges including such products in amounts that will not cause water pollution are authorized under section 10(4) of Act No.28/69 on Coasts of 26 April 1969. Rules on the design and construction of installations for wastewater treatment and discharge into the sea are contained in a Resolution of 23 April 1969. Direct untreated discharges are prohibited. Criteria in rules 13-15 specify varying minimum dilutions of wastewaters depending on kind of treatment and location of discharge. Section 24 of the rules requires a license for industrial discharges. These discharges must be treated to remove substances harmful to marine fauna or flora or to public health in beach areas. These rules have been updated by the Order of 29 April 1977 approving instructions for discharges from land-based sources into the sea via outfalls. Receiving water quality standards based on categories of use and effluent characteristics, treatment requirements and outfall design standards are set forth. The Order of 27 May 1971 on measures to control pollution of the sea requires refineries, petrochemical plants and fuel supply establishments that load or unload oil to have a vessel that can discharge substances into surface waters.

In 1981, specific regulations on used oils were issued under the Ministerial Order (Finance) of 22 July 1963, regarding the sale of mineral oils and other products of petroleum origin, within the precinct of the Monopoly of Petroleum. With regard to used lubricating oils, handling and treatment are prohibited, with the exception of those oil-regenerating industries authorized by the Ministry of Industry with the prior approved of the Ministry of Finance. Containers of regenerated lubricating oils must be clearly labelled as such. All retailers of petroleum products have to deliver all used lubricating oils in their possession to the appropriate authorized agency at a price determined by the official agency (which takes account of the characteristics and viscosity of the oil in question). There are heavy penalties for supplying used oils as though they were new or to supply used oils to third parties without prior official authorization.

Law No 45/1981 of 28 December 1981, which creates a national Petroleum Institute, authorises the Government to liberalize commerce in non-energy-producing petroleum products. Royal Decree-Law 5 of 12 December 1985 on the adaptation of petroleum monopoly stipulates that the free distribution and sale of petroleum products shall not apply in the case of manufacture and sale of basic oils and automotive lubricants, the conditions of which remain subject to governmental control.

The Water Act of 13 June 1879 prohibits discharges of harmful substances into waters. The royal decree of 16 November 1900 prohibits discharges of polluted waters from factories into rivers, streams, estuaries or bays. The Decree of 9 February 1925 prohibits discharges of untreated sewage into rivers unless the assimilative capacity is adequate and authorize municipalities to prescribe treatment methods for industrial effluents or to prohibit them. The Regulations on the Administration of Watercourses of 14 November 1958, in Chapter 2, Section 11, requires licenses for discharges of wastewaters from industrial establishments, etc., that may contaminate public waters. Licenses are granted only after approval of a suitable treatment plant. The 1958 regulations were amended by the Order of 14 September 1959, authorizing the imposition of maximum amounts of pollutants in effluents, establishing classifications of receiving waters and discharges, and coordinating licenses to use public waters with discharge permits. The Order of 23 March 1960, amended by Decree No.2414/61 of 30 November 1961, added requirements for information to be provided in applications for licenses to discharge, required that each license must set limits for several characteristics, including amount of fats and oils, and added authority for water commissioners to monitor compliance and enforce the requirements. The Order of 14 April 1980 prescribes detailed measures for water pollution abatement, including authority for water commissioners to require joint abatement action by dischargers.

The Decree of 30 November 1961 (No.2414, referred to above) also defines unhealthy or harmful activities as those that discharge products that may be directly or indirectly harmful to human health and prohibits new activities of this kind unless they comply with the Regulations of 14 November 1958. Industrial discharges must conform to specified effluent characteristics.

The Law on River Fisheries of 20 February 1942, implemented by the Decrees of 6 April 1943 and 13 August 1966, discharges of any substance liable to harm fish directly or indirectly or interfere with their physiological or ecological requirements.

Law No.42 of 19 November 1975 prescribes how solid wastes and residues from industrial, domestic and agricultural activities are to be collected and treated, having regard for protection of the environment and subsoil and recovery of resources from waste materials.

The basic Law on toxic and dangerous residues (Law No 20 of 14 May 1985, contains a regulation, still not completely developed, concerning used lubricating oils, which are included in the 1st annex to this Law.

