PlasticsEurope
Association of Plastics Manufacturers

Eco-profiles of the European Plastics Industry

CRUDE OIL

A report by

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for

Plastics*Europe*

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IMPORTANT NOTE

Before using the data contained in this report, you are strongly recommended to look at the following documents:

1. Methodology

This provides information about the analysis technique used and gives advice on the meaning of the results.

2. Data sources

This gives information about the number of plants examined, the date when the data were collected and information about up-stream operations.

In addition, you can also download data sets for most of the upstream operations used in this report. All of these documents can be found at: www.plasticseurope.org.

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CONTENTS

INTRODUCTION

Until the middle of the 20th century, the main source of hydrocarbons used in the chemical industry was coal. Since then the use of coal has all but disappeared and the primary source of hydrocarbons used today is petroleum (literally rock oil). The petroleum industry is primarily concerned with three main groups of hydrocarbon mixtures. These are:

1. Crude oil: a naturally occurring mineral oil comprising a mixture of hydrocarbons with associated impurities such as sulphur and some metals which normally exists as a liquid at normal surface temperatures and pressures.

2. Natural gas liquids (NGL): liquid or liquefied gaseous hydrocarbons recovered from natural gas in separation facilities. Typically NGL contains hydrocarbons from ethane (C_2H_6) to pentanes (C_5H_{12}).

3. Natural gas: a naturally occurring deposit, whether liquid or gaseous, consisting mainly of methane.

The world production of these raw materials in 1999 is shown in Table 1. In Table 1 crude oil and natural gas liquids have been combined; NGL represents approximately 6% of the total.

This report is concerned with the production and supply of crude oil to Western Europe because this is one of the major raw materials used in the production of large tonnage polymers and most engineering polymers.

World production of crude oil is shown in Table 1. The values in the table include natural gas liquids which represent approximately 6% of the total.

Table 1
World production of crude oil and natural gas liquids in 2001[1]

Region	Crude oil 10^6 tonne	
OECD North America[1]	659	18.4%
OECD Europe[2]	316	8.8%
OECD Pacific[3]	36	1.0%
Latin America	352	9.8%
Non-OECD Europe	9	0.3%
Former USSR	423	11.8%
Africa	378	10.5%
Middle East	1071	29.9%
Asia (excluding China)	177	4.9%
China	164	4.6%
World production	3584	100.0%

Notes:
1. OECD North America = Canada, Mexico and USA
2. OECD Europe = Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey and UK.
3. OECD Pacific = Australia, Japan, South Korea and New Zealand.
Data includes NGL[2].

CRUDE OIL

Crude oil is a mixture of hydrocarbons with component molecules containing anywhere from three or four carbon atoms to many hundreds. In addition, since crude oils usually occur in the same deposits as natural gas, most samples of crude oil contain dissolved natural gases. These are liberated at the refining stage.

Traditionally crude oil production has been measured in barrels (bbl) where

1 bbl = 42 US gallons = 158.8 litre

Oil densities are often expressed as degrees API (°API) where API denotes American Petroleum Institute. The definition of °API is

°API = [141.5/specific gravity at 60°F] – 131.5

[1] International Energy Agency. *Oil Information 2003*. ISBN 92-64-10221-3. *Energy Statistics of non-OECD Countries 2000-2001*, ISBN 92-64-10215-9. Published by OECD/IEA, Paris 2003.
[2] Natural gas liquids are sometimes referred to as condensates and this can lead to some confusion because the term condensate is also used to refer to condensed steam in energy recovery processes.

Water corresponds to an °API of 10 and most crude oils lie in the range 35 to 40.

Because of their complex compositions, it is difficult to find a simple way to characterise different crude oils. One way is to examine the elemental composition as shown in Table 2.

Table 2
Elemental composition of crude oils.

