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A CATALOGUE OF CRUDE OIL AND OIL PRODUCT PROPERTIES (1992 Edition)

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by

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ABSTRACT

This catalogue provides data on various physical-chemical properties of crude oils and petroleum products. The properties that are reported are those which will likely determine the environmental behaviour and effects of spilled oil. The oils are arranged in alphabetical order.

RÉSUMÉ

Ce catalogue fournit des données sur diverses propriétés physico-chimiques des huiles brutes et des produits pétroliers. Les propriétés énumérées détermineront probablement le comportement environnemental et les effets des hydrocarbures déversés. La liste des huiles et des produits pétroliers est présentée par ordre alphabétique.

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FOREWORD

This catalogue is based on a document initially prepared by Mr. P.T. Chung of S.L. Ross Environmental Research Limited. Information was later compiled by Mr. M. Bobra, Mr. P. Liuzzo, Ms. S. Callaghan, and Mr. S. Whitarcar of Consultchem under contract to Environment Canada. Recent additions of information have been done by Mr. S. Whitarcar of Whitarcar Scientific and J. Cao of Cao Research both under contract to Environment Canada. This is the fifth edition of the catalogue.

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INTRODUCTION

This catalogue is a compilation of available data on crude oils and petroleum products. The emphasis of the catalogue is upon oils which could potentially impact the North American environment. Other oils which are unlikely to be of direct Canadian concern are also included because they have been well characterized and used in relevant studies. The properties listed for each oil are those which will provide an indication of a spilled oil's environmental behaviour and effects.

Most of the chemical and physical properties listed in this catalogue were measured using standard tests, such as ASTM test methods. Certain properties which are reported do not have standard test methods; examples of such properties are aqueous solubility and toxicity. The reader who wishes to make use of such data should refer directly to the original source to obtain specific details on the techniques and parameters used. Since data from many sources are cited, differences in reported values may be due to the variance of samples and inherent differences in measurement techniques.

The oils are arranged in alphabetical order. The names used to identify the oils in this catalogue are those used by the authors of the original data or by the suppliers of the samples. The reader should be aware of the following points when searching for information on a specific oil. Crude oils from the same region are often given the same name even though oils from different wells can have markedly different properties. Oils which are transported are often blends of different crude oils, and the relative proportions of component oils frequently change. Therefore, the physical and chemical properties will vary. Similarly, the properties of oil taken from an individual well can vary with the depth of the well and the year of production. Also, there may be the possibility that different authors refer to the same crude oil by different names. The refined products are indexed according to their most commonly used names and any synonyms are cross referenced in the Table of Contents.

For certain properties, data is given at different temperatures and for different degrees of oil weathering. An oil's degree of weathering is expressed as the volume or weight percent evaporated from the fresh oil. Weathered oils used for testing by the Emergencies Science Division (ESD) were artificially weathered by gas stripping following the method of Mackay and Stiver (Mackay 1982a, Mackay 1983b). Equations are reported to describe the effects of temperature and weathering on some properties. Note that these equations are applicable only to the temperature and weathering range of the original data.

When data was not available for some properties, blank spaces were allocated in their places in order to facilitate future updating. The following abbreviations are used in the data sections: N/A (not applicable), N/M (not measurable), MAX (maximum), MIN (minimum), ND (not detected), MW (molecular weight), and DNF (did not flow).

DESCRIPTION OF DATA

Title

The type of crude or oil product is specified and other information relating to origin or production process is provided in this section. Synonyms may also be included.

Mass and Weight

API Gravity

API gravity is defined as:

$$API\ Gravity = \frac{141.5}{Specific\ Gravity\ (60/60\ ^\circ F)} - 131.5$$

where Specific Gravity (60/60 °F) is the oil density at 60 °F (15.6 °C) divided by the density of water at 60 °F (0.9991 g/mL) (ASTM D 287, ASTM D 1298).

Density

Density is defined as the mass of a unit volume of oil at a specified temperature and has the units g/mL (Speight 1980, ASTM D 941, ASTM D 1217, ASTM D 1298, ASTM D 4052). The density of crude oils and oil products are dependent on temperature and degree of weathering. A convenient equation to express density at different temperatures and degrees of weathering (Mackay 1983a) is:

$$\rho = \rho_0 + C_1F - C_2(T - T_0)$$

where:

- ρ is density at T and F (g/mL)
- ρ_0 is density of fresh oil at T_0 (g/mL)
- C_1, C_2 are constants
- F is fraction of oil weathered
- T is temperature of oil (°C)
- T_0 is standard temperature (°C)

Results reported from EETD and ESD were measured using an Anton Paar density meter and following ASTM method D 4052.

Viscosity

Viscosity is a measure of a fluid's resistance to flow. It is defined as:

$$\text{Dynamic Viscosity} = \frac{\text{Shear Stress}}{\text{Rate of Shear}}$$

The units for dynamic viscosity are millipascal seconds (mPa.s) or centipoise (cP) (ASTM D 2532, ASTM D 2983).

Kinematic viscosity is defined as:

$$\text{Kinematic Viscosity} = \frac{\text{Dynamic Viscosity}}{\text{Density}}$$

The unit for kinematic viscosity is mm²/sec or centistoke (cSt) (ASTM D 445).

Viscosity is dependent upon temperature and the degree of weathering (Mackay 1983a) as follows:

$$\mu = \mu_0 \exp(C_3 F) \exp\left(C_4 \left(\frac{1}{T} - \frac{1}{T_0}\right)\right)$$

where:

- μ is viscosity at F and T (mPa.s)
- μ_0 is viscosity of fresh oil at T_0 (mPa.s)
- C_3, C_4 are constants
- F is fraction of oil weathered
- T is temperature of oil (Kelvin)
- T_0 is standard temperature (Kelvin)

Prior to 1989, the dynamic viscosity results reported from EETD were measured using a Brookfield LVT viscometer. For non-Newtonian oils the viscosity measurements were mainly performed at shear rates of 1 s⁻¹ and 10 s⁻¹. The kinematic viscosity results reported from EETD were measured using Zeitfuchs cross-arm capillary viscometers and following ASTM method D 445. Unless otherwise stated, viscosity data referenced as EETD 1989 or ESD were determined using a Haake RV20 Rotoviscometer equipped with a M5/SV1 sensor.

Pour Point

Pour point is the lowest temperature, expressed as a multiple of 3 °C, at which the oil sample is observed to flow when cooled under prescribed conditions (ASTM D 97). After preliminary heating, the oil sample in a test jar is cooled at a specified rate by

immersion into cooling baths kept at different temperatures. The lowest temperature at which movement of oil is observed in the test jar is recorded as the pour point.

Pour point is affected by weathering (Mackay 1983a) and can be expressed as follows:

$$PP = PP_0(1 + C_7F)$$

where: PP is pour point (°C)
PP₀ is pour point of fresh oil (°C)
C₇ is a constant
F is fraction of oil weathered

Interfacial Tensions

Interfacial tension is the force of attraction between the molecules at the interface of a liquid (Fingas 1979). The oil-air and oil-water interfacial tensions are essential for calculating spreading rates and the likely extent to which the oil will form oil-in-water and water-in-oil emulsions (Mackay 1983a). Interfacial tensions are commonly measured by the duNouy ring technique in which the force required to draw a platinum-iridium ring through the interface is measured (Mackay 1983a, ASTM D 971, ASTM D 2285). The units for interfacial tension are mN/m (or dynes/cm). The results reported from EETD were obtained using a Fisher Surface Tensiometer Model 21. Results from ESD were obtained using a CSC DuNouy Tensiometer #70545. Both formats followed ASTM method D 2285.

The effect of weathering on interfacial tensions (Mackay 1983a) is shown below:

$$S_{OA} = S_{OA_0} + C_5F$$

where: S_{OA} is the oil-air interfacial tension at F (mN/m)
S_{OA₀} is the oil-air interfacial tension of fresh oil (mN/m)
C₅ is a constant
F is fraction of oil weathered

Also,

$$S_{OW} = S_{OW_0} + C_6 F$$

where: S_{OW} is the oil-water interfacial tension at F (mN/m)
 S_{OW_0} is the oil-water interfacial tension of fresh oil (mN/m)
 C_6 is a constant
F is fraction of oil weathered

Spreading

The spreading coefficient is an indication of the tendency for crude oils and oil products to spread. It is defined as:

$$\text{Spreading Coefficient} = S_{WA} - S_{OA} - S_{OW}$$

where: S_{WA} is water-air interfacial tension (mN/m)
 S_{OA} is oil-air interfacial tension (mN/m)
 S_{OW} is oil-water interfacial tension (mN/m)

Spreading to a thin slick will occur if the spreading coefficient of an oil is greater than zero, and the higher the spreading coefficient the faster the spreading will occur (Twardus 80).

Emulsion

A water-in-oil emulsion (colloquially named "chocolate mousse") is a stable emulsion of small droplets of water incorporated in oil. Oil spilled on a water surface may form stable water-in-oil emulsions which can have very different characteristics than the parent crude oil.

Emulsion Formation Tendency

The tendency for a crude oil to form a water-in-oil emulsion is measured using a test method based on the rotating flask apparatus of Mackay and Zagorski (Mackay 1982a, Mackay 1984). Three hundred millilitres of artificial seawater and 30 mL of oil are placed in a 500 mL Fleaker (oil to water ratio of 1:10), and the Fleaker is sealed. The Fleaker is rotated for one hour at a rotation speed of 65 rpm and then allowed to settle for 30 minutes. The fraction of oil that forms an emulsion, f , is determined by measuring the height of the unemulsified oil and comparing it to the original height of the oil. Three additional mixing/settling cycles are performed with

measurements of f taken at each rotation interval. The tendency of an oil to form an emulsion is given by f_{initial} which is obtained by plotting f versus time, and by extrapolating f to time zero.

The following criteria were used to classify the tendency of a crude oil to form a stable emulsion (Mackay 1982a):

Range of f_{initial}	Emulsion Formation Tendency
0.0 to 0.25	Not likely
0.25 to 0.75	Fairly likely
0.75 to 1.0	Very likely

Emulsion Stability

The stability of a water-in-oil emulsion is obtained by allowing the emulsion to settle for an additional 24 hours, and then measuring the fraction of oil in the emulsion (f_{final}) visually. The stability of the water-in-oil emulsion is classified (Mackay 1982a) as follows:

Range of f_{final}	Emulsion Stability
0.0 to 0.25	Unstable
0.25 to 0.75	Fairly stable
0.75 to 1.0	Very stable

Water Content

The water content of the emulsion is calculated by measuring the height of the emulsion, subtracting the height of the oil that has been emulsified, then dividing this value by the total height of the emulsion.

Dispersibility

Chemical Dispersibility

Chemical dispersibility provides a relative indication of how effective a dispersant might be in dispersing oil spilled at sea. Prior to 1989, the Mackay-Nadeau-Steelman (MNS) apparatus described by Mackay and Szeto (Mackay 1980b) was used to test dispersibility.

ESD laboratories now use the swirling flask apparatus as described by Fingas (Fingas 1987, Fingas 1990) for assessing the effectiveness of dispersants. Four dispersants

were tested and their percent effectiveness recorded. Testing was performed on production grade Corexit 9527 (Exxon), Corexit CRX-8 (Exxon), Enersperse 700 (British Petroleum), and Dasic LTS (Dasic International). The value reported is from premixed oil-dispersant mixtures. The oil-to-water ratio is 1:1200 on a volume basis. The oil-to-dispersant ratio for premixed samples is 25:1 on a weight basis.

Natural Dispersibility

Natural dispersibility was determined using the Labofina test method as described by Fingas (Fingas 1987). 250 mL of artificial seawater and 250 μ L of oil are placed in a 250 mL separatory funnel resulting in an oil-to-water ratio of 1:1000. The separatory funnel is rotated at 33 rpm for 10 minutes and allowed to settle for 5 minutes. A 30 mL sample of water is removed through the funnel spout. The water is extracted with three 5 mL aliquots of dichloromethane and analyzed colorimetrically at 340, 370, and 400 nm. Reported values represent percent dispersed at 15 °C. It is important to note that this is a high-energy test and may yield dispersibility values as high as or exceeding that of the low-energy chemical dispersibility tests described above.

Fire and Reactivity

Flash Point

Flash point is the lowest temperature, corrected to one atmosphere (101.3 kPa), at which vapours above an oil sample ignite in air when exposed to a flame under specified test conditions. Flash point can be measured by Cleveland Open-cup, Tag Closed-cup and Open-cup, Pensky-Martens Closed-cup, and Setaflash Closed-cup Testers. Generally, the oil sample in the open-cup type testers is heated in an open vessel to a selected temperature. A test flame is introduced over the surface of the oil to determine whether the vapours ignite. If the vapours fail to ignite, the temperature of the oil sample is raised at a specified rate and the process repeated. In closed-cup testers, the oil sample is enclosed until a test flame is applied at a specified temperature. If the flash point is not reached, the oil sample is covered and the oil temperature is increased at a specified rate and the process is repeated. Loss of volatiles from the oil samples is reduced in this procedure (TSB 1984, ASTM D 92, ASTM D 56, ASTM D 1310, ASTM D 93, ASTM D 3278, Lance 1979).

In the data section, flash points determined by open-cup and closed-cup type testers are designated by "(O.C.)" and "(C.C.)", respectively. No designation is provided if the testing method is not known.

The effect of weathering on flash point (Mackay 1983a) is:

$$L = L_0(1 + C_8F)$$

where: L is flash point at F (°C)
L₀ is flash point of fresh oil (°C)
C₈ is a constant
F is fraction of oil weathered

The results reported from EETD and ESD 91 were obtained using a Pensky-Martens closed-cup tester and following ASTM method D 93. The results reported after ESD 91 were obtained using a SUR-BERLIN TAG 2 flash point tester following ASTM D 56.

Fire Point

Fire point is the lowest temperature, corrected to one atmosphere pressure (101.3 kPa), that the application of a test flame to the oil sample surface causes the vapour of the oil to ignite and burn for at least five seconds. It is measured by Cleveland Open-Cup and modified Pensky-Martens Apparatus. The procedure is similar to the procedure for flash point determination (ASTM D 92, IP 35).

The effect on fire point due to weathering (Mackay 1983a) is:

$$I = I_0(1 + C_9F)$$

where: I is fire point at F (°C)
I₀ is fire point of fresh oil (°C)
C₉ is a constant
F is fraction of oil weathered

Distillation

Distillation

Distillation data provides an indication of an oil's volatility and relative component distribution. Numerous techniques are available for determining the distillation curve (ASTM D 86, ASTM D 216, ASTM D 285, ASTM D 1160, ASTM D 2892).

Unless otherwise stated, the data reported in the catalogue are presented as volume percent recovered versus the measured vapour temperature. The results reported from EETD and ESD 91 were obtained using the distillation method described by Mackay

and Stiver (Mackay 1984) where both the oil's liquid and vapour temperatures are recorded. Results reported after ESD 91 were obtained using a Hewlett-Packard 5890 Series II Gas Chromatograph with a simulated distillation package following ASTM method D 2887.

The following definitions are useful:

Initial boiling point (IBP) is the temperature observed when the first drop of condensate falls from the lower end of the condenser tube.

End point or Final boiling point (FBP) is the maximum temperature obtained during the test. This usually occurs after the evaporation of all liquid from the bottom of the flask.

Percent recovered is the volume in millilitres of condensate collected in a receiving graduated cylinder, at a recorded temperature, per 100 millilitres of starting material.

Yield on Crude

Yield on crude is a routinely performed distillation procedure within the petroleum industry and is part of the procedure of analysis known as the U.S. Bureau of Mines Routine Method for the Analysis of Crude Petroleum. The distillation provides information on the yield of specific fractions obtained from a crude oil (Coleman 1978).

Weathering

Weathering of crude oils in the environment can be estimated from the modified distillation curve described by Stiver and Mackay (Stiver 1984). The oil's liquid temperature is monitored instead of the temperature of the saturated vapour as in standard distillation methods. From the gradient, T_G , and the initial boiling temperature, T_0 , of the distillation curve (a plot of oil temperature versus fraction of oil condensed), the fraction of oil weathered under environmental conditions can be estimated. For some oils, T_G and T_0 are provided. This estimation method is not very accurate for prolonged weathering of oil spills. At low environmental temperatures, some oils have a tendency to form a surface layer that may reduce the evaporation rate. This estimation method does not apply to refined petroleum products (Mackay 1982a, Mackay 1983b). The calculation procedure is as follows:

(1) Obtain or estimate the following:

T (K)	average environmental temperature
V (m ³)	volume of the oil spill
A (m ²)	area of the oil spill
t (s)	duration of oil spill
w (m/s)	average wind speed

(2) Calculate the mass transfer coefficient (K_m) in m/s:

$$K_m = 0.002(w)^{0.78}$$

(3) Calculate evaporative exposure (θ):

$$\theta = \frac{K_m A t}{V}$$

θ can also be calculated if the thickness (in m) of the oil slick can be estimated:

$$\theta = \frac{K_m t}{\text{thickness}}$$

(4) Calculate fraction (by volume) of oil weathered:

$$F_v = \ln[1 + (BT_G/T) \theta \exp(A - BT_0/T)] \cdot [(T/BT_G)]$$

where:

- F_v is fraction of oil weathered by volume
- T_0 is initial boiling point of modified distillation curve (Kelvin)
- T_G is slope of the modified distillation curve (Kelvin)
- T is environmental temperature (Kelvin)
- A is 6.3 (Stiver 1984)
- B is 10.3 (Stiver 1984)

Solubility

Aqueous Solubility

The solubility of oil in water can be determined by bringing to equilibrium a volume of oil and water, and then analyzing the water phase. Since oil is a complex mixture of

components and each component has a different solubility in water, an oil's aqueous solubility is expressed as the cumulative concentration of the individually dissolved components. The composition and concentration of the solubilized mixture will depend upon conditions used during equilibration. The term "solubility" as applied to oils is being replaced by the technically more precise term "water soluble fraction". The values reported in this catalogue were taken from those studies where an excess of oil was used (oil-to-water volume ratios of at least 1:20) and where the processes of evaporation and oil-in-water emulsification were prevented. Results reported for ESD were obtained by placing 10 mL of oil on top of 100 mL of fresh water in a 250 mL separatory funnel. This was then allowed to stand for one week in the dark at room temperature. The analysis was done by purge and trap using a Hewlett-Packard 5890 Gas Chromatograph (FID) with a Tekmar 4000 Dynamic Headspace Concentrator.

Solubility is significantly reduced by weathering (Mackay 1983a) as follows:

$$S = S_0 \exp(-C_{10}F)$$

where: S is solubility at F (mg/L)
S₀ is solubility of fresh oil (mg/L)
C₁₀ is a constant
F is fraction of oil weathered

Hydrocarbon Group Analysis

Hydrocarbon Group Analysis

The main constituents of any oil are generally grouped into four broad classes of chemicals. These are:

- Saturates:** Saturated alkanes with structures of C_nH_{2n+2} (aliphatics) or C_nH_{2n} in the case of cyclic saturates (alicyclics). Paraffins are included in this class.
- Aromatics:** Compounds that have a benzene ring as part of their chemical structure.
- Polars:** Polar compounds which contain oxygen, nitrogen, and sulphur atoms, and have strong adsorption tendencies. These compounds are also called resins.

Asphaltenes: Asphaltenes are defined by their solubility behaviour. They are soluble in aromatic solvents and insoluble in aliphatic alkane solvents. Asphaltenes are generally considered to consist of condensed aromatic nuclei which may carry alkyl and alicyclic systems with heteroatoms such as nitrogen, sulphur, oxygen, and trace elements of nickel vanadium, and sodium.

The above definitions may be overly simplistic given the complex chemical composition of petroleum. A greater appreciation of oil chemistry and of how petroleum can be chemically fractionated can be obtained from more detailed texts such as the one by Speight (Speight 1980).

Saturate, aromatic and polar contents can be determined using various techniques such as open column chromatography, HPLC (ASTM D 936, ASTM D 1319, ASTM D 2007, ASTM D 2549), or thin layer chromatography with flame ionization detection (TLC/FID) (Daling 1988a). TLC/FID is usually restricted to determinations on weathered oils as significant losses of low boiling component are likely with fresh oils. It should be noted that each technique will likely yield different results.

Prior to 1989, EETD used hexane as the precipitating medium for determining asphaltene content. For 1989 and later years, ESD has used n-pentane for the precipitation medium as described by Daling (Daling 1988a). The results reported from EETD for saturate, aromatic, and polar contents were obtained using an HPLC method developed by Water Associates (Waters 1982).

Asphaltene content increases with increasing weathering (Mackay 1983a) as follows:

$$ASPH = \frac{ASPH_0}{(1-F)}$$

where: ASPH is asphaltene content at F (mass fraction)
ASPH₀ is asphaltene content of fresh oil (mass fraction)
F is fraction of oil weathered

Wax Content

Petroleum waxes are divided into two types: paraffinic and microcrystalline. Paraffinic waxes are long-chained normal alkanes with melting points in the range of 32-71 °C. Typically, paraffinic waxes have 20-40 carbon atoms and molecular weights of 300-550. Microcrystalline waxes consist mainly of isoalkanes with 35-75 carbon atoms, melting points of 54-93 °C, and molecular weights of 600-1000 (Clark 1988).

The wax content of a crude oil can be determined as described by Birdie et al. (1980). A six-fold dilution of a deasphalted oil is prepared with a 1:1 volume mixture of methyl ethyl ketone and dichloromethane. The waxes are precipitated at -32 °C, filtered and determined gravimetrically.

Wax content increases with increasing weathering (Mackay 1983a) as follows:

$$WAX = \frac{WAX_0}{(1-F)}$$

where: WAX is wax content at F (mass fraction)
 WAX₀ is wax content of fresh oil (mass fraction)
 F is fraction of oil weathered

Toxicity

Toxicity values are given as:

LC₅₀: Median lethal concentration is the estimated concentration of a compound which will cause death to 50 percent of the test population in a specified time after exposure. In most instances, LC₅₀ is statistically derived by analysis of mortalities in various test concentrations after a fixed period of exposure.

EC₅₀: Median effective concentration is used when an effect other than death is the observed endpoint. EC₅₀ is the estimated concentration of the compound in water which will have a specific effect on 50 percent of the test population in a specified time after exposure. EC₅₀ values cited from Maclean (Maclean 1988) and Bobra (Bobra 1988) are the calculated concentrations that caused 50 percent of the test organisms to stop swimming (this included immobile and dead organisms).

Metal Content

The content of many metals in petroleum can be determined by atomic absorption (ASTM D 2788, Skoog 1976).

The results for ESD were obtained by weighing out approximately 0.2 g of crude oil which is then mixed with 10 mL of reagent grade nitric acid. The mixture is microwave digested for 30 minutes at 190 psi. After digestion the sample is diluted

to 50.0 mL deionized water and then analyzed via an ARL Corporation - Model 3410ICP inductively coupled plasma and spectrophotometer system.