4.4.14 Syria

Article 32 of Legislative Decree No.30 of 25 August 1964 on the protection of aquatic organisms strictly prohibits allowing wastes from factories and laboratories that are harmful to fish and other aquatic life to flow into public waters (defined in Article 1 as inland waters, sea waters and estuaries). Chemical and petroleum substances may likewise not be discharged from sewers. Owners of factories and laboratories and petroleum or chemical pipelines must take necessary measures to avoid harm to these waters and the construction of any of these establishments after the effective date of the decree requires the authorization of the Minister of Agriculture, which will specify measures to prevent harm.

Law No.10 of 26 March 1972 concerning pollution of water by oil assigns responsibility for land-based sources of pollution to the owner or operator of the installation or factory concerned. The owner, operator or person possessing equipment for the storage, transport or pumping of petroleum is responsible for pollution from these sources. Petroleum pumping stations and storage depots are responsible for constructing facilities for storing petroleum wastes from ships. Instructions concerning pollution control measures in ports were issued on 19 April 1973 based on Law No.10.

4.4.15 Tunisia

Law No.75-16 of 31 March 1975 enacted a comprehensive water code. Article 108 prohibits the discharge or dumping into marine waters of any matter, especially domestic or industrial wastes that may injure public health or fauna or flora or the economic development of coastal regions or their tourist potential. Article 109 prohibits discharge into public waters of wastewaters, wastes or other substances that may harm public health or eventual uses of the waters. Depositing on land of anything that may cause ground or surface water pollution is prohibited by Article 110. Article 116 authorizes the discharge of treated wastewaters, provided they contain no suspended, floating or dissolved matter capable of forming deposits on the banks or bed of the watercourse involved or interfering with downstream uses. Article 124 authorizes government decrees regulating discharges and other acts liable to cause deterioration, specifying water quality criteria and monitoring receiving water and effluent characteristics. Article 134 provides that the Minister of Agriculture must approve non-domestic discharges into public sewers. Pretreatment may be required (Decree No.79-768 of 8 September 1979 governs connections with and discharges into public sewers in further detail). Article 136 provides for a decree concerning dangerous, unhealthy and troublesome establishments, including a requirement that new establishments must file an application specifying treatment of the effluents.

Section 12 of the Decree of 26 July 1951 concerning sea fisheries prohibits discharges of effluents or wastes into the sea, tidal reaches of rivers, streams or canals without authorization.

4.4.16 Turkey

The Water Resources Act of 1971 prohibits, in Section 20, dumping into inland waters or marine waters where the sea is being used, substances harmful to water-derived resources or the health of those consuming them or to pipelines, tools, materials or equipment. The Water Resources Ordinance of 1973 based on the 1971 law requires, in Part VIII, Article 1, that industries must take all possible precautions to prevent pollution by products prohibited by the ordinance within two years. Article 2 of Part VIII requires municipalities to prevent pollution by sewers within five years. Annex 5 of the ordinance specifies substances whose physical properties or chemical concentrations indicate they may not be discharged. The Ministerial Ordinances of 4 September 1959 and 29 March 1960 require permits for the discharge of wastewater into watercourses and discharges are classified and wastewater characteristics are prescribed.

Regulations on Groundwater dated 20 July 1961, based on the Ground Water Act of 16 December 1960, require that proper measures be taken to prevent pollution of surface or ground waters on their being made unfit for use. Licenses are required under the act for projects that entail utilization of groundwater.

Under Section 4 of the Ports Law of 1925, as amended in 1965, permission is required to build jetties, quays, docks, factories, warehouses, etc. along the coastline or in coastal areas. Dumping of refuse or ballast into the water may be prohibited at specified points.

Section 242 of the Public Health Law of 6 May 1930 prohibits the construction of establishments that may contaminate rivers, streams or springs and the dumping of industrial wastewater into rivers and streams unless it has first been rendered harmless. Section 244 prohibits discharges of sewage or contaminated domestic wastewater for sewers or municipal drains into rivers and streams unless it is verified that the discharges will not endanger health.

4.4.17 Yugoslavia

The Decree of 28 December 1973 on inter-republic and international waters applies to surface and groundwaters of importance to two or more republics and to maritime coastal waters. The waters are classified according to their intended uses and requisite quality, i.e. physical, biological, chemical and bacteriological properties. Substances liable to endanger life and health of persons, fish and animals (dangerous substances) may not be introduced into these waters if they are liable to adversely affect the characteristics of the receiving waters. Discharges of effluents that would cause water quality deterioration are deemed harmful. They may be prohibited or subject to treatment requirements. Products that contain persistent polluting substances may be prohibited from sale.