Element	wt% composition
Carbon	84 – 87
Hydrogen	11 – 14
Sulphur	0.01 – 8
Oxygen	0.01 – 1.8
Nitrogen	0.01 – 1.6
Nickel & vanadium	0.0 – 0.001

Because of the wide range of sulphur values and the fact that sulphur is a potential problem in subsequent processing, another way of characterising crude oils is on the basis of sulphur content. The term *sweet crude* is often applied to low sulphur crude oils.

Yet a further way of characterising crude oils is by the fraction that will boil off within a specified temperature range. This is the basis of the first separation within an oil refinery and is based on a property of hydrocarbons that the boiling point increases as the chain length increases. Figure 1, for example, shows the boiling points of the linear alkanes of general formula C_nH_{2n+2} as the number of carbon atoms n increases.
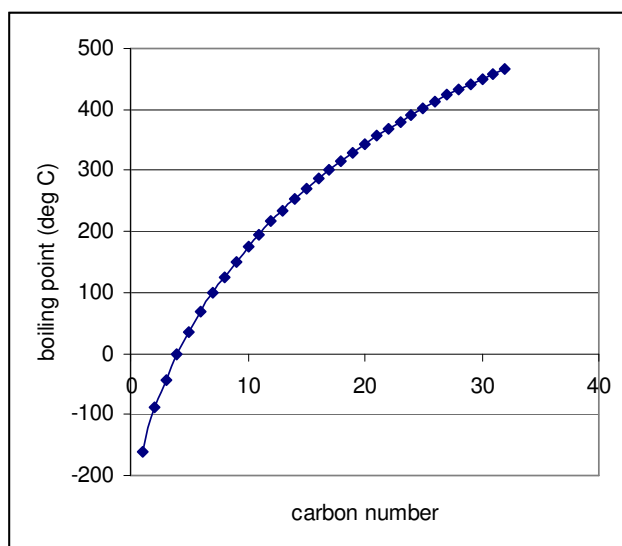

Figure 1
Boiling point as a function of carbon number for the linear alkanes.

The term *light crude* is frequently used to describe crude oils that contain a high proportion of low molecular weight hydrocarbons and conversely, the term *heavy crude* is applied to oils containing a high proportion of heavier molecules.

One important consequence of the varying composition of crude oils from different sources is that their calorific values will be different. In all later calculations, the actual calorific value is used when this is known. When calorific value is not known, a value of 45 MJ/kg has been used (gross calorific value).

CRUDE OIL SOURCES

In 2001 Western Europe consumed some 687 million tonnes of crude oil Figure 2 summarises these oil flows.
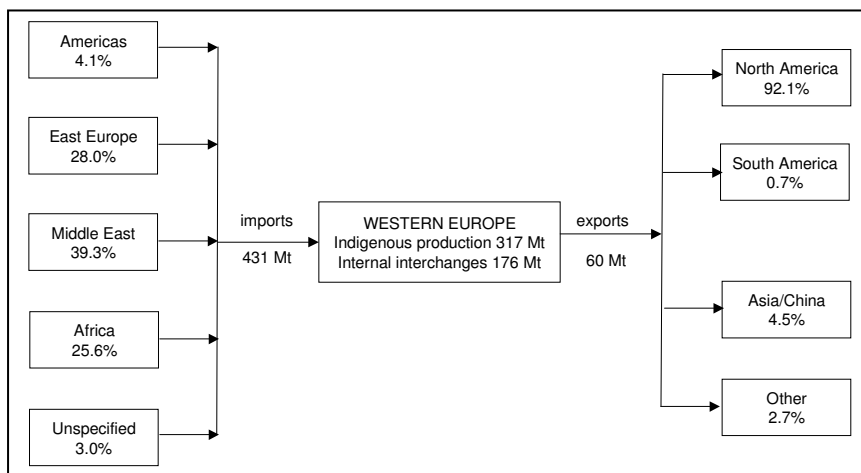
Figure 2
Oil flows in Western Europe in 2001.(Source: IEA, 2003)

Oil statistics tend to be maintained on a country by country basis. This report is concerned with the oil supply to a region rather than a country. Therefore interchanges between the countries within that region do not count as imports or exports. Thus Figure 2 shows that within the Western European region, internal movements of crude oil amount to some 176 million tonne.