Non-Metal Content

Sulphur

The total sulphur content of oil can be determined by numerous standard techniques (ASTM D 129, ASTM D 1226, ASTM D 1552, ASTM D 2622, ASTM D 4294). The sulphur content results from EETD and ESD were obtained by using non-dispersive X-ray fluorescence spectrometry (ASTM D 1266).

Carbon Residue

Carbon residue is the carbonaceous residue formed after evaporation and pyrolysis of a petroleum product. Carbon residue can be determined by the Conradson or the Ramsbottom methods. The Conradson carbon residue method is more applicable to crude oils and heavy fuel oils. It involves destructive distillation of a weighed oil sample in a crucible. The oil sample is further heated severely for a fixed period of time while the distillation residue undergoes cracking and coking. The Conradson carbon residue is the weight percent of the carbonaceous residue left in the crucible (ASTM D 189, ASTM D 524).

Hydrogen Sulphide (H₂S)

Hydrogen sulphide content for natural gas and liquefied petroleum gases can be determined by cadmium sulphate-iodometric titration and lead acetate methods, respectively (ASTM D 2385, ASTM D 2420).

Sensation

Colour

The observed colour of the oil is provided (ASTM D 156, ASTM D 1500, ASTM D 2392).

Odour Threshold

This is the lowest concentration in air that most humans can detect by smell. The value cannot be relied on to prevent over-exposure, because human sensitivity to odours varies over wide limits, some chemicals cannot be smelled at toxic concentrations, odours can be masked by other odours, and some compounds rapidly deaden the sense of smell. (CHRIS 85)

Other

Compositional Analysis

Detailed compositional analysis of petroleum can be obtained through gas chromatography or gas chromatography/mass spectrometry.

Biological Oxygen Demand (BOD)

Also called "biochemical oxygen demand", this is the standard way of describing how much oxygen dissolved in water is consumed by biological oxidation of the chemical during the stated period of time. The unit lb/lb indicates the pounds of oxygen consumed by each pound of chemical during the time stated. When given in percent, the values indicate the pounds of oxygen consumed by each 100 pounds of chemical during the time stated. (CHRIS 85)

Vapour Pressure

Vapour pressure is the pressure that a vapour exerts on its surroundings. Its units are kPa corrected to one atmosphere (101.3 kPa). Vapour pressure can be measured by a variety of methods including Reid, dynamic, static, isoteniscopic, vapour pressure balance and gas saturation. The most commonly used method for crude oils has been the Reid vapour pressure which measures vapour pressure at 37.8 °C (100 °F). It is measured by saturating a known volume of oil in an air chamber of known volume and measuring the equilibrium pressure which is then corrected to one atmosphere (101.3 kPa) (ASTM D 323, ASTM D 2551, ASTM D 2879, OECD 1981, TSB 1984, USEPA 1982).

The results reported from EETD and ESD are Reid vapour pressure determinations (ASTM D 323).



Absorption Oil

Absorbent Oil

Mass and Weight

Density (g/mL)

(°C)	
20	0.848 (estimated) ¹

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	25 (estimated) ¹

Oil-Water (mN/m or dynes/cm)

(°C)	
20	50 (estimated) ¹

Fire and Reactivity

Flash Point (°C)

107 ¹**Distillation**

Boiling Point (°C)

> 260 ¹**Sensation**

Colour

Pale yellow
to colourless ¹**Other**

Reid Vapour Pressure (kPa)

(°C)	
37.8	0.689 (estimated) ¹

References¹ CHRIS 85

ADGO Crude Oil

Beaufort Sea, Canada

Mass and Weight**Density (g/mL)**

(°C)	Weathering (Volume %)				
	0	2.6	4	5.4	12
0	0.9590 1	0.9620 1		0.9672 2	
15	0.9530 1	0.9600 1			
20	0.9520 7		0.9526 7		0.9546 7

Viscosity**Dynamic Viscosity (mPa.s or cP)**

(°C)	Weathering (Volume %)	
	0	2.6
0	165.0 1	220.0 2
15	61.6 1	73.0 2

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)			
	0	2.6	4	12
-10	661.3 7	724.5 7	1302.0 7	
0	172.1 7	228.7 2	263.6 7	413.8 7
15	64.6 7	76.0 2	79.08 7	103.8 7
25	39.83 7		42.74 7	53.58 7

Pour Point (°C)

	Weathering (Volume %)		
	0	4	12
	-26 7	-26 7	-26 7

Interfacial Tensions**Air-Oil (mN/M or dynes/cm)**

(°C)	Weathering (Volume %)	
	0	2.6
0	33.3 1	31.5 1
15	32.0 1	30.6 1

Oil-Seawater (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	2.6
0	16.8 2	16.8 2
15	6.9 1	21.5 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)	
	0	2.6
0	25.9 2	22.6 2
15	24.9 1	22.2 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		5.4
	0	2.6	
0	0.61 1	0.72 1	
15	0 2	0 2	0 2

Emulsion Stability

(°C)	Weathering (Volume %)		5.4
	0	2.6	
0	0.95 1	0.96 1	
15	0 2	1.00 2	0.79 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		5.4
	0	2.6	
0	71.5 1	73.8 1	
15	N/A 2	77.1 2	78.2 2

Dispersibility

Chemical Dispersibility (% Dispersed)

Dasic 10 4

Natural Dispersibility (% Dispersed)

(°C)	
15	10 8

Fire and Reactivity

Flash Point (°C)

Weathering (Volume %)		
0	4	12
95 7	94 7	126 7

ADGO Crude Oil

Fire Point (°C)

Weathering (Volume %)		
0	4	12
116 7	123 7	129 7

Distillation

Distillation (°C)

Weathering (Volume %)			
0	4	12	
Initial BP	159 7	170 7	205 7
50	329 7	326 7	348 7
Final BP	535 7	542 7	538 7
Final Vol	93 % 7	96 % 7	87 % 7

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Weathering (Volume %)		
0	2.6	
Saturates	79.8 2	
Aromatics	18.8 2	
Polars	0.9 2	
Asphaltenes	0.5 2	0.83 4
	0.59 4	
	0.2 5	

Wax Content (Weight %)

0.2 5

Metal Content

Other Metals (ppm)

Weathering (Volume %)		
0	34	
Molybdenum	< 0.6 6	1.1 6
Potassium	< 1.5 6	< 1.5 6
Zinc	1.4 6	1.4 6
Lead	< 3.0 6	< 3 6
Nickel	< 1.2 6	1.9 6
Iron	47 6	51 6
Chromium	< 1.5 6	3.1 6
Magnesium	16.5 6	42 6
Vanadium	< 0.6 6	< 0.6 6
Copper	< 0.6 6	1.4 6
Titanium	< 0.6 6	2.2 6
Barium	18.9 6	2.5 6

Non-Metal Content

Sulphur (Weight %)

Weathering		(Volume %)	
0		5.4	
<hr/>		<hr/>	
0.19	3	0.21	3

Other

Reid Vapour Pressure (kPa)

(°C)	
<hr/>	<hr/>
37.8	N/M 1

References

1 EETD 84
5 ESD 91

2 EETD 85
6 ESD 92

3 EETD 86
7 Esso 83

4 EETD 89
8 Fingas 90a

Alaska North Slope Crude Oil

Alaska North Slope Crude Oil

Alaska (ANS, SUDLEROCHIT)

Trans Alaska pipeline to Valdez terminal.

Mass and Weight

API Gravity (15/15°C)

26.4 1
26.4 2

Density (g/mL)

(°C)
21 0.8954 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
38 42.4 2

Pour Point (°C)

-18 1
-18 2

Distillation

Yield on Crude

	Range, °C	Volume %
C ₁ -C ₄		1.17 1
Light Gasoline	C ₅	2.20 1
	to 65	
Naphtha	65	15.60 1
	to 193	
Distillate	193	28.60 1
	to 343	
Gas Oil	343	16.40 1
	to 449	
Residuum	> 343	52.40 1

Metal Content

Other Metals (ppm)

Nickel 11 1
Vanadium 26 1

Non-Metal Content

Hydrogen Sulfide - Existent (mg/m³)

25.27

Carbon Residue - Ramsbottom (Weight %)

4.40 ¹

Nitrogen (Weight %)

2090 (ppm) ¹

Sulphur (Weight %)

1.06 ¹

1.10 ²

Salt Content

Salt (g/m³)

2.3606 ¹

Other

Reid Vapour Pressure (kPa)

(°C)

37.8

24.5 ¹

24.5 ²

References

¹ Aalund 83

² NSD 88

Alberta Crude Oil

Alberta, Canada

Mass and Weight

API Gravity (15/15°C)

36.8 2

Density (g/mL)

(°C)	Weathering (Weight %)		
	0	10	20
0	0.8500 2		
5	0.8460 2		
10	0.8430 2		
15	0.8400 2		
20	0.8350 2	0.8550 2	0.8660 2
25	0.8320 2		
	0.8300 2		

Note: DEN = 0.8500 - 0.00072T

Where: DEN is the density of fresh oil at T (g/mL)

T is oil temperature (°C) (Mackay 82a)

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)	
	0	
0	17.6 2	
5	12.4 2	
10	9.03 2	
15	6.43 2	
20	4.98 2	
25	4.22 2	

Note: VISC = Exp((4760/(T+273)) - 14.6)

Where: VISC is viscosity of fresh oil at T (mPa.s)

T is oil temperature (°C) (Mackay 82a)

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)	
	0	
0	20.7 2	
5	14.7 2	
10	10.71 2	
15	7.65 2	
20	5.96 2	
25	5.08 2	

Pour Point (°C)

Weathering (Weight %)		
0	10	20
-24 2	12 2	15 2

Distillation

Distillation (°C)

(Vol%)	
10	120 2
25	187 2
40	254 2

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Weathering (Weight %)			
	0	10	20
Paraffins	78.3 2	80.3 2	77.0 2
Aromatics	17.6 2	13.0 2	15.2 2
Polars	2.84 2	3.05 2	3.66 2
Asphaltenes	1.21 2	3.69 2	4.12 2

Wax Content (Weight %)

Weathering (Weight %)		
0	10	20
6.93 2	7.21 2	10.9 2

Other

Reid Vapour Pressure (kPa)

(°C)	
15.6	35.7 1
63	66.9 1

References

1 Mackay 74

2 Mackay 82a

Alberta Sweet Mixed Blend Crude Oil

Alberta, Canada

EPS standard oil for dispersant testing.

Mass and Weight

API Gravity (15/15°C)

37.0³

Density (g/mL)

(°C)	Weathering (Volume %)		
	0	14.8	25.5
0	0.8470 ³	0.8740 ³	0.8880 ³
15	0.8390 ³	0.8680 ³	0.8830 ³

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		
	0	14.8	25.5
0	47.3 ⁴	7500 ⁴	> 10000 ⁴
15	9.2 ⁴	43.5 ⁴	48 ⁴

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	14.8	25.5
0	55.9 ⁴	8581 ⁴	> 11000 ⁴
15	11 ³	50.1 ⁴	54.4 ⁴

Pour Point (°C)

Weathering (Volume %)	
0	14.8
-8 ²	7 ²

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		
	0	14.8	25.5
0	32.0 ⁴	N/M ³	N/M ³
15	25.6 ³	28.1 ³	29.4 ³

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		25.5
	0	14.8	
0	17.5 ⁴	N/M ³	N/M ³
15	8.4 ³	8.6 ³	15.5 ³

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		25.5
	0	14.8	
0	30.3 ⁴	N/M ⁴	N/M ⁴
15	21.5 ³	23.8 ³	21.1 ³

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		25.5
	0	14.8	
0	1.0 ³	1.0 ³	1.0 ³
15	0 ³	0 ³	1.0 ³

Emulsion Stability

(°C)	Weathering (Volume %)		25.5
	0	14.8	
0	1.0 ³	1.0 ³	1.0 ³
15	0.2 ³	0.2 ³	1.0 ³

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		25.5
	0	14.8	
0	46.7 ³	90.0 ³	88.9 ³
15	N/A ³	N/A ³	90.0 ³

Dispersibility

Chemical Dispersibility (% Dispersed)

Dasic 20⁶

Natural Dispersibility (% Dispersed)

15	8 ⁹
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Fire and Reactivity

Flash Point (°C)

73

Distillation

Distillation (°C)

(Vol%)	Liquid Temp.(0%)	Vapour Temp.(0%)	Liquid Temp.(15%)	Vapour Temp.(15%)
IBP	115 4	37 4	171 4	45 4
5	158 4	95 4	213 4	125 4
10	182 4	111 4	235 4	148 4
15	206 4	126 4	256 4	153 4
20	234 4	142 4	276 4	170 4
25	260 4	155 4	296 4	193 4
30	286 4	189 4		
34	304 4	213 4		

Weathering

T_O = 397

T_G = 539 (EETD 84)

Solubility

Aqueous Solubility (mg/L)

		22 °C
Distilled Water		34.8 12
Fresh Water	16.1 11	31.2 12
Salt Water		22.0 12
Seawater	13.66 11	

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

	Weathering (Volume %)		
	0	15	25
Saturates	84.2 5		
Aromatics	12.8 5		
Polars	1.2 5		
Asphaltenes	1.8 5	2.49 6	2.27 6
	1.55 6		
	2.0 7		

Wax Content (Weight %)

6.9 7

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	24h EC ₅₀	48h EC ₅₀	24h LC ₅₀	48h LC ₅₀	96h LC ₅₀
Daphia Magna		1.12 ¹¹ 2.20 ¹		6.28 ¹¹ 12.1 ¹	
Artemia spp.	8.17 ¹¹ 14.95 ¹		10.6 ¹¹ 19.3 ¹		
Frog Larvae					250 mL/L #1 10

1. Static test

Note: Results from (Maclean 88) obtained by fluorescence spectroscopy.

Results from (Bobra 88) obtained by purge-and-trap GC analysis.

Acute Toxicity, Oil in Water Emulsion (mg/L)

	96h LC ₅₀
Frog Larvae (freshwater)	78 μL/L #1 10 28.2 μL/L #2 10
Fathead Minnow (freshwater)	2.5 μL/L #1 10

1. Static test; 2. Flow through test

Acute Toxicity, Floating Oil Layer (mg/L)

	96h LC ₅₀
Frog Larvae (freshwater)	2.5 μL/L #1 10

1. Static test

Alberta Sweet Mixed Blend Crude Oil

Metal Content

Other Metals (ppm)

	Weathering (Volume %)			
	0	15	22.8	25
Molybdenum	0.6 8	0.6 8	< 0.6 8	1.0 8
Potassium	< 1.5 8	3.2 8	< 1.5 8	6.0 8
Zinc	< 0.6 8	0.6 8	0.9 8	5.3 8
Lead	< 3 8	3 8	< 3 8	3.0 8
Nickel	2.0 8	3.2 8	3.3 8	4.5 8
Iron	< 3 8	< 3 8	34 8	69 8
Chromium	< 1.5 8	< 1.5 8	< 1.5 8	< 1.5 8
Magnesium	1.2 8	1.7 8	2.4 8	3.7 8
Vanadium	14 8	18.4 8	21.4 8	24.3 8
Copper	0.6 8	< 0.6 8	< 0.6 8	5.0 8
Titanium	< 0.6 8	0.6 8	< 0.6 8	< 0.6 8
Barium	0.6 8	0.3 8	0.3 8	0.7 8
Selenium	18 8			
Cobalt	< 1 8			
Manganese	< 0.3 8			
Calcium	53.4 8			
Aluminum	< 5 8			
Strontium	< 0.2 8			
Cadmium	< 0.5 8			
Tin	< 15 8			
Mercury	< 15 8			

Non-Metal Content

Sulphur (Weight %)

Weathering (Volume %)		
0	15	23.4
0.55 5	0.61 5	0.66 5

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	18.6 3

References

- | | | | |
|--------------|--------------|---------------|--------------|
| 1 Bobra 88 | 2 EETD 83 | 3 EETD 84 | 4 EETD 85 |
| 5 EETD 86 | 6 EETD 89 | 7 ESD 91 | 8 ESD 92 |
| 9 Fingas 90a | 10 Hedtke 82 | 11 MacLean 88 | 12 Suntio 86 |

Amauligak Crude Oil

Beaufort Sea, Canada

Mass and Weight

API Gravity (15/15°C)

27.4 2

Density (g/mL)

For Fv < 19.4% & T between 0 and 15°C

$$\text{DEN} = 0.900496 + 0.000717 \text{ Fv} - 0.000698 \text{ T}$$

Where: DEN is density of oil at T and Fv (g/mL)

Fv is volume percent of oil weathered

T is oil temperature (°C)

(°C)	Weathering (Volume %)		
	0	13.4	19.4
0	0.9014	2 0.9090 2	0.9146 2
	0.8936 (F-24)	4	
15	0.8896	2 0.8992 2	0.9048 2
	0.8836 (F-24)	4	

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		
	0	13.4	19.4
0	25.0 2	41.9 2	67.5 2
15	14.0 2	21.0 2	32.2 2

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	13.4	19.4
0	27.7 2	46.1 2	73.8 2
15	15.7 2	23.4 2	35.6 2

Pour Point (°C)

Weathering (Volume %)	
0	13.4
-66 3	-48 3

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		
	0	13.4	19.4
0	30.0 2	31.1 2	31.3 2
15	29.2 2	29.0 2	28.5 2

Amauligak Crude Oil

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		19.4
	0	13.4	
0	21.1 2	19.7 2	17.8 2
15	20.9 2	15.0 2	15.1 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		19.4
	0	13.4	
0	27.5 2	21.6 2	20.8 2
15	21.5 2	20.4 2	19.6 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		19.4
	0	13.4	
0	0 2	0 2	1.0 2
15	0 2	0 2	0 2

Emulsion Stability

(°C)	Weathering (Volume %)		19.4
	0	13.4	
0	0.29 2	0.13 2	0.78 2
15	0 2	0 2	0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		19.4
	0	13.4	
0	91.3 2	92.0 2	78.8 2
15	N/A 2	N/A 2	N/A 2

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	55 4
Dasic	25 4
CRX-8	0 4

Natural Dispersibility (% Dispersed)

(°C)	
15	8 6

Fire and Reactivity

Flash Point (°C)

0 2

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	198 2	66 2
5	216 2	134 2
10	238 2	156 2
15	259 2	172 2
20	275 2	187 2
25	289 2	194 2
29	301 2	246 2

Weathering

T_O = 471

T_G = 370 (EETD85)

Solubility

Aqueous Solubility (mg/L)

		22 °C
Fresh Water	9.1 7	9.6 8
Seawater	6.54 7	

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	89.5 3
Aromatics	9.3 3
Polars	0.4 3
Asphaltenes	0.8 3
	0.3 4
	0.1 5

Wax Content (Weight %)

0.8 5

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	24h EC50	48h EC50	24h LC50	48h LC50
Daphnia Magna		1.66 7 1.8 1		6.73 7 7.2 1
Artemia spp.	6.40 7 7.54 1		> 6.54 7 > 7.7 1	

Note: Results from (Maclean 88) obtained by fluorescence spectroscopy.
Results from (Bobra 88) obtained by purge-and-trap GC analysis.

Non-Metal Content

Sulphur (Weight %)

0.15 3

References

- | | | | |
|------------|--------------|--------------|-------------|
| 1 Bobra 88 | 2 EETD 85 | 3 EETD 86 | 4 EETD 89 |
| 5 ESD 91 | 6 Fingas 90a | 7 MacLean 88 | 8 Suntio 86 |

Arabian Crude Oil

Saudi Arabia

Mass and Weight

API Gravity (15/15°C)

32.5 1

Density (g/mL)

(°C)	
15.6	0.862 1 0.874 3

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
38	9.7 3
40	10.11 1
100	2.849 1

Pour Point (°C)

-12 6
-15 3

Dispersibility

Chemical Dispersibility (% Dispersed)

	% Effectiveness
C9527	17 4
CRX-8	9 4
ENER 700	22 4
Dasic	33 4

Natural Dispersibility (% Dispersed)

(°C)	
15	3 5

Distillation

Distillation (°C)

IBP	29	1
5	69	1
10	100	1
15	128	1
20	151	1
25	172	1
30	198	1
35	213	1
40	238	1
45	261	1
50	282	1
55	304	1
60	329	1
65	351	1
70	373	1
75	398	1
80	422	1
85	448	1
90	475	1
95	504	1
FBP	537	1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes	2.61	2
-------------	------	---

Metal Content

Other Metals (ppm)

Nickel	14	1
Vanadium	3.7	1

Non-Metal Content

Nitrogen (Weight %)

0.088 1

Sulphur (Weight %)

1.87 1

References

1 API 81

2 EETD 89

3 Fina 82

4 Fingas 90

5 Fingas 90a

6 Wheeler 78

Arabian Heavy Crude Oil

Saudi Arabia

Mass and Weight

API Gravity (15/15°C)

27.9 1
28.2 5

Density (g/mL)

(°C)	Weathering (Volume %)			
	0	14.7	22.7	30.2
Unknown	0.887 4			
	0.886 5			
15.5	0.8870 2	0.9200 2	0.9350 2	0.9510 2

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)			
	0	14.7	22.7	30.2
6	75 2	386 2	1305 2	6574 2
13	41 2	241 2	700 2	2344 2

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
21.1	37.0 1
37.8	19.0 1
38.0	19.1 4
	18.9 5

Pour Point (°C)

	Weathering (Volume %)			
	0	14.7	22.7	30.2
	-28 2	-23 2	-18 2	-5 2
	-28.9 1			
	-34 6			
	< -30 4			

Interfacial Tensions

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)			
	0	14.7	22.7	30.2
13	20 2	16 2	15 2	16 2

Emulsion

Emulsion Formation Tendency

Weathered fractions form stable emulsions. (Daling 88)

Emulsion Stability

Forms emulsions with relatively high stability and high viscosity. (Daling 91)

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	14.7	22.7	30.2
13	78 2	75 2	55 2

Dispersibility

Chemical Dispersibility (% Dispersed)

Relatively high chemical dispersibility. (Daling 91)

Fire and Reactivity

Flash Point (°C)

	Weathering (Volume %)		
	14.7	22.7	30.2
	36 3	72 3	122 3

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
14.7	205 3	150 3
22.7	255 3	200 3
30.2	310 3	250 3

Yield on Crude

	Range, °C	Volume %
Light Naphtha	20	7.9 1
	to 100	
Heavy Naphtha	100	6.8 1
	to 150	
Kerosene	150	12.4 1
	to 235	
Light Gas Oil	235	16.5 1
	to 343	
Heavy Gas Oil	343	30.6 1
	to 565	
Residual Oil	> 565	23.2 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

	Weathering (Volume %)			
	0	14.7	22.7	30.2
Saturates				23.2 2
Aromatics				49.0 2
Polars				18.4 2
Asphaltenes				9.89 2
Asphaltenes "Hard"	4.33 2	4.89 2	5.31 2	5.80 2
Asphaltenes "Soft"	7.38 2	8.34 2	9.05 2	9.89 2