The Basic Law on Waters was promulgated by the Decree of 15 March 1965. Wastes dangerous to human life or health, fish or livestock may not be discharged. These include those that produce a film of fatty substances, petroleum or petroleum derivatives on the surface of the water. Wastewater treatment plants are prerequisites to the licenses required for construction of any plant, facility or building that may discharge harmful wastes, i.e. those liable to cause changes in physical, chemical or biological properties of waters to an extent that may prevent or restrict their use.

Section 14 of the Basic Law concerning Sanitary Inspection of 1 March 1965 requires approval of the location and plans for facilities for the disposal of effluents and other wastes from built-up areas and industrial installations.

Regulations of 30 June 1950 on the maintenance of order in harbours authorize a harbour master to require treatment of discharges from factories and workshops. Section 10 of the regulations prohibit throwing garbage or other polluting substances into harbour waters.

Section 35 of the Basic Law on Fisheries of 27 February 1965 prohibits discharges into marine waters or rivers or lakes connected with them of industrial wastes or any other materials capable of killing fish or other marine animals, adversely affecting biological conditions governing their growth and development, or reducing their economic value.

4.4.18 European Economic Community

Mediterranean States which are members of the European Economic Community are bound by the terms of Council Directive 75/439/EEC of 16 June 1975 on the disposal of waste oils, as amended by Council Directive 87/101/EEC of 22 December 1986.

Briefly, this Directive, in its current amended form, requires member states to take the necessary measures to ensure that waste oils are collected and disposed of without causing any damage to man or the environment. Priority is given to regeneration; where this cannot be done, any combustion is to be carried out under environmentally acceptable conditions in accordance with stipulated provisions. Otherwise measures have to be taken to ensure the waste oils' safe destruction or their controlled storage or tipping. Discharges into internal surface waters, ground water, coastal waters and drainage systems are prohibited, as are deposits or discharges harmful to soil, uncontrolled discharges of waste oil processing residues, and waste oil processing that violates existing air pollution standards. Member states must ensure that one or more undertakings collect and/or dispose of waste oils offered by holders, where appropriate in the area assigned to them by the competent authorities.

Undertakings collecting waste oils are subject to registration and adequate supervision. Those which dispose of waste oils must have a permit. In regeneration of waste oils, member states must ensure that plant operation will not cause environmental damage, that toxic and dangerous residues do not constitute a toxic or dangerous waste, or contain PCBs or PCTs in concentrations above stipulated limits. In the use of waste oils as fuel, measures must be taken to avoid air pollution, and an annex to the Directive sets out emission limit values for a number of substances. Special provisions also apply for regeneration and disposal of waste oils containing PCBs or PCTs. Measures to comply with the Directive must be taken by member states with effect from 1 January 1990.

4.5 Standardisation and marketing

Because lubricating oils become contaminated with water, sludge, metal particles, etc. during use, it is important to determine how much of the contaminants must be removed for the used oil to be suitable for a particular re-use and to have available relatively inexpensive tests to make sure they are suitable. There are, of course, specifications that oils must meet for their initial uses, whether they are used as lubricants or for fuel. Some of these specifications, as well as test procedures to determine if they are met, are established as standards by testing societies, industrial or professional associations, or public agencies (both military and non-military), some by the purchaser who has a particular application in mind. Automotive engineers, for example, specify the quality standards motor oils must meet for different engines. Similarly, there are several grades of fuel oils. These standards may be enforced by agencies that test the quality of selected products. For motor oils these tests range from relatively simple laboratory bench tests to expensive engine sequence tests that involve using the oil in an engine for many hours and then dismantling and examining the engine.

Re-refining removes more or less all of the contaminants, depending on the process used, leaving base stock oils comparable to those distilled from crude petroleum that can be made usable for a variety of purposes by the addition of selected additives. When available test procedures establish that products made from used oils are substantially equivalent to those made from virgin oil, the fuel and lubricant products made from used oils can be placed on the open market as well as purchased by government procurement programmes, and there is a considerable incentive to collect and re-use used oils.