CRUDE OIL TRANSPORT

Imported oil

The detail underpinning Figure 2 can be used to estimate the transport requirements for the crude oil imports to Western Europe and this is shown in Table 3.

Table 3
Calculation of transport requirements for imported crude oil

Source country	Sea/km	Pipeline/km	Fraction from source	Sea tonne-km/kg	Pipeline tonne-km/kg	Tanker size '000 tonne
Mexico	9300		0.02270	0.21114		100
Venezuela	9900		0.01614	0.15980		100
Russia		3000	0.28051		0.84153	
Romania		3000	0.00004		0.00013	
Iran	12600		0.09204	1.15975		250
Iraq	12600		0.08211	1.03461		250
Kuwait	12600		0.02270	0.28601		250
Saudi Arabia	7600		0.16004	1.21629		250
Other Middle East	12000		0.03622	0.43463		250
Algeria	3500		0.04049	0.14172		100
Angola	9400		0.00897	0.08436		100
Cameroon	9200		0.00713	0.06563		100
Egypt	6400		0.01270	0.08131		100
Gabon	7000		0.00131	0.00914		100
Libya	5200		0.11831	0.61519		100
Nigeria	8300		0.05605	0.46520		100
Tunisia	4300		0.00313	0.01345		100
Other Africa	5000		0.00857	0.04286		100
Unspecified	5000		0.03083	0.15413		100
Summary:	250 000 tonne tanker			4.13129 tonne-km/kg		
	100 000 tonne tanker			2.04393 tonne-km/kg		
	Pipeline			0.84166 tonne-km/kg		

Indigenous production

The transport for indigenous production is based on the characteristics of North Sea production since this represents 98% of indigenous production.

For North Sea oil some 75% is delivered by pipeline with the remainder delivered by tanker.

Assume that, on average, the transport distance from well head to shore is 400 km

At 100% by pipeline this corresponds to a pipeline usage of

$$400/1000 = 0.4 \text{ tonne-km/kg oil.}$$

Given that only 75% is delivered in this way, the pipeline requirement is

$$0.4 \times 0.75 = 0.3 \text{ tonne-km/kg oil}$$

For tanker transport, again assume that the one-way delivery distance is 400 km on 65 000 tonne tankers. It is further assumed that tankers require 10% less fuel when empty, that the load consists of 0.3% oil ballast and that 5% of the load is stores.

Thus for a one way trip at full load, the tanker requirement is

$$400/(65\ 000 \times 1000) = 6.154 \times 10^{-6} \text{ tonne-km/kg oil}$$

The return empty trip exhibits a tanker requirement of

$$6.154 \times 10^{-6} \times 0.9 = 5.538 \times 10^{-6} \text{ tonne-km/kg oil}$$

This gives a total tanker requirement of

$$(6.154 + 5.538) \times 10^{-6} = 1.169 \times 10^{-5} \text{ tonne-km/kg oil}$$

Taking account of ballast, the tanker requirement is

$$1.169 \times 10^{-5}/0.997 = 1.173 \times 10^{-5} \text{ tonne-km/kg oil}$$

and taking account of stores, the requirement is

$$1.173 \times 10^{-5}/0.95 = 1.235 \times 10^{-5} \text{ tonne-km/kg oil}$$

If only 25% of oil is delivered in this way, then the tanker requirement overall is

$$1.235 \times 10^{-5} \times 0.25 = 3.09 \times 10^{-6} \text{ tonne-km/kg oil}$$

Total transport requirements

The total transport requirements for the crude oil supply to Western Europe are summarised in Table 4.

Table 4
Summary of total transport requirements for the Western European crude oil supply. All data in tonne-km.