Wax Content (Weight %)

	Weathering (Volume %)			
	0	14.7	22.7	30.2
	4.62 2	5.22 2	5.67 2	6.19 2
	3.70 5			

Non-Metal Content

Sulphur (Weight %)

2.85 1
2.84 5

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	51.71 1
	58.6 5

References

1 Aalund 83
5 NSD 88

2 Daling 88
6 Wheeler 78

3 Daling 91

4 Fina 82

Arabian Light Crude Oil

Saudi Arabia

Mass and Weight

API Gravity (15/15°C)

33.4 6
31.8 4

Density (g/mL)

(°C)	Weathering (Volume %)		24.2
	0	12.0	
Unknown	0.8580 6		
	0.8510 5		
0	0.8781 4	0.9039 4	0.9225 4
15	0.8658 4	0.8921 4	0.9111 4

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		24.2
	0	12.0	
0	30.95 4	116.3 4	406.0 4
15	13.51 4	32.77 4	94.44 4

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		24.2
	0	12.0	
0	35.25 4	128.7 4	440.1 4
15	15.60 4	36.74 4	103.7 4
38	6.25 6		
	5.45 5		

Pour Point (°C)

	Weathering (Volume %)		24.2
	0	12.0	
	-32 1	-13 4	-12 4
	-34 6		
<	-30 5		
	-28 4		

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	24.2
0	27.1 4	30.2 4
15	26.6 4	28.5 4

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)	
	0	24.2
0	16.8 4	19.3 4
15	20.4 4	20.2 4

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)	
	0	24.2
0	19.8 4	29.0 4
15	22.6 4	21.9 4

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	12.0	24.2
0	1.0 4		1.0 4
15	1.0 4	1.0 4	1.0 4

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	12.0	24.2
0	1.0 4		1.0 4
15	1.0 4	1.0 4	1.0 4

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	12.0	24.2
0	89.9 4		61.7 4
15	88.3 4	89.9 4	87.9

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	25	2
Dasic	25	2
EN 700	10	2
CRX-8	15	2

Fire and Reactivity

Flash Point (°C)

	Weathering (Volume %)	
	0	24.2
	12.0	
	43.5	89.3
	89.3	

Solubility

Air Solubility (Volume %)

Freshwater

Aqueous Solubility (mg/L)

Freshwater 18.9 3

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 3.0 4

Wax Content (Weight %)

3.80 6
4.0 4

Metal Content

Other Metals (ppm)

	Weathering (Volume %)	
	0	24.2
Molybdenum	0.9 4	< 0.6 4
Potassium	< 1.5 4	< 1.5 4
Zinc	< 0.6 4	5.1 4
Lead	< 3 4	3.9 4
Nickel	2.5 4	3.3 4
Iron	< 3 4	6.3 4
Chromium	< 1.5 4	< 1.5 4
Magnesium	5.6 4	2.7 4
Vanadium	16 4	19.6 4
Copper	1.6 4	2.4 4
Titanium	< 0.6 4	< 0.6 4
Barium	< 0.3 4	0.4 4
Selenium		< 15 4
Cobalt		< 1 4
Manganese		< 0.3 4
Calcium		34.9 4
Aluminum		< 5 4
Strontium		< 0.2 4
Cadmium		< 0.5 4
Tin		< 15 4
Mercury		< 15 4

Non-Metal Content

Sulphur (Weight %)

1.79 6

Other

Reid Vapour Pressure (kPa)

(°C)
37.8
29.0 6

References

1 API 81
5 Fina 82

2 EETD 89
6 NSD 88

3 ESD 91

4 ESD 92

Argyl Crude Oil

U.K., North Sea

Mass and Weight

API Gravity (15/15°C)

38.6 3

Density (g/mL)

(°C)	
Unknown	0.8320 3
	0.8349 1
	0.833 2

ViscosityKinematic Viscosity (mm²/sec or cSt)

(°C)	
15	3.70 3
38	3.2 2
40	4.79 1

Pour Point (°C)

9 3
6 1
9 2

Distillation

Yield on Crude

	Range, °C	Volume %
Naphtha	IBP	25.2 1
	to 175	
Kerosene	175	14.9 1
	to 260	
Gas Oil	260	18.9 1
	to 360	
Residuum	> 360	40.6 1

Hydrocarbon Group

Wax Content (Weight %)

5.40 3

Non-Metal Content

Sulphur (Weight %)

0.18 ³

References

¹ Aalund 83b

² Fina 82

³ MSD 88

Athabasca Bitumen

Alberta, Canada

Syncrude Canada Ltd. Coker feed bitumen produced by the hot water process.

Mass and Weight

API Gravity (15/15°C)

7.7
to 9.0 1

Density (g/mL)

(°C)	
Unknown	1.006 to 1.016 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
15	19000 to >700,000 1
25	5320 to 300000 1
60	3630 to 4350 1
100	60 to 303 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 4.41
to 5.44 1

Metal Content

Other Metals (ppm)

Nickel 69
to 85.2 1
Vanadium 81
to 218 1

Non-Metal Content

Oxygen

0.76
to 1.38 ¹

Carbon Residue - Ramsbottom (Weight %)

11.5
to 14.5 ¹

Carbon Content (Weight %)

82.41
to 83.95 ¹

Nitrogen (Weight %)

0.44
to 0.92 ¹

Sulphur (Weight %)

4.41
to 5.44 ¹

Hydrogen (Weight %)

10.16
to 10.63 ¹

Other

Acid Number (mg KOH/g)

1.57
to 2.58 ¹

Ash (Weight %)

0.70
to 1.03 ¹

References

¹ ARC 87

Atkinson Crude Oil

Beaufort Sea, Canada

Mass and Weight

API Gravity (15/15°C)

23.7 2

Density (g/mL)

(°C)	Weathering (Volume %)		
	0	4	12
0	0.9219 3		
15	0.911 2		
20	0.9060 8	0.9172 8	0.9239 8
			19.4
			0.9476 5
			0.9438 5

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)	
	0	19.4
15	65.1 5	533.3 5

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	4	12
-10	304.8 8	762.7 8	2506 8
0	136.2 8	317.0 8	783.7 8
15	57.28 8	113.6 8	245.0 8
25	34.94 8	62.05 8	124.4 8

Pour Point (°C)

Weathering (Volume %)	Weathering (Volume %)	
	0	4
	-38 8	-35 8
		12
		-28 8

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	19.4
0	30.5 3	31.2 5
15	28.8 3	26.6 5

Atkinson Crude Oil

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)	
	0	19.4
0	18.7 3	7.1 5
15	17.9 3	10.9 5

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)	
	0	19.4
0	24.2 3	22.3 5
15	23.2 3	21.2 5

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)	
	0	19.4
0	1.0 5	1.0 5
15	1.0 5	1.0 5

Emulsion Stability

(°C)	Weathering (Volume %)	
	0	19.4
0	1.0 5	1.0 5
15	1.0 5	1.0 5

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)	
	0	19.4
0	83 5	53 5
15	88 5	73 5

Dispersibility

Natural Dispersibility (% Dispersed)

(°C)
15
8 9

Fire and Reactivity

Flash Point (°C)

Weathering (Volume %)		
0	4	12
10 8	32 8	75 8

Fire Point (°C)

Weathering (Weight %)		
0	4	12
26 8	50.5 8	95 8

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	173 3	58 3
5	210 3	106 3
10	252 3	123 3
15	290 3	129 3
17	304 3	201 3

Weathering

T_O = 445.7
 T_G = 780.5 (EETD 85)

Solubility

Aqueous Solubility (mg/L)

	22 °C	
Fresh Water	2.3 10	3.1 11
Seawater	2.5 10	

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	82.7	4
Aromatics	13.2	4
Polars	1.5	4
Asphaltenes	2.6	4
	2.39	5
	2.2	6

Wax Content (Weight %)

1.1 6

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	24h EC50	48h EC50	24h LC50	48h LC50
Daphnia Magna		0.61 10 0.83 1		> 2.27 10 > 3.1 1
Artemia spp.	> 2.03 10 > 2.5 1		> 2.03 10 > 2.5 1	

Note: Results from (Maclean 88) obtained by fluorescence spectroscopy.
Results from (Bobra 88) obtained by purge-and-trap GC analysis.

Metal Content

Other Metals (ppm)

	Weathering (Volume %)	
	0	19.4
Molybdenum	0.6 7	< 0.6 7
Potassium	2.0 7	2.0 7
Zinc	1.4 7	2.6 7
Lead	3.5 7	3.7 7
Nickel	1.8 7	2.7 7
Iron	6.7 7	66 7
Chromium	< 1.5 7	< 1.5 7
Magnesium	4.6 7	4.5 7
Vanadium	9.4 7	11 7
Copper	< 0.6 7	0.6 7
Titanium	0.6 7	< 0.6 7
Barium	0.6 7	0.6 7

Non-Metal Content

Sulphur (Weight %)

Weathering (Volume %)	
0	19.4
0.86 4	1.07 5

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	5.96 6

References

- | | | | |
|--------------|---------------|--------------|-----------|
| 1 Bobra 88 | 2 EETD 84 | 3 EETD 85 | 4 EETD 86 |
| 5 EETD 89 | 6 ESD 91 | 7 ESD 92 | 8 Esso 83 |
| 9 Fingas 90a | 10 MacLean 88 | 11 Suntio 86 | |

Auk Crude Oil

U.K., North Sea

Mass and Weight**API Gravity (15/15°C)**

37.5	3
37.15	1

Density (g/mL)

(°C)		
15	0.837	3
	0.8390	4
	0.837	2

Viscosity**Kinematic Viscosity (mm²/sec or cSt)**

(°C)		
15	3.65	3
38	5.7	2
40	4.38	1

Pour Point (°C)

-1	3
9	1
12	2

Distillation**Distillation (°C)**

(Wt%)		
9.5	5	
	to 100	3
10.6	100	
	to 160	3
16.6	160	
	to 250	3
18.8	250	
	to 350	3
44.5	> 350	3

Yield on Crude

	Range, °C	Volume %	Weight %
	C1	2.2 1	1.5 1
	to C5		
Gasoline	C1	8.0 1	6.5 1
	to 85		
Naphtha	85	15.5 1	14.0 1
	to 165		
Kerosene	165	13.0 1	12.5 1
	to 235		
Gas Oil	235	12.5 1	12.4 1
	to 300		
Gas Oil	300	9.4 1	9.6 1
	to 350		
Residuum	> 350	39.2 1	43.5 1

Hydrocarbon Group

Wax Content (Weight %)

7 3
6.5 1

Non-Metal Content

Hydrogen Sulfide - Existent (mg/m³)

< 1 1

Hydrogen Sulfide - Potential (ppm)

< 1 1

Sulphur (Weight %)

0.4 3
0.45 1

Other

Acid Number (mg KOH/g)

0.13 1

Reid Vapour Pressure (kPa)

(°C)
37.8 41.4 1

References

1 Aalund 83b

2 Fina 82

3 HMSO 76

4 NSD 88

Avalon Crude Oil

Newfoundland, Canada

Mass and Weight

API Gravity (15/15°C)

36.0 1

Density (g/mL)

(°C)	Weathering (Volume %)		20.3
	0	9	
0	0.851	1	0.897 1
10	0.880 (J-34)	8	0.886 1
15	0.844	1	
20	0.871 (J-34)	8	
30	0.864 (J-34)	8	

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		20.3
	0	9	
0	575	1	> 5200 1
15	11.4	1	438 1
20	220 (J-34)	8	
25	40 (J-34)	8	

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		20.3
	0	9	
0	675.7 1	1	> 5780 1
15	13.5 1	1	94.4 1

Pour Point (°C)

Weathering (Volume %)	Weathering (Volume %)		20.3
	0	9	
12 1	21 1	24 1	
18 (J-34) 8			

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		20.3
	0	9	
0	28 1	28.4 1	N/M 1
15	26.4 1	25.8 1	27.9 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		20.3
	0	9	
0	25.2 1	33.2 1	N/M 1
15	20.5 1	25.6 1	26.7 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)	
	0	9
0	49.4 2	
15	29.1 2	

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		20.3
	0	9	
0	1.0 1	1.0 1	0.24 1
15	0.16 1	0.22 1	1.0 1

Emulsion Stability

(°C)	Weathering (Volume %)		20.3
	0	9	
0	1.0 1	1.0 1	1.0 1
15	0.37 1	0.71 1	1.0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		20.3
	0	9	
0	88 1	87 1	69 1
15	89 1	89 1	88 1

Dispersibility

Chemical Dispersibility (% Dispersed)

	J-34	
C 9527	20 4	20 4
Dasic	10 4	5 4
EN 700	15 4	5 4
CRX-8	15 4	5 4

Natural Dispersibility (% Dispersed)

(°C)	
15	4 7

Fire and Reactivity

Flash Point (°C)

Weathering (Volume %)		
0	9	20.3
14 1	33 1	66 1

Distillation

Distillation (°C)

(Vol%)	Liquid Temp (0%)	Vapour Temp (0%)	Liquid Temp (15.5%)	Vapour Temp (15.5%)
IBP	146 2	44 2	229 2	122
5	189 2	95 2	259 2	149
10	218 2	118 2	289 2	171
15	248 2	138 2		
20	279 2	158 2		
25	313 2	177 2		

Weathering

T_O = 402.0

T_G = 580.0 (EETD84)

Solubility

Aqueous Solubility (mg/L)

Freshwater 20.14

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	83.2	3
Aromatics	12.5	3
Polars	1.8	3
Asphaltenes	2.5	3
	2.5 (J-34)	4
	3.2 (J-34)	8
	2.7 (J-34)	5
	1.5 (B-27)	4

Wax Content (Weight %)

3.5 (J-34)	8
12.5 (J-34)	5

Metal Content

Other Metals (ppm)

	J-34	B-27
Molybdenum	0.8 6	2.2 6
Potassium	1.9 6	< 1.5 6
Zinc	< 0.6 6	< 0.6 6
Lead	< 3 6	< 3 6
Nickel	2.1 6	< 1 6
Iron	13 6	5 6
Chromium	< 1.5 6	< 1.5 6
Magnesium	4.4 6	4.7 6
Vanadium	1.6 6	< 0.6 6
Copper	1.1 6	< 0.6 6
Titanium	< 0.6 6	< 0.6 6
Barium	4.9 6	1.8 6

Non-Metal Content

Sulphur (Weight %)

Weathering	(Volume %)
0	5.5
0.71 3	0.86 3

Other

Reid Vapour Pressure (kPa)

(°C)
37.8
63.5 1

References

1 EETD 84
5 ESD 91

2 EETD 85
6 ESD 92

3 EETD 86
7 Fingas 90a

4 EETD 89
8 Ross 89

Aviation Gasoline 100

Aviation Gasoline (<4.86 g lead/gal)

Blend of catalytically cracked naphthas, alkylate, and isopentanes.
Operational fuel for most commercial piston engine aircraft. Dyed green for identification.

Mass and Weight

API Gravity (15/15°C)

66.2 3
67.5 2

Density (g/mL)

(°C)	Weathering (Volume %)
	0
0	0.7277 3
15	0.7151 3
	0.7104 2

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
0	1.29 3
1.7	0.52 (estimated) 2
15	0.44 (estimated) 2
	0.83 3

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
15	0.6194 (estimated) 2

Pour Point (°C)

< 24.4 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
	0
0	20.5 3
15	20.0 3
20	19
	to 23 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering	(Volume %)
	0	
0	40.0	3
15	42.2	3

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering	(Volume %)
	0	
0	42.5	3
15	42.2	3
20	49	
	to 51	2

Emulsion**Emulsion Formation Tendency**

(°C)	Weathering	(Volume %)
	0	
0	0	3
15	0	3

Emulsion Stability

(°C)	Weathering	(Volume %)
	0	
0	0	3
15	0	3

Water Content of Emulsion (Volume %)

(°C)	Weathering	(Volume %)
	0	
0	N/A	3
15	N/A	3

Fire and Reactivity**Flash Point** (°C)

-45.5 2

Flammability Limits (Volume %)

in air 1.2
to 7.1 2

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	71 3	25 3
10 max		75 1
10	94 3	80 3
20	102 3	97 3
22		75 6
30	105 3	102 3
40 min		75 1
40	107 3	105 3
50 max		105 1
50	108 3	106 3
60	109 3	107 3
70	111 3	110 3
76		105 6
80	114 3	112 3
90 max		135 1
90	126 3	119 3
97		135 6
FBP,max		170 1
FBP		159 6

Solubility

Aqueous Solubility (mg/L)

Freshwater 100.44 4

Toxicity

Toxicity (mg/L)

	24h TL _m
Juvenile American Shad	90 #1 2
	91 #2 2

1. Freshwater
2. Saltwater

Biological Oxygen Demand (days)

(%)	
8	5 2

Metal Content

Other Metals (ppm)

Molybdenum	<	0.6	5
Potassium	<	1.5	5
Zinc	<	0.6	5
Lead		795	5
		4.86 g/gal	2
Nickel	<	1	5
Iron	<	3	5
Chromium		1.4	5
Magnesium		7.5	5
Vanadium	<	0.6	5
Copper	<	0.6	5
Titanium	<	0.6	5
Barium	<	0.3	5

Non-Metal Content

Sulphur (Weight %)

max	0.05	1
	0.02	6
	0.05	3

Sensation

Colour

green	6
green	1

Odour Threshold (ppm)

0.25	2
------	---

Other

Reid Vapour Pressure (kPa)

(°C)		
38	46.9	6
	max 48	1
37.8	2.4 (estimated)	2

Freezing Point (°C)

max	-58	1
<	-71	6
<	-24.4	2

TEL Content (ml/l)

max 1.06 1
0.502 6

Antioxidants (mg/L)

max 12 1

References

1 ASTM D 910
5 ESD 92

2 CHRIS 85
6 Esso 73

3 EETD 89

4 ESD 91

Aviation Gasoline 100LL

Blend of catalytically cracked naphthas, alkylate, and isopentanes. Operational fuel for most commercial piston engine aircraft. Similar to grade 100 except with lower lead-additive content. Dyed blue for identification (ASTM D 910).

Distillation

Distillation (°C)

(Vol%)	Vapour Temp
10 max	75 1
40 min	75 1
50 max	105 1
90 max	135 1
FBP	170 1

Non-Metal Content

Sulphur (Weight %)

max 0.05 1

Sensation

Colour

Blue 1

Other

Reid Vapour Pressure (kPa)

(°C)	
38 (max)	48 1

Freezing Point (°C)

max -58 1

TEL Content (ml/l)

max 0.53 1

Antioxidants (mg/L)

max 12 1

References

1 ASTM D 910

Aviation Gasoline 115

Blend of high-octane, quality hydrocarbon components. Operational fuel for most military piston engine aircraft. Dyed purple for identification. (Esso 73)

Distillation

Distillation (°C)

(Vol%)	Vapour Temp
21	75 1
62	105 1
96	135 1
FBP	161 1

Non-Metal Content

Sulphur (Weight %)

0.02 1

Sensation

Colour

Purple 1

Other

Reid Vapour Pressure (kPa)

(°C)	
38	46.9 1

Freezing Point (°C)

< -71 1

TEL Content (ml/l)

max 1.215 1
1.19 1

References

1 Esso 73

Aviation Gasoline 80

Blend of catalytically cracked and straight-run naphthas, alkylates, and isopentanes. Operational fuel for many small piston engine aircraft. Dyed red for identification. (Esso 73)

Mass and Weight

API Gravity (15/15°C)

71.8 2

Density (g/mL)

(°C)	
0	0.7078 2
15	0.6953 2

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
0	0.89 2
15	0.83 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
	0
0	19.7 2
15	19.0 2

Oil-Seawater (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
	0
0	32.1 2
15	33.1 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
	0
0	33.1 2
15	31.7 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
0	0 2
15	0 2

Emulsion Stability

(°C)	Weathering (Volume %)
0	0 2
15	0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	N/A 2
15	N/A 2

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	65 2	26 2
10 max		75 1
10	78 2	64 2
20	87 2	77 2
26		75 4
30	95 2	87 2
40 min		75 1
40	101 2	95 2
50 max		105 1
50	104 2	101 2
60	107 2	105 2
70	110 2	108 2
80	113 2	111 2
89		105 4
90 max		135 1
90	125 2	120 2
95		135 4
FBP		170 1
		147 4

Metal Content

Other Metals (ppm)

Molybdenum		0.6	3
Potassium	<	1.5	3
Zinc	<	0.6	3
Lead		175	3
Nickel	<	1	3
Iron	<	3	3
Chromium	<	1.5	3
Magnesium		8.2	3
Vanadium	<	0.6	3
Copper		1.1	3
Titanium	<	0.6	3
Barium	<	0.3	3

Non-Metal Content

Sulphur (Weight %)

max	0.05	1
	0.01	4
	0.04	2

Sensation

Colour

red	1
red	4

Other

Reid Vapour Pressure (kPa)

(°C)	
38	46.9 4
38 (max)	48 1

Freezing Point (°C)

max	-58	1
<	-71	4

TEL Content (ml/l)

max	0.13	1
	0.08	4

Antioxidants (mg/L)

max 12 1

References

1 ASTM D 910

2 EETD 89

3 ESD 92

4 Esso 73

BCF 24 Crude Oil

La Salina, Lake Maracaibo, Venezuela

Mass and Weight**API Gravity (15/15°C)**23.5 ³23.4 ¹**Density (g/mL)**

(°C)	Weathering (Volume %)		17.3
	0	9.2	
Unknown	0.9130 ³		
0	0.9229 ¹	0.9442 ¹	0.9496 ¹
15	0.9129	0.9342 ¹	0.9399 ¹

Viscosity**Dynamic Viscosity (mPa.s or cP)**

(°C)	Weathering (Volume %)		17.3
	0	9.2	
0	356 ¹	2153 ¹	8729 ¹
15	125 ¹	557 ¹	1629 ¹

Kinematic Viscosity (mm²/sec or cst)

(°C)	Weathering (Volume %)		17.3
	0	9.2	
0	38540 ¹	2280	9192 ¹
15	137 ¹	597 ¹	1733 ¹
38	41.40 ³		

Pour Point (°C)

Weathering	(Volume %)		17.3
	0	9.2	
-51.0 ³	-21 ¹	-18 ¹	
-42 ³			

Interfacial Tensions**Air-Oil (mN/M or dynes/cm)**

(°C)	Weathering (Volume %)		17.3
	0	9.2	
0	29.2 ¹	30.1 ¹	30.5 ¹
15	28.2 ¹	29.6 ¹	30.9 ¹

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		
	0	9.2	17.3
0	24.9 1	22.7 1	22.5 1
15	21.3 1	20.2 1	20.0 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		
	0	9.2	17.3
0	28.1 1	28.0 1	28.1 1
15	21.5 1	23.8 1	24.2 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	9.2	17.3
0	1.0 1	0 1	0 1
15	1.0 1	0 1	0 1