In order to inform consumers, some laws require that oil products made in part from used oils be so labelled. Other laws achieve the same effect by prohibiting the sale of any fuel or lubricating oil in any manner that may deceive the purchaser about its nature or quality. Such requirements tend to impair the marketability of products made from used oils (Becker and Comeford, 1980). It is preferable to label such products on the basis of performance characteristics or suitability for specified uses.

Marketing of products made from used oils can also be promoted by exempting them from taxes placed on products made from virgin oils.

Marketability is not an issue in situations where the generator of used lubricating oils segregates them from other wastes and provides them to a re-refiner to be specially treated and returned for re-use. Acceptability of products made from used lubricating oils is often more easily established with government procurement agencies and large commercial or industrial purchasers than with individual consumers (Irwin, 1978, Irwin and Liroff, 1974).

4.6 Public awareness

Education of the public about the harm and waste that can be caused by improper disposal or re-use of used lubricating oils and the benefits that can accrue from collecting them and conserving their resource values is an effective means to establishing a foundation of awareness upon which a variety of policies and programmes can be built. Important elements in the information to be conveyed are that oil is both scarce and valuable, that significant damage to environmental and human health can be caused by dumping oils or burning them without precautions to prevent air pollution, and that it can be relatively easy to conserve the resource and avoid the damage by keeping used oils separate from other wastes, collecting them and either storing them until they are picked up or taking them where they will be properly re-used or disposed of.

There are of course many ways to convey this message and many audiences who should hear it. For industries, it can be useful to prepare and distribute a manual that explains how to handle lubricants in a plant so as to reduce the amount of used oils generated (by selecting the most appropriate lubricants, extending their useful lives, performing preventive maintenance and using automatic lubricating systems and filters where possible, for example), to segregate used oils from other plant wastes by establishing in-plant collection systems and separate sewers or traps to keep them from mixing with wastewaters and to reclaim as much as possible (e.g. by settling, centrifuging or filtering) in the plant.

Because the use of automotive lubricants is more dispersed they are more difficult to collect. Public awareness about these used oils is accordingly more important. It can be promoted through discussion in driver education and auto mechanic courses and by providing information in vehicle operator manuals and in connection with vehicle registration and driver licensing. It can also be publicized by signs, brochures or bumper stickers at sales outlets, by labels on oil containers, by media or information campaigns conducted or sponsored by public agencies (e.g. as an insert in tax or utility bill mailings), conservation or civic organizations, oil industry associations, or all three. Case histories of successful public education efforts can be distributed at the local and regional level as a means of creating further interest and giving examples of how to act.

Some programmes have distributed containers for collecting oil free of charge. Some donate the proceeds of the oil collected to charity.

Public education efforts may be effectively coordinated with other components of public policy concerning collection, re-use and disposal of used lubricating oils. If legal requirements, prohibitions or limitations apply, they should be publicized. If local collection facilities (e.g. recycling centres) have been established, privately (e.g. gas stations) or publicly, their locations and hours should be announced. If pickup services are provided, on call or on a regular basis, this should be advertised.

5. SUGGESTED OUTLINE OF PROGRESSIVE NATIONAL MEASURES

Article 5 of the Protocol for the Protection of the Mediterranean Sea against Pollution from Land-based Sources provides that the Parties undertake to eliminate pollution from land-based sources by substances listed in Annex I, including used lubricating oils. The parties shall elaborate and implement, jointly or individually, as appropriate, the necessary programmes and measures, including common emission standards and standards for use. Article 7 provides that the parties shall progressively formulate and adopt common guidelines and, as appropriate, standards or criteria dealing in particular with the control and progressive replacement of products, installations and industrial and other processes causing significant pollution of the marine environment and specific requirements concerning the quantities of the substances listed in Annexes I and II discharged, their concentration in effluents and methods of discharging them.

The common guidelines, standards and criteria referred to in Article 7 "shall take into account local ecological, geographical and physical characteristics, the economic capacity of the Parties and their need for development, the level of existing pollution and the real absorptive capacity of the marine environment". The programmes and measures referred to in Article 5 "shall be adopted by taking into account, for their progressive implementation, the capacity to adapt and reconvert existing installations, the economic capacity of the Parties and their need for development".

In December 1985, the Meeting of Experts of the Technical Implementation of the Protocol agreed on a workplan and time-table for activities towards the development of programmes and measures for the implementation of the Protocol, which reflect the provisions of Articles 5 and 7 of the Protocol set forth above. Insofar as substances were concerned, priority was given to those in Annex I (UNEP, 1985b).