Transport type	Imported oil per kg	Indigenous oil per kg	Imported oil per 0.576 kg	Indigenous oil per 0.113 kg	Totals per kg
Pipeline	0.842	0.300	0.485	0.127	0.612
65000 t tanker	-	3.09×10^{-6}	-	1.31×10^{-6}	1.31×10^{-6}
100000 t tanker	2.044	-	1.177	-	1.177
250000 t tanker	4.131	-	2.379	-	2.379

CRUDE OIL EXTRACTION

When the earlier publication[3] on crude oil extraction was being prepared for publication in 1993, only limited information was available on crude oil extraction. Statistical data on world oil extraction was available from a number of different sources but the agreement between these different sources was so poor that they were rejected as inadequate. Data were separately reported for the North Sea operations, which were well documented, and non-North Sea extraction was based on returns from two extraction operations. Despite these difficulties, it was clear that there was relatively little difference between North Sea production and production elsewhere as the gross energy difference was less than 1%.

Today the situation has improved. The IEA now produce more detailed information on world oil production and processing.[4] These data have been used in the present calculations for the use of energy and Table 5 summarises the fuel requirements for the co-production of 3.4×10^9 tonnes of crude oil and 10^{14} MJ of natural gas.[5,6] The total inputs have been partitioned between the products using energy as the partitioning parameter.

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[3] I Boustead. *Eco-profiles of the European plastics industry: Report 2: Olefin feedstock sources.* APME (PWMI), Brussels. May 1993.

[4] International Energy Agency (IEA). *Energy statistics of non-OECD countries 2000-2001.* ISBN 92-64-10215-9. OECD/IEA, Paris. (2003)

[5] Converting oil at 45MJ/kg this corresponds to a total fuel energy production of 2.5×10^{14} MJ

[6] These totals differ slightly from those given in Table 1 because of statistical adjustments.
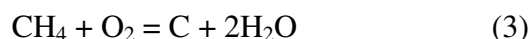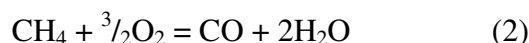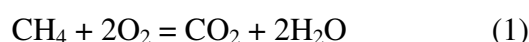
Table 5
Average fuel inputs in MJ to produce 1 kg of crude oil

Fuel	Input
Electricity	0.08505
LPG	0.00270
Diesel	0.02880
Heavy fuel oil	0.10035
Petroleum coke	0.00720
Natural gas	1.19070
TOTAL	1.41480

The IEA statistics provide no information on the emission data and these have been obtained from five industrial extraction sites. Apart from the emissions associated with burning the fuel listed in Table 5, the emissions arise from two main sources; direct hydrocarbon loss to the atmosphere and flaring.

Estimating the accidental losses of hydrocarbons to the atmosphere is extremely difficult. Estimates vary widely but ranges that have been quoted verbally range from 0.1 to 5.0 g/kg oil. In this work an emission of 1000 mg/kg oil has been assumed since most of the estimates are at the lower end of the range.

Estimates for gas sent to the flare average 1.5 g/kg oil. The problem is that the reactions occurring in the flare are uncertain. The three main reactions are:

$$CH_4 + 2O_2 = CO_2 + 2H_2O \qquad (1)$$

$$CH_4 + {}^3/_2O_2 = CO + 2H_2O \qquad (2)$$

$$CH_4 + O_2 = C + 2H_2O \qquad (3)$$

The results of the combustion, based on estimated fractions participating in the above reactions are summarised in Table 6.

Table 6
Estimated flare emissions

Reaction	wt%	Mass/mg	Emission product
Reaction 1	60	900	CO_2 = 2475 mg
Reaction 2	15	225	CO = 394 mg
Reaction 3	15	225	C = 169 mg
Unburned	10	150	CH_4 = 150 mg
TOTALS	100	1500	

In addition to the emission arising at the extraction site, there are also reported losses during subsequent distribution of the oil. IEA[7] statistics show losses of 2809 thousand tonnes for the distribution of 3435720 thousand tonnes

[7] International Energy Agency (IEA). *Energy statistics of non-OECD countries 2000-2001.* ISBN 92-64-10215-9. OECD/IEA, Paris 2003.

corresponding to a hydrocarbon emission of 818 mg/kg oil. It is assumed that all of these emissions will end up in the atmosphere.