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	9.2	17.3
0	1.0 1	0 1	0 1
15	0 1	0 1	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	9.2	17.3
0	51.7 1	N/A 1	N/A 1
15	N/A 1	N/A 1	N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	5 1
Dasic	0 1
EN 700	0 1
CRX-8	0 1

Fire and Reactivity**Flash Point (°C)**

Weathering (Volume %)	
0	9.2
< -43 1	66.7 2

Distillation**Distillation (°C)**

(Vol%)	Liquid Temp	Vapour Temp
IBP	159.3 1	42.5 1
5	233 1	130 1
10	281 1	170 1
15	321 1	219 1
20	354 1	238 1
25	383 1	266 1
30	405 1	284 1
35	418 1	299 1
40	426 1	314 1
45	433 1	323 1
50	438 1	329 1

WeatheringT_G = 1060.0T_O = 446.3 (ESD 91)**Solubility****Aqueous Solubility (mg/L)**

Weathering (Volume %)	
0	9.2
Freshwater	16.39 1
	3.45 1

Hydrocarbon Group**Hydrocarbon Group Analysis (Weight %)**

Asphaltenes 7.0 1

Wax Content (Weight %)

4.4 1

Metal Content

Other Metals (ppm)

	Weathering (Volume %)	
	0	9.2
Molybdenum	< 0.6 2	< 0.6 2
Potassium	< 1.5 2	< 1.5 2
Zinc	< 0.6 2	< 0.6 2
Lead	< 3 2	< 3 2
Nickel	30 2	23.6 2
Iron	< 4 2	5.2 2
Chromium	< 1.5 2	< 1.5 2
Magnesium	6.5 2	< 1 2
Vanadium	290 2	248 2
Copper	< 0.6 2	< 0.6 2
Titanium	< 0.6 2	< 0.6 2
Barium	< 0.3 2	< 0.3 2
Cadmium		< 0.5 2
Selenium		21 2
Cobalt		< 1 2
Manganese		< 0.3 2
Calcium		48.4 2
Aluminum		< 5 2
Strontium		0.37 2
Tin		< 15 2
Mercury		< 15 2

Non-Metal Content

Sulphur (Weight %)

3.85 3

Other

Reid Vapour Pressure (kPa)

(°C)
37.8
4.53 1

References

1 ESD 91

2 ESD 92

3 NSD 88

Beatrice Crude Oil

Nigg Bay, U.K., North Sea

Mass and Weight

API Gravity (15/15°C)

38.7 1

Density (g/mL)

(°C)

Unknown	0.835 2
---------	---------

ViscosityKinematic Viscosity (mm²/sec or cst)

(°C)

38	8.15 2
40	6.85 1
50	5.15 1

Pour Point (°C)

13 1
27 2

Distillation

Yield on Crude

	Range, °C	Volume %
C1-C5		3.77 1
Light Naphtha	20	3.6 1
	to 70	
Naphtha	70	3.5 1
	to 100	
Heavy Naphtha	100	7.3 1
	to 150	
Kerosene	150	8.8
	to 205	
Middle Distillate	205	25.8 1
	to 243	
Gas Oil	343	34.7 1
	to 565	
Residuum	> 565	14.4 1

Non-Metal Content

Sulphur (Weight %)

0.05 ¹

Other

Reid Vapour Pressure (kPa)

(°C)

37.8

38.6 ¹

References

¹ Aalund 83b

² Fina 82

Belridge Heavy Crude Oil

California

Mass and Weight

API Gravity (15/15°C)

13.6 1

Density (g/mL)

(°C)	Weathering (Volume %)	
	0	2.7
0	0.9849 1	0.9871 1
15	0.9746 1	0.9770 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)	
	0	2.7
0	92595 1	156200 1
15	12610 1	17105 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)	
	0	2.7
0	94015 1	158241 1
15	12939 1	17508 1

Pour Point (°C)

Weathering (Volume %)	
0	2.7
2 1	4 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	2.7
0	N/M 1	N/M 1
15	31.2 1	

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)	
	0	2.7
0	N/M 1	N/M 1
15	20.0 1	

Belridge Heavy Crude Oil

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering	(Volume %)
0	0	2.7
0	N/M 1	N/M 1
15	25.1 1	

Emulsion

Emulsion Formation Tendency

(°C)	Weathering	(Volume %)
0	0	2.7
0	0 1	
15	0 1	0 1

Emulsion Stability

(°C)	Weathering	(Volume %)
0	0	2.7
0	0 1	
15	0 1	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering	(Volume %)
0	0	2.7
0	N/A 1	
15	N/A 1	N/A 1

Fire and Reactivity

Flash Point (°C)

> 90 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 4.4 1

Wax Content (Weight %)

1.3 1

Metal Content

Other Metals (ppm)

Molybdenum	<	0.6	1
Potassium	<	1.5	1
Zinc	<	0.6	1
Lead	<	3	1
Nickel		70	1
Iron		40.4	1
Chromium	<	1.5	1
Magnesium		5.4	1
Vanadium		86.4	1
Copper	<	0.6	1
Titanium	<	0.6	1
Barium		0.3	1

References

1 ESD 92

Bent Horn A-02 Crude Oil

Northwest Territories, Canada

Data for EETD 1985 from drill stemp testing sample of A-02 well, 1985.

Mass and Weight

API Gravity (15/15°C)

42.8

Density (g/mL)

For Fv < 32.9% & T between -43 and 18°C:

$$\text{DEN} = 0.829837 + 0.001326 \text{ Fv} - 0.000627 \text{ T}$$

Where: DEN is density of oil at T and Fv (g/mL)

Fv is volume percent of oil weathered

T is oil temperature (°C)

(°C)	Weathering (Volume %)		
	0	20.4	32.9
-43	0.852 1		
-15	0.845 1		
0	0.8299 2	0.8600 2	0.8735 2
	0.833 1		
15	0.8177 2	0.8484 2	0.8615 2
	0.821 1		
18	0.815 1		

Viscosity

Dynamic Viscosity (mPa.s or cP)

$$\text{VISC} = \text{EXP} (4278 / (\text{T} + 273) - 12.32) \quad (\text{Charles } 84)$$

Where: VISC is dynamic viscosity (mPa.s) of fresh oil at T

T is oil temperature (°C)

EXP is exponential base e

(°C)	Weathering (Volume %)		
	0	20.4	32.9
-43	44000 1		
-30	17430 1		
-20	580 1		
-10	207 1		
0	68 1	N/M 2	N/M 2
	25.0 2		
15	12.1 2	100 2	525 2

Pour Point (°C)

	Weathering (Volume %)		
	0	20.4	32.9
-16	2	-2 2	11 2
-18	8		

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		32.9
	0	20.4	
0	27.4 2	31.1 2	N/M 2
15	25.4 2	27.9 2	28.7 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		32.9
	0	20.4	
0	34.4 2	26.7 2	N/M 2
15	17.6 2	1.7 2	2.3 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		32.9
	0	20.4	
0	30.0 2	38.9 2	N/M 2
15	26.6 2	13.8 2	11.4 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	20.4	32.9
0	0 2	1.0 2	1.0 2
15	0 2	1.0 2	1.0 2

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	20.4	32.9
0	0 2	1.0 2	1.0 2
15	0 2	0.54 2	1.0 2

Water Content of Emulsion (volume %)

(°C)	Weathering (Volume %)		
	0	20.4	32.9
0	N/A 2	53.8 2	77.3 2
15	N/A 2	47.6 2	86.0 2

Dispersibility

Chemical Dispersibility (% Dispersed)

17 6
20 6
23 6
35 6

Natural Dispersibility (% Dispersed)

(°C)
15 6 7

Fire and Reactivity

Flash Point (°C)

-14 2

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	133 2	33 2
5	158 2	92 2
10	180 2	113 2
15	203 2	130 2
20	228 2	149 2
25	253 2	169 2
30	279 2	188 2
35	303 2	206 2

Weathering

T_O = 406.0

T_G = 484.0 (EETD 85)

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates 95.0 3
Aromatics 4.3 3
Polars 0.3 3
Asphaltenes 0.4 3
 0.1 4

Wax Content (Weight %)

8.7 4

Metal Content

Other Metals (ppm)

	Weathering (Volume %)	
	0	20.4
Molybdenum	< 0.6 5	1.3 5
Potassium	< 1.5 5	2 5
Zinc	2.9 5	3.9 5
Lead	< 3 5	< 3 5
Nickel	6.5 5	< 1 5
Iron	8.4 5	70 5
Chromium	< 1.5 5	< 1.5 5
Magnesium	38.6 5	24 5
Vanadium	< 0.6 5	< 0.6 5
Copper	< 0.6 5	2.3 5
Titanium	< 0.3 5	0.6 5
Barium	1.9 5	1.0 5
Cadmium	< 0.5 5	
Selenium	17 5	
Cobalt	< 1	
Manganese	0.4 5	
Calcium	105 5	
Aluminum	< 5 5	
Strontium	0.2 5	
Tin	< 15 5	
Mercury	< 15 5	

Non-Metal Content

Sulphur (Weight %)

	Weathering (Volume %)		
	0	20.4	32.9
	0.76 3	0.81 3	0.89 3

Other

Compositional Analysis

	<u>Mole %</u>
N ₂	0.16 9
CO ₂	0.15 9
H ₂ S	0.03 9
C ₁	7.12 9
C ₂	2.75 9
C ₃	2.85 9
iC ₄	1.30 9
C ₄	3.21 9
iC ₅	2.28 9
C ₅	2.91 9
C ₆	5.74 9
C ₇	6.00 9
C ₈	6.95 9
C ₉	5.49 9
C ₁₀	5.49 9
C ₁₁	4.80 9
C ₁₂	3.78 9
C ₁₃	3.98 9
C ₁₄	3.58 9
C ₁₅	2.65 9
C ₁₆	2.24 9
C ₁₇	2.25 9
C ₁₈	1.91 9
C ₁₉	1.53 9
C ₂₀	1.39 9
C ₂₁	1.16 9
C ₂₂	1.08 9
C ₂₃	0.97 9
C ₂₄	0.82 9
C ₂₅	0.79 9
C ₂₆	0.68 9
C ₂₇	0.65 9
C ₂₈	0.63 9
C ₂₉	0.54 9
C ₃₀₊	5.83 9
Aromatics	
C ₆ H ₆	0.08 9
C ₇ H ₈	0.29 9
C ₈ H ₁₀	0.74 9
C ₈ H ₁₀	0.91 9
C ₉ H ₁₂	0.45 9
Naphthenes	
C ₅ H ₁₀	0.36 9
C ₆ H ₁₂	0.60 9
C ₆ H ₁₂	0.64 9
C ₇ H ₁₄	2.14 9

References

1 Charles 84
5 ESD 92
9 Panarctic 84

2 EETD 85
6 Fingas 90.

3 EETD 86
7 Fingas 90a

4 ESD 91
8 Oilweek 85

Bent Horn Crude Oil

Bent Horn Crude Oil

Northwest Territories, Canada

Data for sample taken from the Imperial Bedford tanker on September 10, 1985 at the Port of Montreal.

Mass and Weight

API Gravity (15/15°C)

41.3 2

Density (g/mL)

For $F_v < 33.3\%$ & T between 0 and 15°C:

$$\text{DEN} = 0.830471 + 0.001329 F_v - 0.000784 T$$

Where: DEN is density of oil at T and F_v (g/mL)

F_v is volume percent of oil weathered

T is oil temperature (°C)

(°C)	Weathering (Volume %)		
	0	20.2	33.3
0	0.8298 2	0.8589 2	0.8738 2
15	0.8181 2	0.8472 2	0.8619 2

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		
	0	20.2	33.3
0	53.8 2	14750 2	110000 2
15	24.0 2	60.0 2	5820 2

Pour Point (°C)

Weathering (Volume %)		
0	20.2	33.3
-18 2	-7 2	8 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		
	0	20.2	33.3
0	27.7 2	33.1 2	N/M 2
15	26.2 2	28.2 2	25.0 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		
	0	20.2	33.3
0	53.5 2	32.1 2	N/M 2
15	38.5 2	2.2 2	7.4 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		33.3
	0	20.2	
0	48.0 2	42.3 2	N/M 2
15	39.1 2	16.6 2	15.4 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		33.3
	0	20.2	
0	0 2	1.0 2	1.0 2
15	0 2	1.0 2	1.0 2

Emulsion Stability

(°C)	Weathering (Volume %)		33.3
	0	20.2	
0	0 2	1.0 2	1.0 2
15	0 2	1.0 2	1.0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		33.3
	0	20.2	
0	N/A 2	59.6 2	66.0 2
15	N/A 2	13.6 2	44.4 2

Dispersibility

Chemical Dispersibility (% Dispersed)

CRX-8	15 4
Dasic	15 4
EN 700	15 4

Natural Dispersibility (% Dispersed)

(°C)	Weathering (Volume %)	
	0	20.2
15	6 7	5 7

Fire and Reactivity

Flash Point (°C)

-9 2

Bent Horn Crude Oil

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	111 2	33 2
5	164 2	89 2
10	187 2	110 2
15	210 2	130 2
20	235 2	147 2
25	259 2	174 2
30	284 2	188 2
34	305 2	203 2

Weathering

T_O = 413.0

T_G = 480.0 (EETD 85)

Solubility

Aqueous Solubility (mg/L)

		22 °C
Fresh Water	6.4 8	7.6 9
	5.71 5	
Salt Water	5.34 8	6.0 9

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

	Weathering (Volume %)
	0 20.2
Saturates	94.3 3
Aromatics	4.8 3
Polars	0.3 3
Asphaltenes	0.6 3 0.33 4
	0.4 4
	0.1 5

Wax Content (Weight %)

7.4 5

Toxicity**Acute Toxicity of Water Soluble Fraction (mg/L)**

	48h EC ₅₀	48h LC ₅₀
Daphnia Magna	1.07 8 1.3 1	1.75 8 2.1 1
Artemia spp.	3.39 8 3.87 1	4.49 8 5.1 1

Note: Results from (Maclean 88) obtained by fluorescence spectroscopy.
Results from (Bobra 88) obtained by purge-and-trap GC analysis.

Metal Content**Other Metals (ppm)**

	Weathering (Volume %)	
	0	20.2
Molybdenum	< 0.6 6	0.9 6
Potassium	< 1.5 6	< 1.5 6
Zinc	< 0.6 6	1.9 6
Lead	< 3 6	< 3 6
Nickel	< 1.0 6	< 1 6
Iron	56 6	19 6
Chromium	< 1.5 6	< 1.5 6
Magnesium	3.4 6	16 6
Vanadium	< 0.6 6	< 0.6 6
Copper	< 0.6 6	< 0.6 6
Titanium	< 0.6 6	< 0.6 6
Barium	< 0.3 6	0.6 6

Non-Metal Content**Sulphur (Weight %)**

0.82 3

References

- | | | | |
|-------------|-----------|--------------|--------------|
| 1 Bobra 88 | 2 EETD 85 | 3 EETD 86 | 4 EETD 89 |
| 5 ESD 91 | 6 ESD 92 | 7 Fingas 90a | 8 MacLean 88 |
| 9 Suntio 86 | | | |

Beryl Crude Oil

Beryl Crude Oil

U.K., North Sea

Mass and Weight

API Gravity (15/15°C)

39.6 2

36.5 1

Density (g/mL)

(°C)

Unknown 0.8270 2

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)

15 9.47 1

38 2.90 2

Pour Point (°C)

-54.0 2

Distillation

Yield on Crude

	Range, °C	Volume %
<C ₅		3.77 1
Naphtha	15.5	2.29 1
	to 49	
Naphtha	49	21.899 1
	to 165	
Kerosene	165	10.7 1
	to 218	
Light Gas Oil	219	24.75 1
	to 343	
Heavy Gas Oil	343	25.89 1
	to 535	
Residuum	> 535	12.95 1

Hydrocarbon Group

Wax Content (Weight %)

5.10 2

Metal Content

Other Metals (ppm)

Nickel/Vanadium 4.40 2

Non-Metal Content

Sulphur (Weight %)

0.36 2

0.42 1

Other

Reid Vapour Pressure (kPa)

(°C)

37.8

35.9 1

78.6 2

References

1 Aalund 83b

2 NSD 88

Beta Crude Oil

California

Mass and Weight

API Gravity (15/15°C)

13.7 1

Density (g/mL)

(°C)	Weathering (Volume %)
0	0
0	0.9829 1
15	0.9738 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	0
0	90207 1
15	13377 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
0	0
0	91776 1
15	13737 1

Pour Point (°C)

3 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	N/M 1
15	32.2 1

Oil-Seawater (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	N/M 1
15	30.4 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	N/M 1
15	34.1 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
0	0
0	0 1
15	0 1

Emulsion Stability

(°C)	Weathering (Volume %)
0	0
0	0 1
15	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	0
0	N/A 1
15	N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	0 1
Dasic	0 1
EN 700	0 1
CRX-8	0 1

Fire and Reactivity

Flash Point (°C)

2 1

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	129.1 1	68.6 1
5	290 1	115 1
10	340 1	224 1
15	379 1	256 1
20	403 1	274 1
25	411 1	290 1
30	418 1	306 1
35	425 1	317 1

Weathering

T_G = 2960.7

T_O = 383.3 (ESD 91)

Solubility

Aqueous Solubility (mg/L)

Freshwater 5.71 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 10.7 1

Wax Content (Weight %)

2.7 1

Metal Content

Other Metals (ppm)

Molybdenum	<	0.6	2
Potassium	<	1.5	2
Zinc	<	0.6	2
Lead	<	3	2
Nickel		112	2
Iron		68	2
Chromium	<	1.5	2
Magnesium		25	2
Vanadium		146	2
Copper	<	0.6	2
Titanium		2.2	2
Barium		1.4	2

References

1 ESD 91

2 ESD 92

Boscan Crude Oil

Venezuela

Mass and Weight

API Gravity (15/15°C)

10.9 1

Density (g/mL)

(°C)	
0	1.003 1
15	0.993 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
0	8826000 1
15	485500 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
0	8799601 1
15	488922 1

Pour Point (°C)

21 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
0	N/M 1
15	N/M 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	
0	N/M 1
15	N/M 1

Oil-Water (mN/m or dynes/cm)

(°C)	
0	N/M 1
15	N/M 1

Emulsion

Emulsion Formation Tendency

(°C)	
0	0 1
15	0 1

Emulsion Stability

(°C)	
0	0 1
15	0 1

Water Content of Emulsion (Volume %)

(°C)	
0	N/A 1
15	N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	0 1
Dasic	0 1
EN 700	0 1
CRX-8	0 1

Fire and Reactivity

Flash Point (°C)

57.2 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 16.5 1

Wax Content (Weight %)

4.4 1

Metal Content

Other Metals (ppm)

Molybdenum		4.7	1
Potassium		1.8	1
Zinc		4.7	1
Lead	<	3	1
Nickel		117	1
Iron		56	1
Chromium	<	1.5	1
Magnesium		16.3	1
Vanadium		1320	1
Copper		1.6	1
Titanium	<	0.6	1
Barium		0.5	1
Selenium	<	15	1
Cobalt	<	1	1
Manganese		0.52	1
Calcium		470	1
Aluminum		69.9	1
Strontium		1.58	1
Cadmium	<	0.5	1
Tin	<	15	1
Mercury	<	15	1

References

¹ ESD 92

Bow River Blended Crude Oil

Alberta, Canada

Mass and Weight

API Gravity (15/15°C)

26.7 1

Density (g/mL)

$$\text{DEN} = 0.901 - 0.000617 T$$

Where: DEN is the density of fresh oil at T (mPa.s)

T is oil temperature (°C) (Mackay 82a)

(°C)	Weathering (Weight %)		
	0	10	20
0	0.900 2		
5	0.899 2		
10	0.896 2		
15	0.893 2		
15.5	0.8936 1		
20	0.889 2		
25	0.885 2		
Room Temp	0.90 3	0.923 2	0.938 2

Viscosity

Dynamic Viscosity (mPa.s or cP)

$$\text{VISC} = \text{EXP}((4310/(T+273)) - 11.4)$$

Where: VISC is viscosity of fresh oil at TR (mPa.s)

T is oil temperature (°C) (Mackay 82a)

(°C)	Weathering (Volume %)	
	0	
0	88.4 2	
	74 3	
5	62.0 2	
10	45.1 2	
	67 3	
15	33.7 2	
20	28.3 2	
	42.5 3	
25	23.7 2	

Bow River Blended Crude Oil

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)	
	0	
0	98.2	2
5	69.0	2
10	50.3	2
15	37.7	2
20	31.8	2
25	26.8	2
40	18.30	1

Pour Point (°C)

	Weathering (Weight %)		
	0	10	20
	-39	-15	-3
	2	2	2
	-27		
	3		
	-50		
	1		

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
Room Temp.	15
	3

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Weight %)		
	0	10	20
Unknown	26.8	23.9	27.8
	2	2	2

Oil-Water (mN/m or dynes/cm)

(°C)	
Room Temp.	28.85
	3

Fire and Reactivity

Flash Point (°C)

< 12 3

Fire Point (°C)

22 3

Combustion Results

Fresh oil ignited easily 3
6.1 Vol% residue 3

Distillation

Distillation (°C)

(Vol%)	Vapour Temp.
0	46 3
10	115 3
20	185 3
30	265 3
40	310 3
50	350 3
60	370 3
70	385 3
80	390 3

Yield on Crude

	Range, °C	Volume %
Naphtha	C ₅	20.40 1
	to 190	
Kerosene	190	13.10 1
	to 277	
Distillate	277	10.80 1
	to 343	
Gas Oil	343	32.50 1
	to 565	
Residuum	> 565	23.20 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

	Weathering (Weight %)		
	0	10	20
Paraffins	69.6 2	66.7 2	62.5 2
Aromatics	21.4 2	22.4 2	25.8 2
Polars	3.96 2	3.36 2	3.87 2
Asphaltenes	5.04 2	7.50 2	7.80 2

Wax Content (Weight %)

	Weathering (Weight %)		
	0	10	20
	2.75 2	6.47 2	8.63 2

Metal Content

Other Metals (ppm)

Nickel	20.7	1
Vanadium	54.0	1

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

6.7 1

Sulphur (Weight %)

21000 ppm 1

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	37.2 1

References

1 Aalund 83a

2 Mackay 82a

3 Twardus 80

Bow River Heavy Crude Oil

Alberta, Canada

Mass and Weight

API Gravity (15/15°C)

26.7 ¹

Density (g/mL)

(°C)
Unknown 0.8940 ¹

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
38 18.3 ¹

Pour Point (°C)

-50 ¹

Metal Content

Other Metals (ppm)

Nickel/Vanadium 0.38 ¹

Non-Metal Content

Sulphur (Weight %)

2.10 ¹

Other

Reid Vapour Pressure (kPa)

(°C)
37.8 37.2 ¹

References

¹ NSD 88

Brae Crude Oil

Brae Crude Oil

U.K., North Sea

Mass and Weight

API Gravity (15/15°C)

33.6 ¹

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
10 13.6 ¹

Pour Point (°C)

-6.0 ¹

Distillation

Yield on Crude

	Range, °C	Volume %	
C ₁ -C ₄		2.15	Wt% ¹
Naphtha	C ₅	21.45	¹
	to 149		
Kerosene	149	15.2	¹
	to 232		
Gas Oil	232	21.3	¹
	to 342		
Residuum	> 342	39.3	¹

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 0.35 ¹

Non-Metal Content

Sulphur (Weight %)

0.73 ¹

References

¹ Aalund 83b

Brent Blend Crude Oil

U.K., North Sea

Contributors in early 1983 included North and South Cormorant, Brent, Dunlin, Thistle, and Murchison (Aalund 83b). Collected at South Cormorant platform and transferred by pipeline to Sullom Voe, Shetland Islands (Corbett 90a).