In light of the provisions of Articles 5 and 7 of the Protocol, and of the December 1985 workplan for the implementation of the Protocol, the following outline of progressive national measures concerning used lubricating oils is suggested:

5.1 Definition of used lubricating oils

1. Discharges of oil from oil production, refining and storage installations should not be included within the scope of the definition of used lubricating oils, even though they constitute significant sources of pollution of the Mediterranean Sea, because they are not "used" and, in addition, are often not "lubricating" oils.

2. It should also be recognized that "used lubricating oils" are those made at least in part from petroleum (including chemical additives) but do not include lubricants that are wholly synthetic or chlorinated lubricating or insulating oils, e.g. those containing PCB's or PCT's. Experience under the European Economic Community directive's original definition that included synthetic oils led the Commission to amend the definition, which now excludes them. Used motor vehicle lubricants consisting of mixtures of mineral oils and synthetic oils would still be included, since such oils do not differ greatly from the other lubricants in question. Contamination of used lubricating oils with PCBs and PCTs has been a severe and continuing problem in several countries, e.g. in the Federal Republic of Germany, which has had a comprehensive used oil collection and recycling law since 1968 (88). This problem is also catered for in the EEC's amended Directive.
3. Strictly speaking, the term "used lubricating oils" should not include other substances such as pesticide residues, gasoline, solvents, PCB's or hazardous wastes, or include oils with more than specified proportions of other substances. In this context, it would be expected that any used oils containing significant proportions of such substances would automatically fall under the legal provisions pertaining to these substances.
4. For practical purposes, three types of used lubricating oils can be considered:
 - used lubricating oils which can be reutilised;
 - contaminated used lubricating oils, i.e. those containing a certain proportion of toxic substances, while the main constituent remains the lubricating oil;
 - used lubricating oils present in various industrial wastes without, however, constituting the main constituent of such wastes.
5. A suitable definition of used lubricating oils for the purposes of Article 5 and Annex I to the Protocol for other Protection of the Mediterranean Sea against Pollution from Land-based sources could be the following:

"Any mineral-based lubricating oils which, through use, storage or handling, have become unfit for the purpose for which they were originally intended, in particular used oils from combustion engines and transmission systems, as well as mineral oils for machinery, turbines and hydraulic systems".

5.2 Assessment of sources and levels of used lubricating oils

1. A special effort should be made to provide data that will facilitate the determination of levels of oil pollution in the Mediterranean that are attributable to sources of used lubricating oils as distinct from other sources of petroleum pollution. Article 7 of the Protocol calls for such information to be taken into account in formulating common guidelines, standards or criteria for controlling significant causes of pollution.

2. Each country should conduct its own assessment of the sources of used lubricating oils, kinds and amounts generated and current collection, re-use and disposal practices within its borders as a means of determining not only its pollution load, but also other environmental and public health effects of those practices. Such assessments constitute a basis for deciding how to implement measures agreed upon by the Parties under the Protocol to eliminate pollution of the Mediterranean, as well as any additional measures taken as a matter of national policies.

5.3 Controlling sources of used lubricating oils causing significant pollution

1. Once the "installations and industrial and other processes causing significant pollution of the marine environment" have been identified by these regional and national assessments, they should be regulated by a system of authorization that would control used lubricating oil generation. Authorizations issued and periodically reviewed for renewal under this system should require each source:
 - (a) to collect used lubricating oils and keep them separate from other substances and wastes;
 - (b) to limit or prohibit amounts of used lubricating oils discharged into water or onto land or burned as a supplemental fuel and specify the pretreatment and emission or effluent applicable controls when they are discharged or burned (cf. Article 7(1)(e) of the Protocol), (there can be serious health and equipment operational effects from burning untreated used oil; and
 - (c) to transfer used lubricating oils that are collected but not re-used or burned as a supplemental fuel on the premises to an authorized collector.
2. Concurrently, a public education programme should be undertaken, including:
 - (a) the preparation and distribution of a manual on how to separate and collect used crankcase lubricating oils; and
 - (b) public information on the environmental and resource conservation benefits from collecting used lubricating oils.