Thus the emissions arising from the extraction and distribution of crude oil, but excluding emissions from fuel burning are summarised Table 7.

Table 7
Total air emissions in mg for the extraction and distribution of 1 kg of oil, excluding emissions from fuel burning

Emission	From losses	From flare	From distribution	Total
CH_4	1000	150		1150
Hydrocarbons			818	818
CO_2		2475		2475
CO		394		394
C		169		169

ECO-PROFILE OF CRUDE OIL

Table 8 shows the gross or cumulative energy to produce 1 kg of crude oil feedstock and deliver it to the refinery and Table 9 gives this same data expressed in terms of primary fuels. Table 10 shows the energy data expressed as masses of fuels. Table 11 shows the raw materials requirements and Table 12 shows the demand for water. Table 13 shows the gross air emissions and Table 14 shows the corresponding carbon dioxide equivalents of these air emissions. Table 15 shows the emissions to water. Table 16 shows the solid waste generated and Table 17 gives the solid waste in EU format.

Table 8
Gross energy required to produce 1 kg of crude oil feedstock. (Totals may not agree because of rounding)

Fuel type	Fuel prod'n & delivery energy (MJ)	Energy content of delivered fuel (MJ)	Energy use in transport (MJ)	Feedstock energy (MJ)	Total energy (MJ)
Electricity	0.60	-	0.27	-	0.87
Oil fuels	0.03	0.14	0.08	45.00	45.26
Other fuels	0.06	1.15	<0.01	-	1.21
Totals	0.69	1.30	0.36	45.00	47.35

Table 9
Gross primary fuels required to produce 1 kg of crude oil feedstock crude oil feedstock. (Totals may not agree because of rounding)

Fuel type	Fuel prod'n & delivery energy (MJ)	Energy content of delivered fuel (MJ)	Fuel use in transport (MJ)	Feedstock energy (MJ)	Total energy (MJ)
Coal	0.22	0.01	0.10	-	0.32
Oil	0.03	0.14	0.09	45.00	45.27
Gas	0.27	1.15	0.09	-	1.51
Hydro	<0.01	-	<0.01	-	0.01
Nuclear	0.15	-	0.07	-	0.22
Lignite	<0.01	-	<0.01	-	<0.01
Wood	<0.01	-	<0.01	-	<0.01
Sulphur	<0.01	-	<0.01	-	<0.01
Biomass (solid)	<0.01	-	<0.01	-	<0.01
Hydrogen	<0.01	-	<0.01	-	<0.01
Recovered energy	<0.01	-	<0.01	-	<0.01
Unspecified	<0.01	-	<0.01	-	<0.01
Peat	<0.01	-	<0.01	-	<0.01
Geothermal	<0.01	-	<0.01	-	<0.01
Solar	<0.01	-	<0.01	-	<0.01
Wave/tidal	<0.01	-	<0.01	-	<0.01
Biomass (liquid/gas)	0.01	-	<0.01	-	0.01
Industrial waste	<0.01	-	<0.01	-	<0.01
Municipal Waste	<0.01	-	<0.01	-	<0.01
Wind	<0.01	-	<0.01	-	<0.01
Totals	0.69	1.30	0.36	45.00	47.35

Table 10
Gross primary fuels used to produce 1 kg of crude oil feedstock crude oil feedstock expressed as mass.

Fuel type	Input in mg
Crude oil	1000000
Gas/condensate	29000
Coal	11000
Metallurgical coal	2
Lignite	<1
Peat	<1
Wood	<1

Table 11
Gross raw materials required to produce 1
kg of crude oil feedstock.