Mass and Weight

API Gravity (15/15°C)

38.0 1

37.88 3

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)

20 5.67 2

6.14 3

37.8 3.64 2

Pour Point (°C)

-15 2

-9 3

Distillation

Yield on Crude

	Range, °C	Weight %	Volume %
Naphtha	C ₅	21.67 3	24.5 2
	to 165		24.64 3
Heavy Naphtha	165	4.19 3	4.42 3
	to 190		
Gas Oil	190	10.11 3	
	to 250		
Gas Oil	250	11.57 3	
	to 310		
Gas Oil	310	11.49 3	
	to 375		
Heavy Gas Oil	375	5.03 3	
	to 420		
Heavy Gas Oil	420	17.7 3	
	to 525		
Residuum	> 525	15.47 3	13.09 3

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 0.26 ²

Wax Content (Weight %)

5.2 ²

Metal Content

Other Metals (ppm)

Vanadium	3.8	²
	6	³
Nickel	0.80	²
	< 2	³
Iron	0.10	²
Sodium	6	³

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

2 ³

Sulphur (Weight %)

0.38 ²
0.37 ³

Salt Content

Salt (g/m³)

NaCl: 24 ³

Other

Acid Number (mg KOH/g)

total: 0.06 ³

References

¹ Aalund 83a

² Aalund 83b

³ Corbett 90a

Brent Crude Oil

U.K., North Sea

This key UK crude is produced pure and is a major component of Brent Blend (Aalund 83b). Aalund 83b results are assay of unblended Brent crude loaded at offshore SPAR (Aalund 83b).

Mass and Weight

API Gravity (15/15°C)

38.2 3

Density (g/mL)

(°C)

0.8340 3

0.833 2

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)

38 4.6 2

40 3.70 3

Pour Point (°C)

-3.0 3

-6.0 2

Distillation

Yield on Crude

	Range, °C	Volume %
C ₁ -C ₄		3.2 1
Gasoline	C ₅	7.5 1
	to 85	
Naphtha	85	17.7 1
	to 165	
Kerosene	165	13.5 1
	to 235	
Gas Oil	235	12.9 1
	to 300	
Gas Oil	300	9.2 1
	to 350	
Residuum	> 350	36.5 1

Hydrocarbon Group

Wax Content (Weight %)

6.5 ³

Metal Content

Other Metals (ppm)

Nickel/Vanadium 2.67 ³

Non-Metal Content

Sulphur (Weight %)

0.26 ³

Other

Reid Vapour Pressure (kPa)

(°C)

37.8

58.6 ³

References

¹ Aalund 83b

² Fina 82

³ MSD 88

Buchan Crude Oil

U.K., North Sea

Mass and Weight**API Gravity (15/15°C)**33.5 2
33.7 1**Density (g/mL)**

(°C)	
Unknown	0.8580 2

Viscosity**Kinematic Viscosity (mm²/sec or cst)**

(°C)	
20	11.8 2 20.37 1

Pour Point (°C)

6.0 2

Distillation**Yield on Crude**

	Range, °C	Volume %	
C ₁ -C ₄		1.5	Wt% 1
Gasoline	C ₅	19.9	1
	to 149		
Kerosene	149	14.45	1
	to 232		
Gas Oil	232	20.55	1
	to 342		
Residuum	> 342	43.25	1

Hydrocarbon Group**Hydrocarbon Group Analysis (Weight %)**

Asphaltenes 2.70 2

Wax Content (Weight %)

4.10 2

Metal Content

Other Metals (ppm)

Nickel/Vanadium 5.78 ²

Non-Metal Content

Sulphur (Weight %)

0.81 ²

0.84 ¹

References

¹ Aalund 83b

² NSD 88

Bunker C Fuel Oil

Fuel Oil No. 6

Mass and Weight

API Gravity (15/15°C)

14.1 2
 10 15
 7.3 21
 15.5 26
 12.3 11

Density (g/mL)

For T between 0 and 30°C:

$$\text{DEN} = 0.97871 - 0.000710 T$$

Where: DEN is density of fresh oil at T (g/mL)

T is oil temperature (°C)

(°C)	Weathering (Volume %)
	0
0	0.969
	to 0.980 9
	0.986 10
	0.980 17
	0.9941 11
5	0.976 17
	0.9904 11
10	0.973 17
	0.963 9
	0.9867 11
15	0.974 10
	0.969 17
	0.9830 11
15.6	0.959
	to 0.972 9
	0.9710 2
	0.963 26
20	0.956
	to 0.970 9
	0.966 17
	0.9788 11
	0.9483 (estimated) 7
25	0.964 17
	0.9749 11
30	0.950
	to 0.964 9
	0.9718 11

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)	
	0	
0	73500000	24
	1400000	11
10	28700000	24
15	48000	11
20	5980000	24
25	3180	17
50	545	26

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)	
	0	
10	> 1000	9
20	> 500	9
40	> 130	9
55	90	
	to 2000	9
60	65	
	to 1000	9
70	65	
	to 360	9
80	65	
	to 180	9

Note: Data obtained from a graph

Pour Point (°C)

-4	
to 13	7
2	15
< 16	9
-1	26
15	11
6	17
7	24

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	
0	N/M	11
15	N/M	11
Room Temp.	27	24
	25 (estimated)	7

Oil-Seawater (mN/M of dynes/cm)

(°C)	
	N/M 11

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)	
	0	
0	N/M	11
15	N/M	11
Room Temp.	39.82	24
	50 (estimated)	7

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)	
	0	
0	0.1	10
	0	11
15	0	10
	0	11

Bunker C from the Arrow incident formed stable emulsions. (Yuen 70)

Emulsion Stability

(°C)	Weathering (Volume %)	
	0	
0	0.2	10
	0	11
15	0.1	10
	0	11

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)	
	0	
0	N/A	11
15	N/A	11

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	0	12
Dasic	0	12
EN 700	0	12
CRX-8	5	12

Natural Dispersibility (% Dispersed)

(°C)
15 0 16

Fire and Reactivity

Flash Point (°C)

> 110	10
66	20
60. MIN	4
174	24
80	15
> 66	9
99	26
98	11
> 65.5	7

Fire Point (°C)

> 257	24
164	26

Auto Ignition Temperature (°C)

408	20
407	9

Combustion Results

Relatively long ignition time (1.9 min)
26.4 Vol% residue (Twardus 80)

Flammability Limits (Volume %)

in air	1
	to 5 7

Distillation
Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	324 11	115 24
		151 2
5	391 11	78 11
		222 2
10	414 11	126 11
		310 24
		248 2
15	422 11	166 11
		259 2
20	427 11	199 11
		335 24
		267 2
25	428 11	217 11
		272 2
30	432 11	225 11
		345 24
		277 2
35	435 11	231 11
		282 2
40	438 11	233 11
		350 24
		286 2
45	440 11	234 11
		293 2
50	441 11	235 11
		355 24
		299 2
55	445 11	235 11
		304 2
60	448 11	235 11
		367 24
		312 2
65	449 11	235 11
		318 2
70		235 11
		370 24
75		326 2
		375 24
80		333 2
85		344 2
90		357 2
95		387 2
FBP		417 2
		441 2

Initial Boiling Point (°C)

180
to 500 15

Final Boiling Point (°C)

212
to >> 588 7
400 20

Solubility

Aqueous Solubility (mg/L)

		20 °C	22 °C
Seawater	2.29 18	6.3 1	
Distilled Water	1.7 19		0.4 23
Fresh Water	4.45 18		

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	21.1 21
	21.1 3
	20.98 25
	15 9
	24.4 17
Aromatics	21.1 8
	34.2 21
	34.2 3
	33.83 25
	25 9
Polars	54.6 17
	34.2 8
	30.3 21
	30.3 3
	7.39 25
Asphaltenes	15 9
	14.9 17
	30.3 8
	14.4 21
	14.4 3
Naphthenes	6.17 17
	9.28 26
	14.4 8
	6.73 12
	6.5 13
	45 9

Wax Content (Weight %)

11.7 13
55.4 17

Toxicity

Toxicity (mg/L)

	48h TL _m
Juvenile American shad	2400 #1 7 2417 #2 7
1. Freshwater	
2. Saltwater	

Acute Toxicity of Water Soluble Fraction (mg/L)

	24h LC ₅₀	48h EC ₅₀	48h LC ₅₀	96h LC ₅₀
Daphnia Magna		0.37 5 4.14 18	> 0.4 5 > 4.45 18	
Artemia spp.		> 0.32 5 > 2.29 18	> 0.32 5 > 2.29 18	
POLYCHAETA:				
Neanthes Arenaceodentata	> 6.3 22		4.6 22	3.6 22
Capitella Capitata	> 6.3 22		1.1 22	0.9 22
CRUSTACEA:				
Mysidopsis Almyra	6.3 1		0.9 1	
Palaemonetes Pugio	3.2 1		2.8 1	2.6 1
Penaeus Aztecus	3.8 1		3.5 1	1.9 1
FISH:				
Menidia Beryllina	3.6 1		2.7 1	1.9 1
Fundulus Similis	3.8 1		2.3 1	1.7 1
Cyprinodon Variegatus	4.7 1		4.4 1	3.1 1

Note: Results from (Maclean 88) obtained by fluorescence spectroscopy.
Results from (Bobra 88) obtained by purge-and-trap
GC analysis.

Metal Content

Other Metals (ppm)

Nickel	62	2
	89	21
	35	26
	8.6	14
	34.3	6
Vanadium	25	2
	73	21
	272	26
	42	14
	270	6
Molybdenum	< 0.6	14
	272	ppb 6
Potassium	< 1.5	14
Zinc	1.6	14
	1.22	6
Lead	< 3	14
Iron	35	14
	13.2	6
Chromium	< 1.5	14
	440	ppb 6
Magnesium	23.9	14
Copper	1.2	14
	0.60	6
Titanium	< 0.6	14
Barium	< 0.3	14
Cobalt	197	ppb 6
Manganese	149	ppb 6

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

12 26

Nitrogen (Weight %)

0.34 2
 0.94 21
 149 ppb 6

Sulphur (Weight %)

2.40 2
 1.46 21
 2.24 26
 1.5 6

Other

Ash (Weight %)

0.08 26

Reid Vapour Pressure (kPa)

(°C)

37.8

0.689 (estimated) 7

Compositional Analysis

Saturates		
n-Alkanes C ₁₃ +	1.73	8
Isoalkanes	5.0	8
1-Ring Cycloalkanes	3.9	8
2-Ring Cycloalkanes	3.4	8
3-Ring Cycloalkanes	2.9	8
4-Ring Cycloalkanes	2.7	8
5-Ring Cycloalkanes	1.9	8
6-Ring Cycloalkanes	0.4	8
Aromatics		
Benzenes	1.9	8
Indans and Tetralins	2.1	8
Dinaphtheno Benzenes	2.0	8
Methylnaphthalenes	2.6	8
Acenaphthenes	3.1	8
Acenaphthalenes	7.0	8
Phenanthrenes	11.6	8
Pyrenes	1.7	8
Benzothiophenes	1.5	8
Dibenzothiophenes	0.7	8

References

- | | | | |
|----------------|---------------|---------------|---------------|
| 1 Anderson 74 | 2 API 81 | 3 ASTM D 2007 | 4 ASTM D 396 |
| 5 Bobra 88 | 6 Chiang 80 | 7 CHRIS 85 | 8 Clark 77 |
| 9 Curl 77 | 10 EETD 84 | 11 EETD 88 | 12 EETD 89 |
| 13 ESD 91 | 14 ESD 92 | 15 Fingas 79 | 16 Fingas 90a |
| 17 Mackay 82a | 18 MacLean 88 | 19 Murray 84 | 20 OHMTADS 81 |
| 21 Pancirov 74 | 22 Rossi 76 | 23 Suntio 86 | 24 Twardus 80 |
| 25 Waters 82 | 26 Yuen 70 | | |

California Crude Oil (API Gravity:11)

California, U.S.A.

Mass and Weight

API Gravity (15/15°C)

10.3 1

Density (g/mL)

(°C)	Density	Weathering (Volume %)
		0
0	0.9968	1
5	0.9942	1
10	0.9915	1
15	0.9882	1
20	0.9852	1
25	0.9824	1
30	0.9796	1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Dynamic Viscosity	Weathering (Volume %)
		0
0	220000	1
15	34000	1

Pour Point (°C)

0 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Air-Oil	Weathering (Volume %)
		0
0	N/M	1
15	37.0	1

Oil-Seawater (mN/M or dynes/cm)

(°C)	Oil-Seawater	Weathering (Volume %)
		0
0	N/M	1
15	N/M	1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
	0
0	N/M 1
15	N/M 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
	0
0	0 1
15	0 1

Emulsion Stability

(°C)	Weathering (Volume %)
	0
0	0 1
15	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
	0
0	N/A 1
15	N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	0 2
Dasic	0 2
EN 700	0 2
CRX-8	0 2

Natural Dispersibility (% Dispersed)

(°C)	
15	0 5

Fire and Reactivity

Flash Point (°C)

28 1

Distillation

Distillation (°C)

Sample contained approximately 6% water;
distillation could not be properly performed (EETD 88)

Solubility

Aqueous Solubility (mg/L)

	22 °C
Double Distilled Water	11.33 6
Salt Water	9.74 6

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	13.7 6
Aromatics	29.8 6
Polars	31.4 6
Asphaltenes	24.8 6
	18.6 2
	15.9 3

Wax Content (Weight %)

1.2 3

Metal Content

Other Metals (ppm)

Molybdenum		4.0	4
Potassium	<	1.5	4
Zinc	<	0.6	4
Lead		3.0	4
Nickel		106	4
Iron		21.5	4
Chromium		1.5	4
Magnesium		237	4
Vanadium		245	4
Copper	<	0.6	4
Titanium		2.2	4
Barium		1.0	4
Cadmium	<	0.5	4
Selenium		23.3	4
Cobalt	<	1	4
Manganese		0.5	4
Calcium		64	4
Aluminum		5.4	4
Strontium		1.13	4
Tin	<	15	4
Mercury	<	15	4

Non-Metal Content

Sulphur (Weight %)

3.3 1

References

1 EETD 88

5 Fingas 90a

2 EETD 89

6 Mackay 88

3 ESD 91

4 ESD 92

California Crude Oil (API Gravity:15)

California, U.S.A.

Mass and Weight

API Gravity (15/15°C)

13.2 1

Density (g/mL)

(°C)	Weathering (Volume %)
0	0
0	0.9907 1
5	0.9832 1
10	0.9802 1
15	0.9770 1
20	0.9735 1
25	0.9702 1
30	0.9672 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	0
0	31000 1
15	6400 1

Pour Point (°C)

-9 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	N/M 1
15	33.6 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	N/M 1
15	N/M 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
	0
0	N/M 1
15	N/M 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
	0
0	0 1
15	0 1

Emulsion Stability

(°C)	Weathering (Volume %)
	0
0	0 1
15	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
	0
0	N/A 1
15	N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	0 2
Dasic	0 2
EN 700	0 2
CRX-8	0 2

Natural Dispersibility (% Dispersed)

(°C)	
15	0 5

Fire and Reactivity

Flash Point (°C)

12 1

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	159 1	45 1
5	244 1	113 1
10	283 1	135 1
15	330 1	158 1
20	369 1	185 1
25	387 1	203 1
30	399 1	214 1
35	406 1	224 1
40	411 1	232 1
45	415 1	237 1
50	420 1	243 1

Weathering

To = 446.9
T_G = 1141 (EETD 88)

Solubility

Aqueous Solubility (mg/L)

	22 °C
Double Distilled Water	25.7 6
Salt Water	14.7 6

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	13.7 6
Aromatics	36.4 6
Polars	24.1 6
Asphaltenes	25.8 6
	20.1 2
	17.9 3

Wax Content (Weight %)

2.7 3

Metal Content**Other Metals (ppm)**

Molybdenum		5.1	4
Potassium	<	1.5	4
Zinc	<	0.6	4
Lead		3.0	4
Nickel		111	4
Iron		9.1	4
Chromium		1.7	4
Magnesium		8.0	4
Vanadium		266	4
Copper	<	0.6	4
Titanium		2.2	4
Barium		1.0	4

Non-Metal Content**Sulphur (Weight %)**

5.5 1

References

1 EETD 88
5 Fingas 90a

2 EETD 89
6 Mackay 88

3 ESD 91

4 ESD 92

Carpenteria Crude Oil

California

Mass and Weight

API Gravity (15/15°C)

22.9 1

Density (g/mL)

(°C)	Weathering (Volume %)		
	0	10.3	14.9
0	0.9263 1	0.9397 1	0.9589 1
15	0.9155 1	0.9299 1	0.9482 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		
	0	10.3	14.9
0	790 1	13750 #1 1 63273 #2 1	56276 #1 1 61579 #2 1
15	164 1	755 1	3426 1

1. shear rate of 10/s
shear rate of 1/s

2.

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	10.3	14.9
0	853 1	N/A 1	N/A 1
15	180 1	812 1	3613 1

Pour Point (°C)

	Weathering (Volume %)		
	0	10.3	14.9
	-21 1	6 1	12 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		
	0	10.3	14.9
0	30.8 1	N/M 1	N/M 1
15	27.8 1	28.6 1	33.3 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		14.9
	0	10.3	
0	27.5 1	N/M 1	N/M 1
15	23.7 1	21.3 1	30.0 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		14.9
	0	10.3	
0	31.0 1	N/M 1	N/M 1
15	26.0 1	24.7 1	35.5 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		14.9
	0	10.3	
0	0 1	0 1	0 1
15	0 1	0 1	0 1

Emulsion Stability

(°C)	Weathering (Volume %)		14.9
	0	10.3	
0	0 1	0 1	0 1
15	0 1	0 1	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		14.9
	0	10.3	
0	N/A 1	N/A 1	N/A 1
15	N/A 1	N/A 1	N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	0 1
Dasic	0 1
EN 700	0 1
CRX-8	0 1

Carpenteria Crude Oil

Fire and Reactivity

Flash Point (°C)

Weathering	(Volume %)	
0	10.3	14.9
-15 1	54.1 2	> 90 2

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	127 1	51 1
5	197 1	100 1
10	231 1	142 1
15	268 1	177 1
20	305 1	214 1
25	338 1	247 1
30	368 1	268 1
35	394 1	287 1

Weathering

T_G = 816.5

T_O = 419.7 (ESD 91)

Solubility

Aqueous Solubility (mg/L)

Freshwater 11.46 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 9.0 1

Wax Content (Weight %)

7.0 1

Metal Content

Other Metals (ppm)

	Weathering (Volume %)		
	0	10.3	14.9
Molybdenum	< 0.6 2	1.3 2	< 0.6 2
Potassium	< 1.5 2	< 1.5 2	< 1.5 2
Zinc	< 0.6 2	0.9 2	< 0.6 2
Lead	< 3 2	< 4 2	< 3 2
Nickel	48.9 2	58.4 2	65.5 2
Iron	29.5 2	32.4 2	35.9 2
Chromium	< 1.5 2	< 1.5 2	< 1.5
Magnesium	< 1 2	4.1 2	1.4 2
Vanadium	112 2	112 2	148 2
Copper	< 0.6 2	< 0.6 2	< 0.6 2
Titanium	< 0.6 2	0.9 2	< 0.6 2
Barium	< 0.3 2	< 0.3 2	< 0.3 2
Selenium	39 2		
Cobalt	< 1 2		
Manganese	< 0.3 2		
Calcium	170 2		
Aluminum	< 5 2		
Strontium	< 0.2 2		
Cadmium	< 0.5 2		
Tin	< 15 2		
Mercury	< 15 2		

References

1 ESD 91

2 ESD 92

Cat Cracking Feed

Mass and Weight

API Gravity (15/15°C)

23.2 2

Density (g/mL)

(°C)	Weathering (Volume %)	
	0	2.1
0	0.9260 2	0.9271 2
15	0.9139 2	0.9144 2

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)			
	0		2.1	
0	9602	#1 2	11290	#1 2
	49310	#2 2	55390	#2 2
15	780.3	2	938.3	#1 2
			1151	#2 2

#1. Shear rate 10/s

#2. Shear rate 1/s

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)	
	0	2.1
15	853.8 2	

Pour Point (°C)

	Weathering (Volume %)	
	0	2.1
25 2		23 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	2.1
0	N/M 2	N/M 2
15	32.3 2	31.9 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)	
	0	2.1
0	N/M 2	N/M 2
15	27.7 2	26.3 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)	
	0	2.1
0	N/M 2	N/M 2
15	31.5 2	30.5 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)	
	0	2.1
0	0 2	0 2
15	1.0 2	0 2

Emulsion Stability

(°C)	Weathering (Volume %)	
	0	2.1
0	0 2	0 2
15	1.0 2	0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)	
	0	2.1
0	N/A 2	N/A 2
15	46.2 2	N/A 2

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	5 1
Dasic	5 1
EN 700	5 1
CRX-8	10 1

Fire and Reactivity

Flash Point (°C)

> 90 2

Solubility

Aqueous Solubility (mg/L)

Freshwater 0.9 2

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 0.9 2

Wax Content (Weight %)

12.0 2

Metal Content

Other Metals (ppm)

	Weathering (Volume %)	
	0	2.1
Molybdenum	< 0.6 2	< 0.6 2
Potassium	< 1.5 2	< 1.5 2
Zinc	0.9 2	0.6 2
Lead	< 3 2	< 3 2
Nickel	1.8 2	4.7 2
Iron	< 3 2	4.5 2
Chromium	< 1.5 2	< 1.5 2
Magnesium	3.7 2	8.7 2
Vanadium	< 0.6 2	0.6 2
Copper	< 0.6 2	< 0.6 2
Titanium	< 0.6 2	< 0.6 2
Barium	< 0.3 2	0.4 2

References

1 ESD 91

2 ESD 92

Clarified Oil

Cat Cracked Clarified Oil
 Catalytic Cracked Oil
 Decanted Oil

Mass and Weight

Density (g/mL)

(°C)	
20	0.848 ¹

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
15	7.119 ¹
20	5.770 ¹

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
20	6.804 ¹

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	25 (estimated) ¹

Oil-Water (mN/m or dynes/cm)

(°C)	
20	50 (estimated) ¹

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	0.689 (estimated) ¹

References

¹ CHRIS 85

Coal Tar Oil

Mass and Weight

Density (g/mL)

(°C)	
20	0.898 (estimated) ¹

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
15	7.119 (estimated) ¹

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	25 (estimated) ¹

Fire and Reactivity

Flash Point (°C)

15.5
to 25 (C.C.) ¹

Flammability Limits (Volume %)

in air 1.3
to 8 ¹

Distillation

Boiling Range (°C)

106
to 167 ¹

Sensation

Colour

Colourless
to yellow ¹

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	0.689 (estimated) ¹

References

¹ CHRIS 85

Cohasset Crude Oil

Offshore Nova Scotia, Canada

Data for equilibrium liquid of separator flash test.