5.4 Industrial used oil policies

Surveys of industrial used oils volumes, and their physical and chemical properties indicate that there is a potential for much greater re-use and recovery of oil than is presently practiced. Policies aimed at promoting recovery could be designed in a number of different ways to encourage the generators of used oil, and consumers of recycled oil, toward more conservation oriented actions. Among the desired actions that regulatory and educational policies might seek to promote are:

- (1) a re-examination of the relative economics of disposal, versus recovery by industries (particularly those impacted by wastewater treatment and solid waste regulations);
- (2) the segregation of used oil streams within manufacturing plants so that the value of such oil is greater to the plant itself and to firms specializing in oil recycling and re-refining;
- (3) the improvement of the market for recycled or re-refined oil, by seeking to change consumer attitudes towards its use.

Two specific policy initiatives are outlined below that would provide incentives in one or more of these areas. These policies include:

- (1) an industrial environmental education programme aimed at aiding industry in assessing the benefits and costs of oil recovery programmes;
- (2) the designation of used oil recovery equipment such that there are tax advantages for this equipment such as faster tax write-offs and property tax exemptions.

These two policies are examined below in terms of the required action and the mechanism by which a policy would foster industrial used oil recovery.

In order to aid in assessing these policy impacts, an example of an economic analysis of one type of in-plant oil recycling system has been chosen as a benchmark against which to analyze how a firm may react to the implementation of policies presented above. This example is not presented to characterize used oil recycling economics in general, but only to illustrate the relative impact of potential policies.

Figure 5.1 shows the number of years that industrial used oil generators would have to operate an oil filtering recycling system for a "typical oil" in order to pay for the initial purchase price of the system. The payback period varies significantly with the volume of oil involved and the type of use of the recycled product. In general, the most favourable economic conditions for recycling are for the large volume users who recycle oil as fuel. This applies only if the oil does not contain high levels of contaminants which may be harmful if emitted to the air and which are difficult to remove, e.g. trace metals. The payback periods for small volume users are not conducive to in-plant recycling with high capital cost equipment. However, this oil might be sent to a re-refiner.

The sensitivity of recycling economics to oil volume suggests that, for maximum efficiency, policies be aimed at the education of middle volume users. Partial subsidization of demonstrations of recovery systems should also be directed toward middle volume users, in order to promote an awareness of the benefits of oil conservation practices by the categories of firms most likely to respond to such demonstrations.