Raw material	Input in mg
Air	<1
Barytes	<1
Bauxite	<1
Bentonite	<1
Biomass (including water)	1900
Calcium sulphate (CaSO4)	<1
Chalk (CaCO3)	<1
Clay	<1
Cr	<1
Cu	<1
Dolomite	<1
Fe	4
Feldspar	<1
Ferromanganese	<1
Fluorspar	<1
Granite	<1
Gravel	<1
Hg	<1
Limestone (CaCO3)	1
N2	<1
Ni	<1
O2	<1
Olivine	<1
Pb	<1
Phosphate as P2O5	<1
Potassium chloride (KCl)	<1
Rutile	<1
S (bonded)	<1
S (elemental)	<1
Sand (SiO2)	<1
Shale	<1
Sodium chloride (NaCl)	<1
Talc	<1
Unspecified	<1
Zn	<1

Table 12
Gross water consumption required for the production of 1 kg of crude oil feedstock. (Totals may not agree because of rounding)

Source	Use for processing (mg)	Use for cooling (mg)	Totals (mg)
Public supply	79	-	79
River canal	<1	<1	<1
Sea	<1	20	20
Well	<1	<1	<1
Unspecified	16000	140	16000
Totals	16000	160	16000

Table 13

Gross air emissions associated with the production of 1 kg of crude oil feedstock. (Totals may not agree because of rounding)

Emission	From fuel prod'n (mg)	From fuel use (mg)	From transport (mg)	From process (mg)	From biomass (mg)	From fugitive (mg)	Totals (mg)
dust (PM10)	38	15	<1	170	-	-	220
CO	160	42	3	390	-	-	600
CO2	53000	75000	5800	2500	<1	-	140000
SOX as SO2	240	160	110	-	-	-	520
H2S	<1	-	<1	-	-	-	<1
mercaptan	<1	<1	<1	-	-	-	<1
NOX as NO2	120	200	28	-	-	-	340
NH3	<1	-	<1	-	-	-	<1
Cl2	<1	-	<1	-	-	-	<1
HCl	6	<1	<1	-	-	-	6
F2	<1	-	<1	-	-	-	<1
HF	<1	<1	<1	-	-	-	<1
hydrocarbons not specified	56	18	9	920	-	-	1000
aldehyde (-CHO)	<1	-	<1	-	-	-	<1
organics	<1	-	<1	-	-	-	<1
Pb+compounds as Pb	<1	-	<1	-	-	-	<1
Hg+compounds as Hg	<1	-	<1	-	-	-	<1
metals not specified elsewhere	<1	<1	<1	-	-	-	<1
H2SO4	<1	-	<1	-	-	-	<1
N2O	<1	-	<1	-	-	-	<1
H2	10	-	<1	-	-	-	10
dichloroethane (DCE) C2H4Cl2	<1	-	<1	-	-	-	<1
vinyl chloride monomer (VCM)	<1	-	<1	-	-	-	<1
CFC/HCFC/HFC not specified	<1	-	<1	-	-	-	<1
organo-chlorine not specified	<1	-	<1	-	-	-	<1
HCN	<1	-	<1	-	-	-	<1
CH4	560	87	<1	1200	-	-	1800
aromatic HC not specified	<1	-	<1	-	-	-	<1
polycyclic hydrocarbons (PAH)	<1	-	<1	-	-	-	<1
NMVOC	<1	-	<1	-	-	-	<1
CS2	<1	-	<1	-	-	-	<1
methylene chloride CH2Cl2	<1	-	<1	-	-	-	<1
Cu+compounds as Cu	<1	-	<1	-	-	-	<1
Cd+compounds as Cd	<1	-	<1	-	-	-	<1
Zn+compounds as Zn	<1	-	<1	-	-	-	<1
Cr+compounds as Cr	<1	-	<1	-	-	-	<1
Ni+compounds as Ni	<1	-	<1	-	-	-	<1