Mass and Weight

API Gravity (15/15°C)

50.1⁵

Density (g/mL)

(°C)	Weathering (Volume %)		
	0	11.2	25.6
0	0.8002 ¹	0.8149 ¹	0.8469 ¹
15	0.7900 ¹	0.8046 ¹	0.8367 ¹
	0.7789 ⁵		

Relative Molecular Mass

148.2⁵**Viscosity**Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	11.2	25.6
0	2.79 ¹	4.05 ¹	7.23 ¹
15	2.06 ¹	2.7 ¹	4.83 ¹

Pour Point (°C)

	Weathering (Volume %)		
	0	11.2	25.6
-30 ¹	-18 ¹	-12 ¹	

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		
	0	11.2	25.6
0	25.7 ¹	25.4 ¹	27.4 ¹
15	25.6 ¹	25.2 ¹	26.8 ¹

Oil-Seawater (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		
	0	11.2	25.6
0	15.3 ¹	13.1 ¹	12.1 ¹
15	16.5 ¹	12.5 ¹	13.0 ¹

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	11.2	25.6
0	0 1	0 1	0 1
15	0 1	0 1	0 1

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	11.2	25.6
0	0 1	0 1	0 1
15	0 1	0 1	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	11.2	25.6
0	N/A 1	N/A 1	N/A 1
15	N/A 1	N/A 1	N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

EN 700	35 2
Dasic	5 2

Natural Dispersibility (% Dispersed)

(°C)	Weathering (Volume %)			
	0	11.2	25.6	28.1
15	6 4	6 4	5 4	4 4

Fire and Reactivity

Flash Point (°C)

Weathering	(Volume %)	
	11.2	25.6
0	11.2	25.6
32 1	40 1	82 1

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	180 2	87 2
5	190 2	134 2
10	199 2	143 2
15	211 2	157 2
20	221 2	166 2
25	231 2	176 2
30	241 2	187 2
35	251 2	197 2
40	260 2	207 2
45	269 2	215 2
50	276 2	222 2
55	288 2	230 2
60	297 2	233 2
65	306 2	235 2
70	319 2	233 2
75	332 2	220 2

Weathering

$T_0 = 367.8$

$T_G = 195.3$ (ESD 91)

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

	Weathering (Volume %)			
	0	11.2	25.6	28.1
Asphaltenes	0.35 1	0.24 1	0.46 1	0.32 1

Metal Content

Other Metals (ppm)

Molybdenum	0.9 3
Potassium	7.2 3
Zinc	2.6 3
Lead	9.4 3
Nickel	< 1 3
Iron	24.3 3
Chromium	3.9 3
Magnesium	26.9 3
Vanadium	1.9 3
Copper	8.5 3
Titanium	2.0 3
Barium	1.3 3

Other Compositional Analysis

	Mole Fraction	Mass Fraction	Volume Fraction
N ₂	0.0000 5	0.0000 5	0.0000 5
CO ₂	0.0000 5	0.0000 5	0.0000 5
H ₂ S	0.0000 5	0.0000 5	0.0000 5
C ₁	0.0032 5	0.0003 5	0.0009 5
C ₂	0.0007 5	0.0001 5	0.0003 5
C ₃	0.0020 5	0.0006 5	0.0009 5
iC ₄	0.0023 5	0.0009 5	0.0012 5
C ₄	0.0032 5	0.0013 5	0.0017 5
iC ₅	0.0090 5	0.0044 5	0.0055 5
C ₅	0.0108 5	0.0053 5	0.0065 5
C ₆	0.0589 5	0.0337 5	
C ₇	0.0969 5	0.0646 5	
C ₈	0.1288 5	0.0979 5	
C ₉	0.0819 5	0.0699 5	
C ₁₀	0.0894 5	0.0846 5	
C ₁₁	0.0722 5	0.0750 5	
C ₁₂	0.0583 5	0.0661 5	
C ₁₃	0.0529 5	0.0649 5	
C ₁₄	0.0451 5	0.0595 5	
C ₁₅	0.0400 5	0.0565 5	
C ₁₆	0.0285 5	0.0430 5	
C ₁₇	0.0241 5	0.0385 5	
C ₁₈	0.0167 5	0.0282 5	
C ₁₉	0.0132 5	0.0235 5	
C ₂₀	0.0102 5	0.0191 5	
C ₂₁	0.0086 5	0.0170 5	
C ₂₂	0.0070 5	0.0144 5	
C ₂₃	0.0049 5	0.0106 5	
C ₂₄	0.0040 5	0.0091 5	
C ₂₅	0.0032 5	0.0076 5	
C ₂₆	0.0024 5	0.0059 5	
C ₂₇	0.0022 5	0.0056 5	
C ₂₈	0.0014 5	0.0037 5	
C ₂₉	0.0010 5	0.0028 5	
C ₃₀₊	0.0031 5	0.0102 5	
Aromatics			
C ₆ H ₆	0.0014 5	0.0007 5	
C ₇ H ₈	0.0071 5	0.0044 5	
C ₈ H ₁₀	0.0234 5	0.0166 5	
C ₈ H ₁₀	0.0102 5	0.0072 5	
C ₉ H ₁₂	0.0090 5	0.0072 5	
Naphthenes			
C ₅ H ₁₀	0.0037 5	0.0017 5	
C ₆ H ₁₂	0.0073 5	0.0041 5	
C ₆ H ₁₂	0.0054 5	0.0030 5	
C ₇ H ₁₄	0.0464 5	0.0303 5	

References

1 EETD 89

2 ESD 91

3 ESD 92

4 Fingas 90a

5 PetroCan 88

Cold Lake Bitumen

Alberta, Canada

From Esso Resources Canada

Mass and Weight

API Gravity (15/15°C)

9.8 1

Density (g/mL)

(°C)	Weathering (Volume %)
	0
0	1.0075 1
5	1.0049 1
10	1.0023 1
15	1.0002 1
20	0.9968 1
25	0.9943 1
30	0.9916 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
0	> 3000000 1
15	235000 1

Pour Point (°C)

9 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
	0
0	0 1
15	0 1

Emulsion Stability

(°C)	Weathering (Volume %)
	0
0	0 1
15	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
	0
0	N/A 1
15	N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C9527	0 2
Dasic	0 2
EN 700	0 2
CRX-8	0 2

Natural Dispersibility (% Dispersed)

(°C)	
15	0 5

Fire and Reactivity

Flash Point (°C)

81 1

Solubility

Aqueous Solubility (mg/L)

	22 °C
Double Distilled Water	0.26 6
Seawater	0.13 6

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	16.6 6
Aromatics	39.2 6
Polars	24.9 6
Asphaltenes	19.3 6
	11.9 2
	12.9 3

Wax Content (Weight %)

2.2 3

Metal Content**Other Metals (ppm)**

Molybdenum		3.7	4
Potassium	<	1.5	4
Zinc		4.3	4
Lead	<	3	4
Nickel		69	4
Iron		15.2	4
Chromium	<	1.5	4
Magnesium		9.0	4
Vanadium		190	4
Copper	<	0.6	4
Titanium	<	0.6	4
Barium	<	0.3	4
Cadmium	<	0.5	4
Selenium	<	15	4
Cobalt	<	1	4
Manganese		0.5	4
Calcium		111	4
Aluminum		6.3	4
Strontium	<	0.2	4
Tin	<	15	4
Mercury	<	15	4

Non-Metal Content**Sulphur (Weight %)**

6.9 1

References

1 EETD 88

5 Fingas 90a

2 EETD 89

6 Mackay 88

3 ESD 91

4 ESD 92

Cold Lake Crude Oil

Alberta, Canada

Mass and Weight

API Gravity (15/15°C)

25.2 2

Density (g/mL)

(°C)	
Unknown	0.9031 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
15	70.7 1

Pour Point (°C)

-60 1

Distillation

Yield on Crude

	Range, °C	Volume %
C ₅ & lighter		7.43 1
Naphtha	20	30.0 1
	to 175	
Distillate	175	10.5 1
	to 295	
Gas Oil	343	18.7 1
	to 517	
Residuum	> 343	51.6 1
Asphalt	> 405	47.8 1
Asphalt	> 470	37.7 1

Non-Metal Content

Nitrogen (Weight %)

0.29 1

Sulphur (Weight %)

2.91 1

References

1 Aalund 83a

2 NSD 88

Cold Lake Dilbit

Alberta, Canada

From Esso Resources Canada. Blend of Cold Lake Bitumen and Diluent.

Mass and Weight

API Gravity (15/15°C)

22.6 1

Density (g/mL)

(°C)	Weathering (Volume %)
0	0
0	0.9273 1
15	0.9172 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	0
0	425 1
15	150 1

Pour Point (°C)

-45 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	29.2 1
15	27.1 1

Oil-Seawater (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	28.1 1
15	16.3 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	28.3 1
15	21.7 1

Emulsion**Emulsion Formation Tendency**

(°C)	Weathering (Volume %)
0	0
0	1.0 1
15	1.0 1

Emulsion Stability

(°C)	Weathering (Volume %)
0	0
0	1.0 1
15	1.0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	0
0	65 1
15	71 1

Fire and Reactivity**Flash Point (°C)**

< -35 1

Distillation**Distillation (°C)**

(Vol%)	Liquid Temp	Vapour Temp
IBP	78 1	29 1
5	127 1	41 1
10	189 1	60 1
15	276 1	72 1
20	353 1	145 1
25	391 1	198 1
30	409 1	222 1
35	419 1	234 1
40	426 1	249 1
45	435 1	260 1
50	439 1	262 1
55	443 1	263 1
60	445 1	263 1

Cold Lake Dilbit

Weathering

T_O = 332.5

T_G = 1423 (EETD 88)

Solubility

Aqueous Solubility (mg/L)

Distilled Water $\frac{25 \text{ }^{\circ}\text{C}}{28.2 \text{ }^1}$

Non-Metal Content

Sulphur (Weight %)

4.72 ¹

References

¹ EETD 88

Cold Lake Diluent

Alberta, Canada

From Esso Resources Canada. Diluent used in Cold Lake Dilbit.

Mass and Weight

API Gravity (15/15°C)

69.3 1

Density (g/mL)

(°C)	Weathering (Volume %)
0	0
0	0.7162 1
15	0.7040 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	0
0	0.66 1
15	0.62 1

Pour Point (°C)

< -75 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	20.0 1
15	19.9 1

Oil-Seawater (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	7.5 1
15	6.8 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	8.3 1
15	8.3 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
0	0 1
15	0 1

Emulsion Stability

(°C)	Weathering (Volume %)
0	0 1
15	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	N/A 1
15	N/A 1

Fire and Reactivity

Flash Point (°C)

< -35 1

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	47 1	23 1
5	55 1	42 1
10	60 1	45 1
15	65 1	48 1
20	70 1	49 1
25	77 1	49 1
30	85 1	49 1
35	93 1	52 1
40	103 1	56 1
45	113 1	68 1
50	121 1	73 1
55	131 1	77 1
60	144 1	89 1
65	162 1	97 1
70	190 1	101 1

Weathering

T_O = 310.1

T_G = 179.5 (EETD 88)

Solubility

Aqueous Solubility (mg/L)

Distilled Water $\frac{25 \text{ }^{\circ}\text{C}}{57.9 \text{ l}}$

Non-Metal Content

Sulphur (Weight %)

0.25 l

References

¹ EETD 88

Cook Inlet Crude Oil

Cook Inlet, Alaska

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	96h LC ₅₀ (aromatics)
FISH:	
<i>Clupea Pallasii</i>	1.22 1
<i>Salvelinus Malna</i>	1.55 1
<i>Oncorhynchus Gorbuscha</i>	1.69 1
<i>Theragra Chalcogrammus</i>	1.73 1
<i>Aulorhynchus Flavidae</i>	2.55 1
<i>Myoxocephalus Polyacanthcephalus</i>	3.96 1
<i>Platichthys Stellatus</i>	> 5.34 1
<i>Pholis Laeta</i>	> 11.72 1
<i>Anoplarchus Purpurescens</i>	> 11.72 1
CRUSTACEANS:	
<i>Crangon alaskensis</i>	0.87 1
<i>Pandalus Goniurus</i>	1.79 1
<i>Eualus Suckleyi</i>	1.86 1
<i>Pandalus Borealis</i>	4.94 1
<i>Paralithodes Camtschatica</i>	3.69 1
<i>Hemigrapsis Nudus</i>	8.45 1
<i>Pagurus Hirsuticulus</i>	> 10.58 1
<i>Oechomene Pinguis</i>	> 7.98 1
<i>Acanthomysis Pseudomacropsis</i>	> 9.02 1
ECHINODERMS:	
<i>Cucumaria Vega</i>	> 6.84 1
<i>Strongylocentrotus Drobachiensis</i>	> 10.58 1
<i>Leptasterias Hexactis</i>	> 10.58 1
<i>Eupentacta Quinquesimita</i>	> 12.29 1
MOLLUSKS:	
<i>Chlamys Hericus</i>	3.94 1
<i>Mytilus Edulis</i>	> 8.97 1
<i>Protothaca Staminea</i>	> 6.84 1
<i>Collisella Scutum</i>	8.18 1
<i>Notoacmaea Pelta</i>	> 8.46 1
<i>Latharina Tunicata</i>	> 8.46 1
<i>Tonicella Lineata</i>	> 8.46 1
<i>Mopalia Cilliata</i>	> 8.46 1
<i>Margarites Pupillus</i>	> 8.46 1
<i>Littorina Sitkana</i>	> 8.46 1
<i>Thais Lima</i>	> 8.46 1
<i>Colus Halli</i>	> 8.46 1
<i>Neptunea Lyrata</i>	> 10.58 1
ANNELIDS:	
<i>Nereis Vexillosa</i>	> 10.58 1
<i>Harmothoe Imbricata</i>	> 10.58 1
NEMERTEANS:	
<i>Paranemertes Peregrina</i>	> 10.58 1
<i>Lineus Nevetus</i>	> 10.58 1

References

¹ Rice 79

Cutting Oil

#7020, 7021, 7022, 7023, 7024 (Crown Industrial)

#400, 500, 681, 291, 341 (Sunoco)

Fire and Reactivity**Flash Point (°C)**

341	> 150	3
291	> 150	3
400	> 149	4
500	> 178	3
681	> 149	3
7020	< -6.7	2
7021	135	1
7022	135	1
7023	135	1
7024	135	1

Flammability Limits (Volume %)

	LEL	VEL
in air # 7020	1.8 1	9.5 1
in air # 7021	1.0 1	6.0 1
in air # 7022	1.0 1	6.0 1
in air # 7023	1.0 1	6.0 1
in air # 7024	1.0 1	6.0 1

Distillation**Final Boiling Point (°C)**

7021	> 260	1
7022	> 260	1
7023	> 260	1
7024	> 260	1

Metal Content**Other Metals (ppm)**

4

Non-Metal Content**Sulphur (Weight %)**

#400	1.7	3
#291	1.2	3

Cutting Oil

Chlorine Content (weight %)

#400	1	3
#500	10.5	3
#291	1.3	3

Sensation

Colour

341	Dark fluid	3
400	Dark fluid	3
500	Dark fluid	3
7020	Brown liquid	2
7021	Brown fluid	1
7022	Brown fluid	1
7023	Brown fluid	1
7024	Brown Fluid	1

References

¹ Crown Indst. 87

² Crown Indst. 88

³ Sunoco 85

⁴ Sunoco 89

Dan Crude Oil

Denmark, North Sea

Contributor to Gorm Blend

Mass and Weight

API Gravity (15/15°C)

30.4 1

ViscosityKinematic Viscosity (mm²/sec or cSt)

(°C)	
40	8.90 1

Pour Point (°C)

< -45.0 1

Distillation

Yield on Crude

	Range, °C	Volume %
C ₄ & lighter		0.80 1
Light Gasoline	C ₅	5.80 1
	to 93	
Naphtha	93	20.3 1
	to 207	
Light Gas Oil	207	26.6 1
	to 343	
Residuum	> 343	46.5 1

Non-Metal Content

Sulphur (Weight %)

0.34 1

References

1 Aalund 83b

Diesel Fuel Oil

Data from reference (EETD 85) are based on diesel sample purchased from a service station in the summer of 1984.

Grade 1-D: Straight-run fractions including kerosenes to intermediate distillates from mixed-base crudes. Used for mobile service such as trucks, railroads and submarines.

Grade 2-D: Similar to Grade 1-D but with lower volatility. Used for industrial and heavy mobile service.

Grade 4-D: Residual fuel oils blended with more viscous distillates. Used for larger stationary installations (ASTM D 975).

Mass and Weight

API Gravity (15/15°C)

39.4	4
43.2	3
to 35.0 (grade 1-D)	3

Density (g/mL)

(°C)	Weathering (Volume %)	
	0	27.9
0	0.838	4 0.8450 7
15	0.809	0.8350 7
	to 0.849 (grade 1-D)	3
	0.827	4
20	0.868	
	to 0.898 (grade 2-D)	3

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)	
	0	
-1.1	2.8 (1-D)	3
0	3.9	5
	1.3 (grade 1-D)	3
	2.1 (grade 2-D)	3
1.7	1.9 (1-D)	3
15	2.7	5
	1.3 (1-D)	3
	2.1 (2-D)	3

Kinematic Viscosity (mm²/sec or cSt)

(°C)		
15	1.5	
	to 1.6	(grade 1-D) 3
40	1.3	
	to 2.4	(grade 1-D)
	1.9	
	to 4.1	(grade 2-D)
	5.5	
	to 24.0	(grade 4-D) 1

Pour Point (°C)

-20	10
-30	6
-34	(grade 1-D) 3
-17.8	(grade 2-D) 3

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	
0	27.7	4
15	26.0	4
20	23	
	to 32	(grade 1-D) 3

Oil-Seawater (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	
0	28.2	5
15	28.0	5

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)	
	0	
0	30.1	5
15	29.4	5
20	47	3
	to 49	(grade 1-D) 3

Emulsion

Emulsion Formation Tendency

(°C)	Weathering	(Volume %)
	0	27.9
0	0 5	
15	0 5	0 7

Emulsion Stability

(°C)	Weathering	(Volume %)
	0	27.9
0	0 5	
15	0 5	0 7

Water Content of Emulsion (Volume %)

(°C)	Weathering	(Volume %)
	0	27.9
0	N/A 5	
15	N/A 5	N/A 7

Fire and Reactivity

Flash Point (°C)

	55	10
min	38 (grade 1-D)	1
min	52 (grade 2-D)	1
min	55 (grade 4-D)	1
	37.7 (C.C.) (grade 1-D)	3
	51.7 (C.C.) (grade 2-D)	3

Flammability Limits (Volume %)

in air	1.3	
	to 6 (grade 1-D)	3
	1.3	3
	to 6 (grade 2-D)	3

Distillation

Initial Boiling Point (°C)

	180	
	to 360	10

Final Boiling Point (°C)

193	
to 293 (grade 1-D)	3
282	3
to 338 (grade 2-D)	3

Solubility

Aqueous Solubility (mg/L)

		22 °C
Fresh Water	39.1 12	2.8 14
Gulf P20 Diesel in Distilled Water	2.3 13	
Gulf P40 Diesel in Distilled Water	8.3 13	
Seawater	60.4 12	

Hydrocarbon Group

Wax Content (Weight %)

0.6 8

Toxicity

Toxicity (mg/L)

	24h TL _m	LD50
Juvenile American Shad	204 #1 (grade 1-D) 3	
	204 #1 (grade 2-D) 3	
Mallard		20 mg/kg (grade 1-D) 3
1. Saltwater		

Acute Toxicity of Water Soluble Fraction (mg/L)

	48h EC ₅₀	48h LC ₅₀	
Daphnia Magna	4.07 12	7.16	12
	0.29 2	0.57	2
Artemia spp.	21.7 12	23.7	12
	0.80 2	0.88	2
Larval Rainbow Trout		2.43 (C.C.)	11
		2.52 (O.C.)	11

Note: Results from (Maclean 88) obtained by fluorescence spectroscopy.
Results from (Bobra 88) obtained by purge-and-trap GC analysis.