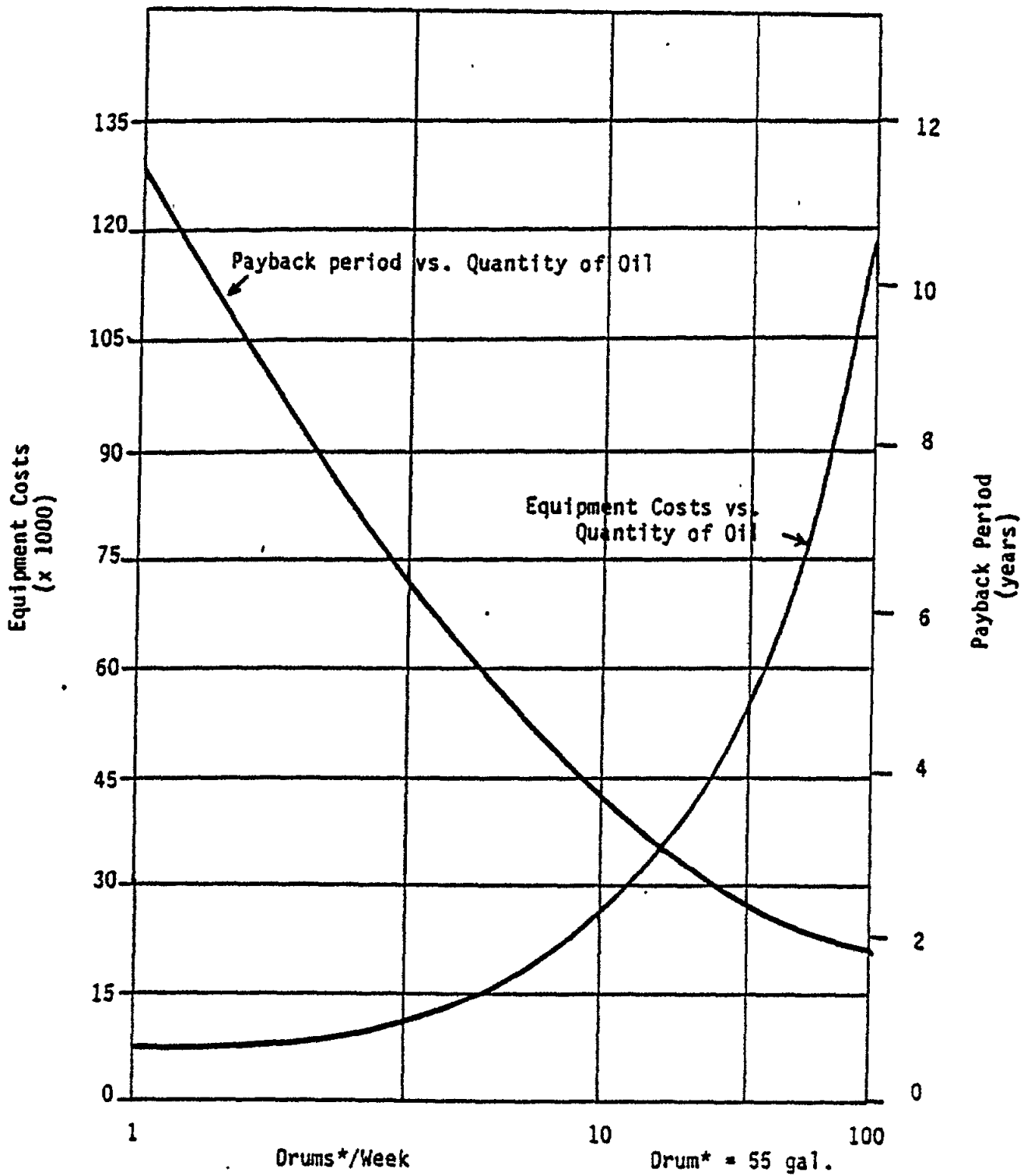


Figure 5.1. Equipment costs and payback period vs. drums of oil

1. Industrial education programme

- (a) Policy action: The policy action would consist of disseminating information to industries that would aim them in assessing the feasibility and economics of increased industrial oil recovery. A used oil audit manual might be prepared describing the procedure to inventory oils used in manufacturing processes and the equipment presently available for recovery operations. Distribution of the manual would constitute implementation of one phase of an industrial education programme.
- (b) Mechanism by which recovery is encouraged: The manual would seek to draw attention to the potential of industrial oil recovery. Those industries presently facing wastewater and other oily waste problems should be targeted for attention. Significant savings can often be realized in wastewater treatment, investment in other pollution control equipment and recycling of oils and minimizing oily waste production. The large fraction of unaccounted oil indicated by some industrial surveys suggests that the dissemination of procedural techniques to aid such industries to evaluate investments in recovery equipment would be beneficial.

A major thrust of such a manual would be to encourage in-plant oil segregation, filtering, centrifuging and use of settling equipment. Such equipment can be employed to lengthen the life of the oil in the plant or to lower the water and contamination levels of used oil, allowing more economical recovery by professional recycling firms.

2. Tax advantage for oil recovery equipment

- (a) Policy action: A declaration that oil recovery equipment be granted some tax advantages would be helpful. In some countries, there are a number of tax advantages afforded to pollution control equipment. These include:
- (1) a real property tax exemption;
 - (2) a sales-use tax exemption;
 - (3) accelerated depreciation of pollution control equipment;
 - (4) financial programmes for the purchase of pollution control facilities.
- (b) Mechanism to foster industrial oil recovery: It is difficult to assess the impact of these tax benefits without reference to a specific firm's financial situation. One major benefit to firms could be derived from the accelerated depreciation benefits. A significant tax benefit could accrue to those specializing in used oil recovery. It would raise their after-tax profit margin, and thereby provide incentives to recover presently marginal oil. This, in turn, would raise the price which they would be willing to pay to used oil generators for the oil.

5.5 Controlling re-use and disposal of used lubricating oils

Within a reasonable period of establishing the system for authorizing significant sources of used lubricating oils, two other authorization systems should be concurrently established:

1. a system of authorizing collectors, specifying minimum amounts of used lubricating oils that must be collected; and
2. a system of authorizing alternative means of re-use and disposal, specifying what authorized collectors may do with what they collect, e.g. re-refine it, burn it as a fuel supplement after prescribed pretreatment or with prescribed emission controls, or dispose of it in accordance with approved hazardous waste disposal techniques.

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