Table 14

Carbon dioxide equivalents corresponding to the gross air emissions for the production of 1 kg of crude oil feedstock. (Totals may not agree because of rounding)

Type	From fuel prod'n (mg)	From fuel use (mg)	From transport (mg)	From process (mg)	From biomass (mg)	From fugitive (mg)	Totals (mg)
20 year equiv	88000	81000	5800	77000	<1	-	250000
100 year equiv	66000	77000	5800	32000	<1	-	180000
500 year equiv	57000	76000	5800	14000	<1	-	150000

Table 15

Gross emissions to water arising from the production of 1 kg of crude oil feedstock. (Totals may not agree because of rounding).

Emission	From fuel prod'n (mg)	From fuel use (mg)	From transport (mg)	From process (mg)	Totals (mg)
COD	<1	-	<1	-	<1
BOD	<1	-	<1	-	<1
Pb+compounds as Pb	<1	-	<1	-	<1
Fe+compounds as Fe	<1	-	<1	-	<1
Na+compounds as Na	<1	-	<1	-	<1
acid as H+	<1	-	<1	-	<1
NO3-	<1	-	<1	-	<1
Hg+compounds as Hg	<1	-	<1	-	<1
metals not specified elsewhere	<1	-	<1	-	<1
ammonium compounds as NH4+	<1	-	<1	-	<1
Cl-	<1	-	<1	-	<1
CN-	<1	-	<1	-	<1
F-	<1	-	<1	-	<1
S+sulphides as S	<1	-	<1	-	<1
dissolved organics (non-	<1	-	<1	-	<1
suspended solids	3	-	<1	-	3
detergent/oil	<1	-	<1	-	<1
hydrocarbons not specified	<1	-	<1	-	<1
organo-chlorine not specified	<1	-	<1	-	<1
dissolved chlorine	<1	-	<1	-	<1
phenols	<1	-	<1	-	<1
dissolved solids not specified	<1	-	<1	-	<1
P+compounds as P	<1	-	<1	-	<1
other nitrogen as N	<1	-	<1	-	<1
other organics not specified	<1	-	<1	-	<1
SO4--	<1	-	<1	-	<1
dichloroethane (DCE)	<1	-	<1	-	<1
vinyl chloride monomer (VCM)	<1	-	<1	-	<1
K+compounds as K	<1	-	<1	-	<1
Ca+compounds as Ca	<1	-	<1	-	<1
Mg+compounds as Mg	<1	-	<1	-	<1
Cr+compounds as Cr	<1	-	<1	-	<1
ClO3--	<1	-	<1	-	<1
BrO3--	<1	-	<1	-	<1
TOC	<1	-	<1	-	<1
AOX	<1	-	<1	-	<1
Al+compounds as Al	<1	-	<1	-	<1
Zn+compounds as Zn	<1	-	<1	-	<1
Cu+compounds as Cu	<1	-	<1	-	<1
Ni+compounds as Ni	<1	-	<1	-	<1

Table 16
Gross solid waste associated with the production of 1 kg of crude oil feedstock.
(Totals may not agree because of rounding)

Emission	From fuel prod'n (mg)	From fuel use (mg)	From transport (mg)	From process (mg)	Totals (mg)
Plastic containers	<1	-	<1	-	<1
Paper	<1	-	<1	-	<1
Plastics	<1	-	<1	-	<1
Metals	<1	-	<1	-	<1
Putrescibles	<1	-	<1	-	<1
Unspecified refuse	72	-	<1	-	72
Mineral waste	2	-	1	-	4
Slags & ash	770	20	<1	-	790
Mixed industrial	72	-	<1	<1	72
Regulated chemicals	88	-	<1	-	88
Unregulated chemicals	67	-	<1	-	67
Construction waste	<1	-	<1	-	<1
Waste to incinerator	<1	-	<1	-	<1
Inert chemical	<1	-	<1	-	<1
Wood waste	<1	-	<1	-	<1
Wooden pallets	<1	-	<1	-	<1
Waste to recycling	<1	-	<1	-	<1
Waste returned to mine	2200	-	<1	-	2200
Tailings	<1	-	<1	-	<1
Municipal solid waste	-410	-	-	-	-410
Note: Negative values correspond to consumption of waste e.g. recycling or use in electricity generation.					