Metal Content

Other Metals (ppm)

Molybdenum	<	0.6	9
Potassium		2.8	9
Zinc		1.2	9
Lead	<	3	9
Nickel	<	1	9
Iron		4.6	9
Chromium	<	1.5	9
Magnesium		12.3	9
Vanadium	<	0.6	9
Copper	<	0.6	9
Titanium	<	0.6	9
Barium	<	0.3	9

Non-Metal Content

Sulphur (Weight %)

	0.10	6
	0.16 (winter diesel)	6
max	0.50 (grade 1-D)	1
max	0.50 (grade 2-D)	1
max	2.00 (grade 4-D)	1

Sensation

Colour

	Light brown (grade 1-D)	3
	Light brown (grade 2-D)	3

Odour Threshold (ppm)

	0.7 (grade 1-D)	3
--	-----------------	---

Other

Reid Vapour Pressure (kPa)

(°C)		
37.8	0.683 (grade 1-D)	3
	4.323 (grade 2-D)	3
38	1.51	8

Cloud Point (°C)

References

- | | | | |
|--------------|--------------|----------------|---------------|
| 1 ASTM D 975 | 2 Bobra 88 | 3 CHRIS 85 | 4 EETD 84 |
| 5 EETD 85 | 6 EETD 86 | 7 EETD 89 | 8 ESD 91 |
| 9 ESD 92 | 10 Fingas 79 | 11 Lockhart 87 | 12 MacLean 88 |
| 13 Murray 84 | 14 Suntio 86 | | |

Distillates: Flashed Feed Stocks

Petroleum Distillate

Mass and Weight

API Gravity (15/15°C)

57.2
to 67.8 1

Density (g/mL)

(°C)
15 0.709
to 0.749 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)
1.7 0.52 1
15 0.44 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)
15 0.59
to 0.62 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)
20 19
to 23 1

Oil-Water (mN/m or dynes/cm)

(°C)
20 49
to 51 1

Fire and Reactivity

Flash Point (°C)

-17.8
to 60.6 (C.C.) 1

Distillation

Boiling Range (°C)

14
to 135¹

Toxicity

Toxicity (mg/L)

	<u>24h TL_m</u>
Juvenile American Shad	90 #1 ¹
	91 #2 ¹

1. Freshwater
2. Seawater

Biological Oxygen Demand (days)

(%)
8 5¹

Sensation

Colour

Colourless¹

Odour Threshold (ppm)

0.25¹

Other

Reid Vapour Pressure (kPa)

(°C)
37.8 11.259¹

References

¹ CHRIS 85

Distillates: Straight run

Distillates: Straight run

Petroleum Distillate
Straight Run Gasoline

Mass and Weight

API Gravity (15/15°C)

62.1 1

Density (g/mL)

(°C)	
16	0.730 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
1.7	0.52 1
15	0.44 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
15	0.60 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	19
	to 23 1

Oil-Water (mN/m or dynes/cm)

(°C)	
20	49
	to 51 1

Fire and Reactivity

Flash Point (°C)

-17.8
to 60.6 (C.C.) 1

Flammability Limits (Volume %)

in air 1.1
to 8.7 1

Distillation

Boiling Range (°C)

14
to 135 1

Toxicity

Toxicity (mg/L)

	<u>24h TL_m</u>
Juvenile American Shad	90 #1 1
	91 #2 1

1. Freshwater
2. Saltwater

Biological Oxygen Demand (days)

(%)
8 5 1

Sensation

Colour

Colourless 1

Odour Threshold (ppm)

0.25 1

Other

Reid Vapour Pressure (kPa)

(°C)
37.8 11.259 1

References

1 CHRIS 85

Dos Cuadras Crude Oil

Santa Barbara, California (Offshore)

Mass and Weight

API Gravity (15/15°C)

25.6 2
25.0 1

Density (g/mL)

(°C)	Weathering (Volume %)		20.3
	0	11.2	
0	0.9105 2	0.9380 2	0.9467 2
15	0.9000 2	0.9270 2	0.9359 2

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		20.3
	0	11.2	
0	130 2	709 2	3997 2
15	50.9 2	187 2	741 2

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		20.3
	0	11.2	
0	143 2	756 2	4222 2
15	57.5 2	202 2	764 2
37.8	12.5 1		

Pour Point (°C)

Weathering (Volume %)		20.3
0	11.2	
-30 2	-3 2	6 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		20.3
	0	11.2	
0	28.9 2	30.3 2	N/M 2
15	28.1 2	28.7 2	30.6 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		20.3
	0	11.2	
0	20.2 2	23.4 2	N/M 2
15	21.2 2	22.6 2	21.0 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		20.3
	0	11.2	
0	22.4 2	25.2 2	N/M 2
15	21.6 2	24.1 2	23.1 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		20.3
	0	11.2	
0	0 2	0 2	0 2
15	0 2	0 2	0 2

Emulsion Stability

(°C)	Weathering (Volume %)		20.3
	0	11.2	
0	0 2	0 2	0 2
15	0 2	0 2	0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		20.3
	0	11.2	
0	N/A 2	N/A 2	N/A 2
15	N/A 2	N/A 2	N/A 2

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	10 2
Dasic	0 2
EN 700	5 2
CRX-8	5 2

Fire and Reactivity

Flash Point (°C)

Weathering		(Volume %)	
0		11.2	20.3
< -30	2	53.2	3
			> 90

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	90.6 2	28.3 2
5	194 2	110 2
10	228 2	135 2
15	264 2	172 2
20	295 2	197 2
25	324 2	226 2
30	352 2	253 2
35	378 2	271 2
40	400 2	289 2
45	415 2	298 2
50	426 2	312 2

Weathering

T_G = 788.8

T_O = 416.5 (ESD 91)

Solubility

Aqueous Solubility (mg/L)

Freshwater 11.99 2

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 4.4 2

Wax Content (Weight %)

5.8 2

Metal Content

Other Metals (ppm)

	Weathering (Volume %)		
	0	11.7	20.3
Molybdenum	< 0.6 2	< 0.6 2	< 0.6 2
Potassium	< 1.5 2	< 1.5 2	< 1.5 2
Zinc	< 0.6 2	< 0.6 2	0.9 2
Lead	< 3 2	< 3 2	< 3 2
Nickel	62 2	51 2	61 2
Iron	42.1 2	42.3 2	46.5 2
Chromium	< 1.5 2	< 1.5 2	< 1.5 2
Magnesium	16 2	1.8 2	7.4 2
Vanadium	70.5 2	63.9 2	74 2
Copper	< 0.6 2	< 0.6 2	< 0.6 2
Titanium	< 0.6 2	< 0.6 2	0.7 2
Barium	< 0.3 2	< 0.3 2	< 0.3 2
Selenium			< 15 2
Cobalt			2.1 2
Manganese			< 0.3 2
Calcium			85.4 2
Aluminum			< 5 2
Strontium			< 0.2 2
Cadmium			< 0.5 2
Tin			< 15 2
Mercury			< 15 2

Non-Metal Content

Nitrogen (Weight %)

0.477 1

Sulphur (Weight %)

1.14 1

Sensation

Colour

Brownish black 1

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	32.06 2

References

1 Coleman 78

2 ESD 91

3 ESD 92

Dunlin Crude Oil

U.K., North Sea

Contributor to the Brent system at Sullom Voe, Shetland Islands.

Mass and Weight

API Gravity (15/15°C)

34.9 3

Density (g/mL)

(°C)	
Unknown	0.8500 3
	0.8500 2

ViscosityKinematic Viscosity (mm²/sec or cSt)

(°C)	
38.0	5.3 2
40.0	4.9 3

Pour Point (°C)

6.0 3
3.0 2**Distillation**

Yield on Crude

	Range, °C	Volume %
C ₁ -C ₄		2.3 1
Gasoline	C ₅	6.8 1
	to 85	
Naphtha	85	15.2 1
	to 165	
Kerosene	165	11.8 1
	to 235	
Gas Oil	235	13.0 1
	to 300	
Gas Oil	300	10.0 1
	to 350	
Residuum	> 350	41.2 1

Hydrocarbon Group

Wax Content (Weight %)

4.30 ³

5.0 ¹

Metal Content

Other Metals (ppm)

Nickel/Vanadium 2.50 ³

Non-Metal Content

Sulphur (Weight %)

0.39 ³

References

¹ Aalund 83b

² Fina 82

³ NSD 88

East Texas Crude Oil

Texas, U.S.A.

Mass and Weight

API Gravity (15/15°C)

38.0 2
37.4 1

Density (g/mL)

(°C)	
Unknown	0.8350 2
	0.838 1

ViscosityKinematic Viscosity (mm²/sec or cSt)

(°C)	
37.8	4.2 1
38.0	4.30 2

Pour Point (°C)

6.7 1

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

6.1 1

Sulphur (Weight %)

2.50 2
0.25 1**Sensation**

Colour

Brownish black 1

References

1 Bland 67

2 NSD 88

Ekofisk Crude Oil

Norway, North Sea

Phillips Petroleum.

Mass and Weight

API Gravity (15/15°C)

35.6 5
43.4 1
40.0 3

Density (g/mL)

(°C)	Weathering (Volume %)			
	0	25.6	37.4	48.2
15	0.847 5			
	0.8060 6			
	0.808 4			
15.5		0.8242 3	0.8652 3	0.8821 3
				0.8991 3

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)			
	0	25.6	37.4	48.2
13	9 3	24 3	63 3	206 3

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
20	3.00 6
38	2.4 4
50	4.25 5

Pour Point (°C)

	Weathering (Volume %)			
	0	25.6	37.4	48.2
-5 5		15 3	21 3	27 3
-12 1				
-16 6				
-12 4				
-4 4				
-3 3				

Interfacial Tensions

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		
	0	25.6	37.4
13	24 3	24 3	23 3
			48.2
			29 3

Emulsion

Emulsion Formation Tendency

Forms emulsions with relatively high stability. (Daling 91)

Dispersibility

Chemical Dispersibility (% Dispersed)

Medium dispersibility with Finasol OSR-5 (Daling 91)

Fire and Reactivity

Flash Point (°C)

Weathering (Volume %)	
25.6	37.4
46 3	85 3
	133 3
	48.2

Distillation

Distillation (°C)

7	5
	to 100 2
11.1	100
	to 160 2
15.1	160
	to 250 2
19	250
	to 350 2
47.8	> 350 2

Yield on Crude

	Range, °C	Volume %
C ₁ -C ₅		6.43 1
Gasoline	IBP	11.9 1
	to 80	
Naphtha	80	20.2 1
	to 150	
Gas Oil	150	37.3 1
	to 375	
Heavy Gas Oil	375	13.2 1
	to 525	

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

	Weathering (Volume %)				
	0	25.6	37.4	48.2	
Saturates					49.3 Vol% ³
Aromatics					41.2 Vol% ³
Polars					8.1 Vol% ³
Asphaltenes	0.03	2			1.3 Vol% ³
Asphaltenes "Hard"	0.08 Vol% ³	0.11 Vol% ³	0.13 Vol% ³	0.15 Vol% ³	
Asphaltenes "Soft"	0.67 Vol% ³	0.86 Vol% ³	1.00 Vol% ³	1.18 Vol% ³	

Wax Content (Weight %)

	Weathering (Volume %)							
	0	25.6	37.4	48.2				
	6.5	5	6.05	3	7.01	3	8.28	3
	4.5	6						
	4.69	3						

Non-Metal Content

Sulphur (Weight %)

	0.18	5
	0.14	1
	0.21	6

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	34.5 1
	52.4 6

References

¹ Aalund 83b
⁵ HMSO 76

² Cormack 78
⁶ MSD 88

³ Daling 91

⁴ Fina 82

Electrical Insulating Oil (Used)

Sample obtained from Ontario Hydro. Naphthenic-based oil used in electrical transformers, circuit breakers and other kinds of electrical equipment.

Mass and Weight

API Gravity (15/15°C)

31.5 1

Density (g/mL)

(°C)	Weathering (Volume %)
0	0
0	0.8779 1
15	0.8673 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	0
0	35.8 1
15	18.1 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
0	0
0	40.8 1
15	20.9 1

Pour Point (°C)

< -34 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	30.6 1
15	29.5 1

Oil-Seawater (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	23.9 1
15	16.7 1

Electrical Insulating Oil (Used)

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	24.1 1
15	23.6 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
0	0
0	0 1
15	0 1

Emulsion Stability

(°C)	Weathering (Volume %)
0	0
0	0 1
15	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	0
0	N/A 1
15	N/A 1

Fire and Reactivity

Flash Point (°C)

> 110 1

Distillation

Weathering

Insulating oil did not weather when stripped by air at room temperature. (EETD 85)

Solubility

Aqueous Solubility (mg/L)

Freshwater 0.27 3

Metal Content

Other Metals (ppm)

Molybdenum	<	0.6	4
Potassium	<	1.5	4
Zinc		2.4	4
Lead	<	4	4
Nickel	<	1	4
Iron		32	4
Chromium	<	1.5	4
Magnesium		8.7	4
Vanadium	<	0.6	4
Copper	<	0.6	4
Titanium	<	0.6	4
Barium	<	0.3	4

Non-Metal Content

Sulphur (Weight %)

0.10 2

References

1 EETD 85

2 EETD 86

3 ESD 91

4 ESD 92

Electrical Insulating Oil (Virgin)

Insulating Oil
PetroCan Transformer Oil C-50
Petroleum Insulating Oil
Transformer Oil
Transformer Oil 10

Sample obtained from Ontario Hydro. Naphthenic-based oil for use in electrical transformers, circuit breakers and other kinds of electrical equipment.

A mixture of saturated and unsaturated hydrocarbons derives from naphthenic distillate and additives. (MSDS 90)

Mass and Weight

API Gravity (15/15°C)

31.6 6
28.8 3
27.3 1

Density (g/mL)

(°C)	Weathering (Volume %)
0	0
0	0.8922 3
15	0.8818 3
	0.8666 6
	0.8902 1
	0.87 7
	0.87 9

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	0
0	37.8 3
15	18.8 3

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
0	0
-45	5000 6
-40	2000 6
-30	600 6
0	42.4 3
	50 6
15	21.3 3
40	8.0 2
	7.5 7
	7.5 9
100	2.2 6

Pour Point (°C)

< -34 3
 -51 6
 -59 1
 -51 7
 -51 9

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	30.2 3
15	29.6 3
25	49 1

Oil-Seawater (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	17.7 3
15	14.2 3

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	20.2 3
15	19.8 3
25	49 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
0	0
0	0 3
15	0 3

Emulsion Stability

(°C)	Weathering (Volume %)
0	0
0	0 3
15	0 3

Electrical Insulating Oil (Virgin)

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
	0
0	N/A 3
15	N/A 3

Fire and Reactivity

Flash Point (°C)

> 110	3
151	6
146 (O.C.)	1
144 (O.C.)	7
144 (O.C.)	9

Fire Point (°C)

177 6

Distillation

Distillation (°C)

(Vol%)	
10	278 6
20	297 6
50	336 6
90	390 6
95	404 6

Boiling Range (°C)

229	7
to 444	7
229	9
to 444	9

Weathering

Insulating oil did not weather when stripped by air at room temperature. (EETD 85)

Solubility

Air Solubility (Volume %)

15.6 9.8 6

Toxicity

Occupational Exposure Limit (mg/m³)

Metal Content

Other Metals (ppm)

Molybdenum	0.8	5
Potassium	< 1.5	5
Zinc	< 0.6	5
Lead	< 4	5
Nickel	< 1	5
Iron	92.4	5
Chromium	< 1.5	5
Magnesium	6.7	5
Vanadium	< 0.6	5
Copper	< 0.6	5
Titanium	< 0.6	5
Barium	0.3	5

Non-Metal Content

Sulphur (Weight %)

0.15	6
0.08	4

Sensation

Colour

Colourless	
to light brown	1
0.5	6
Yellow oil	8

Other

Acid Number (mg KOH/g)

NIL 6

Reid Vapour Pressure (kPa)

(°C)			
37.8	0.689	(estimated)	1
40	3	microns	6
100	350	microns	6
150	5	mm	6
200	45	mm	6

Water Saturation Levels (ppm)

0	16
10	27
15	35
20	45
25	56 6

Aniline Point (°C)

81 6

References

- | | | | |
|---------------|-----------|-----------|-----------|
| 1 CHRIS 85 | 2 EETD 84 | 3 EETD 85 | 4 EETD 86 |
| 5 ESD 92 | 6 Esso 84 | 7 Esso 90 | 8 MSDS 90 |
| 9 PetroCan 90 | | | |

Electrical Lubricating Oil (Used)

Sample obtained from Ontario Hydro. Lube 27 is used in hydraulic turbine and governor systems of hydraulic generating stations.

Mass and Weight

API Gravity (15/15°C)

30.5 1

Density (g/mL)

(°C)	Weathering (Volume %)
0	0
0	0.8834 1
15	0.8737 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	0
0	359 1
15	145 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
0	0
0	406 1
15	176 1

Pour Point (°C)

-27 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	31.9 1
15	31.0 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	21.8 1
15	11.4 1

Electrical Lubricating Oil (Used)

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	24.4 1
15	22.0 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
0	0
0	0 1
15	0 1

Emulsion Stability

(°C)	Weathering (Volume %)
0	0
0	0 1
15	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	0
0	N/A 1
15	N/A 1

Fire and Reactivity

Flash Point (°C)

> 110 1

Distillation

Weathering

Lube 27 did not weather when stripped by air at room temperature.
(EETD85)

Non-Metal Content

Sulphur (Weight %)

0.43 2

References

1 EETD 85

2 EETD 86

Electrical Lubricating Oil (Virgin)

Sample obtained from Ontario Hydro. Lube 27 is used in hydraulic turbine and governor systems of hydraulic generating stations.

Mass and Weight

API Gravity (15/15°C)

30.5 1

Density (g/mL)

(°C)	Weathering (Volume %)
0	0
0	0.8820 1
15	0.8727 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	0
0	350 1
15	144 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
0	0
0	396.8 1
15	165 1

Pour Point (°C)

-24 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	32.8 1
15	31.2 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	19.0 1
15	13.6 1

Electrical Lubricating Oil (Virgin)

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
0	22.3 1
15	19.4 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
0	0 1
15	0 1

Emulsion Stability

(°C)	Weathering (Volume %)
0	0 1
15	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	N/A 1
15	N/A 1

Fire and Reactivity

Flash Point (°C)

> 110 1

Distillation

Weathering

Lube 27 did not weather when stripped by air at room temperature.
(EETD85)

Non-Metal Content

Sulphur (Weight %)

0.43 2

References

1 EETD 85

2 EETD 86

Empire Crude Oil
 Heavy Louisiana Sweet Crude
 Louisiana, U.S.A

Mass and Weight

API Gravity (15/15°C)

33.9 2

Density (g/mL)

(°C)	Weathering (Volume %)		20.3
	0	10.1	
0	0.8664 2	0.8831 2	0.8953 2
15	0.8554 2	0.8721 2	0.8839 2

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		20.3
	0	10.1	
0	20.99 2	43.39 2	110.7 2
15	11.10 2	19.97 2	41.82 2

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		20.3
	0	10.1	
0	24.23 2	49.13 2	123.6 2
15	12.98 2	22.90 2	47.31 2

Pour Point (°C)

Weathering (Volume %)		20.3
0	10.1	
-41 2	-9 2	-1 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	20.3
0	27.5 2	30.1 2
15	24.4 2	28.7 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)	
	0	20.3
0	18.5 2	19.4 2
15	15.9 2	16.7 2

Empire Crude Oil

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)	
	0	20.3
0	21.8 2	23.0 2
15	18.7 2	20.6 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	10.1	20.3
0	0 2		1.0 2
15	0 2	0 2	0 2

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	10.1	20.3
0	0 2		1.0 2
15	0 2	0 2	0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	10.1	20.3
0	N/A 2		57.5 2
15	N/A 2	N/A 2	N/A 2

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	10 1
Dasic	10 1
EN 700	10 1
CRX-8	15 1

Fire and Reactivity

Flash Point (°C)

Weathering	(Volume %)	
	0	20.3
-8.5 2	51.6 2	> 90 2

Solubility

Aqueous Solubility (mg/L)

Freshwater 23.3 2

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 0.4 2

Wax Content (Weight %)

4.9 2

Metal Content

Other Metals (ppm)

Molybdenum	<	0.6	2
Potassium	<	1.5	2
Zinc	<	0.6	2
Lead	<	3	2
Nickel	<	1.5	2
Iron		39.5	2
Chromium	<	1.5	2
Magnesium		17.4	2
Vanadium	<	0.6	2
Copper	<	0.6	2
Titanium		1.5	2
Barium		0.3	2

References

1 ESD 91

2 ESD 92

Endicott Crude Oil

Cook Inlet, Alaska

Mass and Weight

API Gravity (15/15°C)

23.0 1

Density (g/mL)

(°C)	Weathering (Volume %)		12.6
	0	8.4	
0	0.9258 1	0.9436 1	0.9520 1
15	0.9149 1	0.9318 1	0.9401 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		12.6
	0	8.4	
0	501 1	1583 1	2609 1
15	84 1	321 1	682 1

Pour Point (°C)

	Weathering (Volume %)		12.6
	0	8.4	
-5 1	8 1	14 1	

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		12.6
	0	8.4	
0	29.9 1	30.8 1	N/M 1
15	29.1 1	27.7 1	30.9 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		12.6
	0	8.4	
0	26.1 1	29.0 1	N/M 1
15	25.8 1	26.0 1	23.0 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		12.6
	0	8.4	
0	26.2 1	28.7 1	N/M 1
15	25.4 1	24.4 1	25.5 1

Emulsion**Emulsion Formation Tendency**

(°C)	Weathering (Volume %)		
	0	8.4	12.6
0	1.0 1	1.0 1	0 1
15	1.0 1	1.0 1	1.0 1

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	8.4	12.6
0	0 1	0 1	0 1
15	0 1	0 1	1.0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	8.4	12.6
0	N/A 1	N/A 1	N/A 1
15	N/A 1	N/A 1	31.0 1

Dispersibility**Chemical Dispersibility (% Dispersed)**

	Weathering (Volume %)		
	0	8.4	12.6
C 9527	10 1	5 1	5 1
Dasic	5 1	0 1	0 1
EN 700	10 1	5 1	0 1
CRX-8	20 1	5 1	5 1

Natural Dispersibility (% Dispersed)

(°C)	0	8.4	12.6
15	3 4	3 4	2 4

Distillation**Distillation (°C)**

(Vol%)	Liquid Temp	Vapour Temp
IBP	162 1	42 1
5	259 1	82 1
10	309 1	151 1
15	346 1	160 1

Solubility

Aqueous Solubility (mg/L)

Freshwater 27.7 2

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

	Weathering (Volume %)		12.6
	0	8.4	
Asphaltenes	3.16 1	4.00 1	4.46 1
	3.7 2		

Wax Content (Weight %)

8.1 1

Metal Content

Other Metals (ppm)

	Weathering (Volume %)		
	0	12.6	
Molybdenum	1 3	< 0.6 3	
Potassium	< 1.5 3	< 1.5 3	
Zinc	< 0.6 3	< 0.6 3	
Lead	< 3 3	< 3 3	
Nickel	5.4 3	5.2 3	
Iron	< 4 3	< 4 3	
Chromium	< 1.5 3	< 1.5 3	
Magnesium	< 0.6 3	0.6 3	
Vanadium	17.1 3	18.4 3	
Copper	< 0.6 3	< 0.6 3	
Titanium	< 0.6 3	0.6 3	
Barium	< 0.3 3	< 0.3 3	

Non-Metal Content

Sulphur (Weight %)

	Weathering (Volume %)		12.6
	0	8.4	
	1.34 1	1.34 1	1.40 1

Other

Reid Vapour Pressure (kPa)

(°C)

37.8 24.9 1

References

1 EETD 89

2 ESD 91

3 ESD 92

4 Fingas 90a

FCC Heavy Cycle Oil

Mass and Weight

API Gravity (15/15°C)

24.3 2

Density (g/mL)

(°C)	Weathering (Volume %)		9.2
	0	4.2	
0	0.9185 2	0.9213 2	0.9237 2
15	0.9075 2	0.9102 2	0.9127 2

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		9.2
	0	4.2	
0	3.79 2	4.09 2	4.76 2
15	2.51 2	2.64 2	3.73 2

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		9.2
	0	4.2	
0	4.13 2	4.44 2	5.15 2
15	2.77 2	2.90	4.08 2

Pour Point (°C)

Weathering (Volume %)		9.2
0	4.2	
-58 2	-58 2	-55 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	9.2
0	30.8 2	29.7 2
15	31.0 2	30.4 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)	
	0	9.2
0	26.1 2	22.8 2
15	26.2 2	23.6 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)	
	0	9.2
0	26.2 2	26.8 2
15	27.1 2	24.2 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	4.2	9.2
0	0 2		0 2
15	0 2	0 2	0 2

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	4.2	9.2
0	0 2		0 2
15	0 2	0 2	0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	4.2	9.2
0	N/A 2		N/A 2
15	N/A 2	N/A 2	N/A 2