Table 17
Gross solid waste in EU format associated with the production of 1 kg of crude oil feedstock. Entries marked with an asterisk (*) are considered hazardous as defined by EU Directive 91/689/EEC

Emission	Totals (mg)
010101 metallic min'l excav'n waste	3
010102 non-metal min'l excav'n waste	2200
010306 non 010304/010305 tailings	<1
010308 non-010307 powdery wastes	<1
010399 unspecified met. min'l wastes	<1
010408 non-010407 gravel/crushed rock	<1
010411 non-010407 potash/rock salt	<1
010499 unsp'd non-met. waste	<1
010505*oil-bearing drilling mud/waste	86
010508 non-010504/010505 chloride mud	67
010599 unspecified drilling mud/waste	72
020107 wastes from forestry	<1
050107*oil industry acid tars	<1
050199 unspecified oil industry waste	3
050699 coal pyrolysis unsp'd waste	2
060101*H2SO4/H2SO3 MFSU waste	<1
060102*HCl MFSU waste	<1
060204*NaOH/KOH MFSU waste	<1
060313*h. metal salt/sol'n MFSU waste	<1
060314 other salt/sol'n MFSU waste	<1
060399 unsp'd salt/sol'n MFSU waste	<1
060404*Hg MSFU waste	<1
060405*other h. metal MFSU waste	<1
060499 unsp'd metallic MFSU waste	<1
060602*dangerous sulphide MFSU waste	<1
060603 non-060602 sulphide MFSU waste	<1
060701*halogen electrol. asbestos waste	<1
060703*BaSO4 sludge with Hg	<1
060704*halogen pr. acids and sol'ns	<1
060799 unsp'd halogen pr. waste	<1
070107*hal'd still bottoms/residues	<1
070108*other still bottoms/residues	<1
070111*org. chem. dan. eff. sludge	<1
070199 unsp'd organic chem. waste	<1
070207*polymer ind. hal'd still waste	<1
070208*polymer ind. other still waste	<1
070213 polymer ind. waste plastic	<1
070214*polymer ind. dan. additives	<1
070299 unsp'd polymer ind. waste	<1
080199 unspecified paint/varnish waste	<1
100101 non-100104 ash, slag & dust	780
100102 coal fly ash	<1
100105 FGD Ca-based reac. solid waste	<1
100114*dangerous co-incin'n ash/slag	<1
100115 non-100115 co-incin'n ash/slag	<1

Table 17 - continued
Gross solid waste in EU format associated with the production of 1 kg of crude oil feedstock. Entries marked with an asterisk (*) are considered hazardous as defined by EU Directive 91/689/EEC

100116*dangerous co-incin'n fly ash	<1
100199 unsp'd themal process waste	<1
100202 unprocessed iron/steel slag	1
100210 iron/steel mill scales	<1
100399 unspecified aluminium waste	<1
100501 primary/secondary zinc slags	<1
100504 zinc pr. other dust	<1
100511 non-100511 Zn pr. skimmings	<1
101304 lime calcin'n/hydration waste	<1
150103 wooden packaging	<1
170107 non-170106 con'e/brick/tile mix	<1
190199 unspecified incin'n/pyro waste	<1
190905 sat./spent ion exchange resins	<1
200101 paper and cardboard	<1
200108 biodeg. kitchen/canteen waste	<1
200138 non-200137 wood	<1
200139 plastics	<1
200140 metals	<1
200199 other separately coll. frac'ns	<1
200301 mixed municipal waste	<1
200399 unspecified municipal wastes	-340
Note: Negative values correspond to consumption of waste e.g. recycling or	