Dispersibility

Chemical Dispersibility (% Dispersed)

EN 700	10 (dyed 102) 1
Dasic	10 (dyed 102) 1

Fire and Reactivity

Flash Point (°C)

Weathering (Volume %)	Flash Point (°C)	
	0	9.2
0	68.7 2	83.3 2
9.2		> 90 2

Solubility

Aqueous Solubility (mg/L)

Freshwater	16.8 2
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Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 0 2

Wax Content (Weight %)

0 2

Metal Content

Other Metals (ppm)

	Weathering (Volume %)	
	0	9.15
Molybdenum	< 0.6 2	< 0.6 2
Potassium	< 1.5 2	< 1.5 2
Zinc	0.4 2	< 0.6 2
Lead	< 3 2	< 3 2
Nickel	< 1 2	< 1 2
Iron	< 4 2	< 3 2
Chromium	< 1.5 2	< 1.5 2
Magnesium	3.8 2	< 1 2
Vanadium	< 0.6 2	< 0.6 2
Copper	< 0.6 2	< 0.6 2
Titanium	< 0.6 2	< 0.6 2
Barium	< 0.3 2	< 0.3 2

References

1 ESD 91

2 ESD 92

Federated Crude Oil

Alberta, Canada

Mass and Weight

API Gravity (15/15°C)

39.7 1

Density (g/mL)

(°C)	Weathering (Volume %)		
	0	14.3	31.4
0	0.8378 1	0.8661 1	0.8860 1
15	0.8258 1	0.8537 1	0.8742 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		
	0	14.3	31.4
0	10.0 1	207 1	40000 1
15	4.5 1	10.7 1	140.7 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	14.3	31.4
0	15.8 1	239.1	N/M 1
15	5.2 1	12.6 1	161 1

Pour Point (°C)

	Weathering (Volume %)		
	0	14.3	31.4
	-9 1	3 1	9 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		
	0	14.3	31.4
0	26.9 1	28.3 1	N/M 1
15	25.7 1	28.0 1	29.5 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		
	0	14.3	31.4
0	22.4 1	23.1 1	N/M 1
15	22.2 1	23.0 1	24.1 1

Federated Crude Oil

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		
	0	14.3	31.4
0	23.6 1	25.9 1	N/M 1
15	23.1 1	24.4 1	24.6 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	14.3	31.4
0	1.0 1	1.0 1	1.0 1
15	0.3 1	1.0 1	1.0 1

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	14.3	31.4
0	1.0 1	1.0 1	1.0 1
15	0.07 1	0.5 1	1.0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	14.3	31.4
0	89.3 1	88.5 1	88.3 1
15	90.0 1	90.0 1	89.8 1

Dispersibility

Natural Dispersibility (% Dispersed)

(°C)	
15	3 5

Fire and Reactivity

Flash Point (°C)

-26 1

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	105 1	28 1
5	145 1	89 1
10	165 1	108 1
15	184 1	118 1
20	203 1	120 1
25	225 1	121 1
30	249 1	124 1
35	274 1	132 1
40	299 1	144 1
45	324 1	159 1
50	350 1	176 1
55	373 1	195 1
60	396 1	215 1
65	414 1	245 1
70	433 1	272 1
75	450 1	304 1
80	464 1	323 1
85	477 1	338 1
90	484 1	345 1

Weathering

T_O = 390.7

T_G = 443.7 (EETD 86)

Solubility

Aqueous Solubility (mg/L)

Freshwater 17.8 3

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	87.1 1
Aromatics	10.9 1
Polars	1.3 1
Asphaltenes	0.7 1
	0.9 2
	1.2 3

Wax Content (Weight %)

6.7 3

Metal Content

Other Metals (ppm)

	Weathering	
	0	
Molybdenum	< 0.6	4
Potassium	< 1.5	4
Zinc	0.4	4
Lead	< 3	4
Nickel	< 1	4
Iron	40.2	4
Chromium	< 1.5	4
Magnesium	11.8	4
Vanadium	1.3	4
Copper	< 0.6	4
Titanium	< 0.6	4
Barium	< 0.3	4
Cadmium	< 0.5	4
Selenium	< 15	4
Cobalt	< 1	4
Manganese	< 0.3	4
Calcium	54.6	4
Aluminum	< 5	4
Strontium	0.25	4
Tin	< 15	4
Mercury	< 15	4

Non-Metal Content

Sulphur (Weight %)

	Weathering (Volume %)	
	0	1
	14.3	31.4
	0.21	0.35

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	29.24

References

1 EETD 86

2 EETD 89

3 ESD 91

4 ESD 92

5 Fingas 90a

Federated Light and Medium Crude Oil

Alberta, Canada

Mass and Weight

API Gravity (15/15°C)

39.7 1

Density (g/mL)

(°C)	
21	0.8258 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
40	42.42 1

Pour Point (°C)

-10 1

Distillation

Yield on Crude

	Range, °C	Volume %
Naphtha	C5	30.90 1
	to 190	
Kerosene	190	18.25 1
	to 277	
Distillate	277	13.73 1
	to 343	
Gas Oil	343	28.29 1
	to 565	
Residuum	> 565	8.83 1

Hydrocarbon Group

Wax Content (Weight %)

9.12 1

Metal Content

Other Metals (ppm)

Nickel	0.07	1
Vanadium	0.00	1

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

1.46 1

Nitrogen (Weight %)

0.11 1

Sulphur (Weight %)

2010 ppm 1

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	31.0 1
	31.0 2

References

1 Aalund 83a

2 NSD 88

Flotta Mix Crude Oil

U.K., North Sea

Flotta is a blend made up of Piper, Claymore, and Tartan crudes.
(Aalund 83b)

Mass and Weight

API Gravity (15/15°C)

35.7 2

Density (g/mL)

(°C)

Unknown	0.8460 2
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Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)

4	30.8 1
40	4.40 2

Pour Point (°C)

-9 2
-6 1

Distillation

Yield on Crude

	Range	Volume
	C1	4.3 1
	to C5	
Naphtha	C5	5.0 1
	to 65	
Naphtha	65	14.9 1
	to 150	
Naphtha	150	5.6 1
	to 180	
Kerosene	180	8.0 1
	to 235	
Gas Oil	235	11.8 1
	to 300	
Gas Oil	300	8.4 1
	to 343	
Residuum	> 343	42.0 1

Hydrocarbon Group

Wax Content (weight %)

5.50 2

Metal Content

Other Metals (ppm)

Nickel/Vanadium 3.29 2

Non-Metal Content

Sulphur (weight %)

1.06 2

1.14 1

Other

Reid Vapour Pressure (kPa)

(°C)

38

62.7 1

References

1 Aalund 83c

2 MSD 88

Forties Crude Oil

U.K., North Sea

British Petroleum

Mass and Weight

API Gravity (15/15°C)

37.35	3
37.4	5
36.6	1

Density (g/mL)

(°C)		
15	0.838	3
16	0.8373	5
Unknown	0.842	2

ViscosityKinematic Viscosity (mm²/sec or cSt)

(°C)		
10	9.6	1
20	6.8	6
21.1	6.81	1
38	4.43	2
	3.7	3
50	3.7	5
	3.7	3

Pour Point (°C)

-1	3
-3	5
-3	1
-13	2

Distillation

Distillation (°C)

7.9	5
	to 100 3
11.7	100
	to 160 3
12.5	160
	to 250 3
21.9	250
	to 350 3
46.0	> 350 3

Yield on Crude

	Range, °C	Volume %	
	C1	2.74	Wt% 1
	to C4		
Naphtha	C5	5.0	1
	to 65		
Naphtha	65	14.9	1
	to 150		
Naphtha	150	5.6	1
	to 180		
Kerosene	180	8.0	1
	to 235		
Gas Oil	235	11.8	1
	to 300		
Gas Oil	300	8.4	1
	to 343		
Residuum	> 343	42.0	1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes	0.2	1
	0.2	4
	0.2	5

Wax Content (Weight %)

9	3
9	5
7	1
3.8	6

Metal Content

Other Metals (ppm)

Nickel	2	1
Vanadium	3	1

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

2.2 1

Sulphur (Weight %)

0.29	3
0.30	1

References

1 Aalund 83c
5 Lynch 81

2 Fina 82
6 NSD 88

3 HMSO 76

4 IP Method 143/90

Fosterton Crude Oil

Canada

Mass and Weight

API Gravity (15/15°C)

24.1 2
22.5 1

Density (g/mL)

(°C)
Unknown 0.9090 2

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
37.8 24.7 1
38 30.0 2

Pour Point (°C)

-9.0 2

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

16.1 1

Sulphur (Weight %)

2.79 2
2.76 1

References

1 Bland 67

2 NSD 88

Fuel Oil No.1 (J.P.-3)

J.P.-3
Jet Fuels

Mass and Weight

Density (g/mL)

(°C)	
20	0.798 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
1.7	1.082 1
15	0.891 1
21.1	0.829 1

Fire and Reactivity

Flash Point (°C)

43.3
to 65.5 1

Distillation

Boiling Range (°C)

30
to 260 1

Toxicity

Toxicity (mg/L)

	24h TL _m
Bluegill	2990 #1 1
1. Freshwater	

Biological Oxygen Demand (days)

(%)	
53	5 1

Sensation

Colour

Colourless
to light brown ¹

Odour Threshold (ppm)

¹ 1

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	45.733 ¹

References

¹ CHRIS 85

Fuel Oil No.1 (J.P.-4)

65% Gasoline, 35% Light Petroleum Distillates (CURL 77).
 U.S. Air Force wide-cut aviation turbine fuel (DUKEK 78).

Mass and Weight

API Gravity (15/15°C)

44.8
 to 56.7 3

Density (g/mL)

(°C)	Weathering (Volume %)	
	0	
0	0.7669	4
15	0.751	
	to 0.802	3
	0.7549	5
20	0.80	app. 6
	0.808	1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)	
	0	
0	1.29	4
1.7	1.08	1
	0.89	1
	0.94	4
15	0.891	1
	0.829	1

Pour Point (°C)

< -48 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	
0	22.7	4
15	22.8	4
20	25	(estimated) 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	9.3 4
15	17.0 4

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	32.8 4
15	36.0 4
20	50 (estimated) 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
0	0
0	0 4
15	0 4

Emulsion Stability

(°C)	Weathering (Volume %)
0	0
0	0 4
15	0 4

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	0
0	N/A 4
15	N/A 4

Fire and Reactivity

Flash Point (°C)

	-23	
to	-1	2
	-23.3	2
to	-1.1	1
	-25	app. 6

Smoke Point (mm)

min 20 3

Auto Ignition Temperature (°C)

242 2

Flammability Limits (Volume %)

in air 1.3
to 8.0 1

Heat Content (MJ/Kg)

min 42.8 3

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	95 4	23 4
5	104 4	84 4
10	110 4	92 4
15	114 4	99 4
20	119 4	102 4
25	123 4	108 4
30	127 4	112 4
35	132 4	117 4
40	137 4	122 4
45	143 4	128 4
50	148 4	133 4
		max 190 3
55	154 4	139 4
60	161 4	146 4
65	168 4	153 4
70	175 4	159 4
75	183 4	166 4
80	194 4	174 4
FBP		max 270 3

Boiling Range (°C)

176
to 287 1

Solubility

Aqueous Solubility (mg/L)

	20 °C
Deionized Water	25.14 8
Seawater	21.41 8

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Aromatics max 25 (Vol%) 3

Toxicity

Toxicity (mg/L)

	96h LC50	Lethal
Bluegill	2 #1,#4 7	
Salmon fingerling	500 #2,#4 7	500 #3 1
Menhaden	16 #1,#5 7	
Mullet	4 #2,#5 7	
Grass Shrimp	100 #1,#5 7	
#1. unspecified cut		
#2. agitated environment		
#3. time period not specified		
#4. Freshwater		
#5. Salt water		

Biological Oxygen Demand (days)

(%)
53 5 1

Metal Content

Other Metals (ppm)

Molybdenum	< 0.6	5
Potassium	< 1.5	5
Zinc	< 0.6	5
Lead	< 3	5
Nickel	< 1	5
Iron	< 3	5
Chromium	< 1.5	5
Magnesium	3.8	5
Vanadium	< 0.6	5
Copper	< 0.6	5
Titanium	< 0.6	5
Barium	< 0.3	5

Non-Metal Content

Sulphur (Weight %)

max 0.4 3
0.04 4

Sensation

Colour

Colourless
to light brown 1

Odour Threshold (ppm)

1 1

Other

Reid Vapour Pressure (kPa)

(°C)

37.8

14

max 21 3

18.5 1

Freezing Point (°C)

max -58 3

< -48 1

References

1 CHRIS 85

5 ESD 92

2 Curt 77

6 Navy 77

3 Dukek 78

7 OHMTADS 81

4 EETD 89

8 Smith 81

Fuel Oil No.1 (J.P.-5)

Kerosene, Heavy

Specially refined kerosene (CURL 77).

A high flash point kerosene (DUKEK 78)

Mass and Weight

API Gravity (15/15°C)

35.8
to 47.9 3
41.1 1

Density (g/mL)

(°C)

15 0.788
to 0.845 3
max 0.844 4
0.819 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)

1.7 3.229 1
15 2.282 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)

-20 max 8.5 3
15 2.786 1

Pour Point (°C)

< -48 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)

20 25 (estimated) 1

Oil-Water (mN/m or dynes/cm)

(°C)

20 20 (estimated) 1

Fire and Reactivity

Flash Point (°C)

	35	
	to 63	2
	min 60	4
	min 60	3
	min 60 (C.C.)	1

Smoke Point (mm)

min 19 3

Auto Ignition Temperature (°C)

246 2

Flammability Limits (Volume %)

in air	0.6	
	to 4.6	1

Heat Content (MJ/Kg)

min 42.6 3

Distillation

Distillation (°C)

	<u>Vapour Temp</u>	
10	max 205	3
FBP	max 290	3

Boiling Range (°C)

176
to 287 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Aromatics	max 25 (Vol%)	3
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Toxicity

Toxicity (mg/L)

	96h LC50	Lethal
Bluegill	2 #1, #4	5
Salmon fingerling	500 #2, #4	5 500 #3 1
Menhaden	16 #1, #5	5
Mullet	4 #1, #5	5
Grass Shrimp	100 #1, #5	5

1. unspecified cut
2. agitated environment
3. time period not specified
4. freshwater
5. salt water

Biological Oxygen Demand (days)

(%)
53 5 1

Non-Metal Content

Sulphur (Weight %)

max 0.4 3

Sensation

Colour

Colourless
to light brown 1

Odour Threshold (ppm)

1 1

Other

Freezing Point (°C)

max -46 3
< -48 1

References

1 CHRIS 85
5 OHMTADS 81

2 Curl 77

3 Dukek 78

4 Navy 77

Fuel Oil No.1 (J.P.-6)

A higher kerosene cut than J.P.-4 with fewer impurities.

Fire and Reactivity

Flash Point (°C)

38 ¹

Auto Ignition Temperature (°C)

224 ¹

References

¹ Curt 77

Fuel Oil No.1 (J.P.-7)

A high flash point special kerosene used in advanced supersonic aircraft(DUKEK 78).

Mass and Weight

API Gravity (15/15°C)

43.9
to 50.0 1

Density (g/mL)

(°C)	
15	0.779
	to 0.806 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
-20	max 8.0 1

Fire and Reactivity

Flash Point (°C)

min 60 1

Smoke Point (mm)

min 35 1

Heat Content (MJ/Kg)

min 43.5 1

Distillation

Distillation (°C)

(Vol%)	Vapour Temp
10	max 196 1
FBP	max 288 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Aromatics max 5 (Vol%) 1

Non-Metal Content

Sulphur (Weight %)

max 0.1 ¹

Other

Freezing Point (°C)

max -43 ¹

References

¹ Dukek 78

Fuel Oil No.1 (J.P.-8)

A kerosene modelled on Jet A-1 which is used in new military aircraft (DUKEK 78).

Mass and Weight

API Gravity (15/15°C)

36.8
to 50.9 1

Density (g/mL)

(°C)	
15	0.775
	to 0.840 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
-20	max 8.0 1

Fire and Reactivity

Flash Point (°C)

min 38 1

Smoke Point (mm)

min 20 1

Heat Content (MJ/Kg)

min 42.8 1

Distillation

Distillation (°C)

(Vol%)	Vapour Temp
10	max 205 1
FBP	max 300 1

Solubility

Aqueous Solubility (mg/L)

	20
Deionized Water	<u>2.00</u> ²
Seawater	1.61 ²

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Aromatics max 25 (Vol%) ¹

Non-Metal Content

Sulphur (Weight %)

max 0.4 ¹

Other

Freezing Point (°C)

max -50 ¹

References

¹ Dukek 78

² Smith 81

Fuel Oil No.1 (Jet Fuel A)

A petroleum distillate blended from kerosene fractions and used in civilaviation. Operational fuel for commercial turboprop and turbojet aircraft in U.S. (Esso73)

Mass and Weight

API Gravity (15/15°C)

36.8
to 50.9 2
42.0 3

Density (g/mL)

(°C)		
15	0.775	2
	to 0.840	2
	0.7753	1
	to 0.8398	1
15.6	0.816	3

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)		
-34.4	7.9	3
-20	max 8.0	2
	max 8.0	1
0	2.1	2
15	1.6	2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

Fire and Reactivity

Flash Point (°C)

min 38 2
min 38 1
46 3

Smoke Point (mm)

min 20 2
min 18 1
23 3

Heat Content (MJ/Kg)

min 42.8 2

Distillation

Distillation (°C)

(Vol%)	Vapour Temp
IBP	163 3
10	max 204 2
	max 204 1
	179 3
20	184 3
50	203 3
90	232 3
FBP	max 300 2
	max 300 1
	259 3

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Aromatics	20 (Vol%) 2
	max 25 (Vol%) 1
	16 (Vol%) 3

Non-Metal Content

Sulphur (Weight %)

max 0.3 2
max 0.3 1
0.05 3

Other

Freezing Point (°C)

max -40 2
max -40 1
-44 3

References

1 ASTM D 1655

2 Dukek 78

3 Esso 73

Fuel Oil No.1 (Jet Fuel A-1)

Jet A-1 Kerosene

Turbo Fuel A-1

A petroleum distillate blended from kerosene fractions and used in civil aviation. Jet A-1 is similar to Jet A except for a lower freezing point. Operational fuel for all turboprop and turbojet aircraft requiring a low freezing point product.

(Esso 73)

Mass and Weight

API Gravity (15/15°C)

44.0 6

Density (g/mL)

(°C)	Weathering (Volume %)
0	0
0	0.8155 3
15	0.8043 3
15.6	0.806 6

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	0 45.5
0	2.11 3 3.10 3
15	1.26 3 2.39 3

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
-34.4	0 7.9 6
0	1.5 2
15	1.2 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	26.5 3
15	26.0 3

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	37.4 3
15	38.4 3

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
	0
0	40.7 3
15	40.4 3

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
	0
0	0 3
15	0 3

Emulsion Stability

(°C)	Weathering (Volume %)
	0
0	0 3
15	0 3

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
	0
0	N/A 3
15	N/A 3

Fire and Reactivity

Flash Point (°C)

42 6

Smoke Point (mm)

26 6

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	184 3	163 6
		139 3
5	188 3	171 3
10	192 3	179 6
		176 3
15	195 3	181 3
20	198 3	184 6
		184 3
25	200 3	187 3
30	203 3	191 3
35	206 3	194 3
40	209 3	197 3
45	213 3	200 3
50	215 3	203 6
		203 3
55	219 3	207 3
60	223 3	210 3
65	227 3	214 3
70	231 3	218 3
75	236 3	223 3
90		232 6
FBP		259 6

Solubility

Aqueous Solubility (mg/L)

Freshwater 8.73 4

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Aromatics 13 (Vol%) 6

Metal Content

Other Metals (ppm)

	Weathering (Volume %)	
	0	45.5
Molybdenum	1.9 5	< 0.6 5
Potassium	< 1.5 5	< 1.5 5
Zinc	2.4 5	0.8 5
Lead	< 3 5	< 3 5
Nickel	< 1 5	< 1 5
Iron	39 5	< 4 5
Chromium	< 1.5 5	< 1.5 5
Magnesium	9.6 5	4.7 5
Vanadium	< 0.6 5	< 0.6 5
Copper	< 0.6 5	< 0.6 5
Titanium	2.7 5	< 0.6 5
Barium	0.3 5	< 0.3 5

Non-Metal Content

Sulphur (Weight %)

0.05 6
0.04 3

Other

Reid Vapour Pressure (kPa)

(°C)
37.8 1.07 4

Freezing Point (°C)

-51 6
-47 1

References

1 ASTM D 1655
5 ESD 92

2 Dukek 78
6 Esso 73

3 EETD 89

4 ESD 91

Fuel Oil No.1 (Jet Fuel B)

Jet B wide-cut

Turbo Fuel B

A wide-boiling-range petroleum distillate blended from gasoline and kerosene fractions. Operational fuel for U.S. and NATO military aircraft and for many commercial turboprop and turbojet aircraft.
(Esso73)

Mass and Weight

API Gravity (15/15°C)

53.8 5
44.8 TO 56.7 1

Density (g/mL)

(°C)	Weathering (Volume %)	
	0	62.5
0	0.7689	2 0.8022 2
15	0.7567	2 0.7915 2
	0.751 TO 0.802	1
15.6	0.764	5

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)	
	0	
0	1.04	2
15	1.02	2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	
0	23.1	2
15	23.0	2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)	
	0	
0	10.8	2
15	10.8	2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering	(Volume %)
	0	
0	10.8	2
15	12.4	2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering	(Volume %)
	0	62.5
0	0	2
15	0	2

Emulsion Stability

(°C)	Weathering	(Volume %)
	0	62.5
0	0	2
15	0	2

Water Content of Emulsion (Volume %)

(°C)	Weathering	(Volume %)
	0	62.5
0	N/A	2
15	N/A	2

Fire and Reactivity

Smoke Point (mm)

min 20 1
29.0 5

Heat Content (MJ/Kg)

MIN, 42.8 1

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	92 2	72 5
		25 2
5	104 2	124 5
		84 2
10	110 2	94 2
15	115 2	99 2
20	120 2	135 5
		104 2
25	124 2	109 2
30	128 2	114 2
35	133 2	118 2
40	137 2	123 2
45	142 2	128 2
50	148 2	159 5
		max 188 1
		134 2
55	153 2	140 2
60	159 2	146 2
65	165 2	152 2
70	171 2	157 2
75	177 2	163 2
90		193 5
FBP		235 5

Solubility

Aqueous Solubility (mg/L)

Freshwater 20.34 3

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Aromatics	20	max	1
	11		5
Olefins	1.0		5

Metal Content

Other Metals (ppm)

	Weathering (Volume %)	
	32	
Molybdenum	< 0.6	4
Potassium	< 1.5	4
Zinc	0.6	4
Lead	< 3	4
Nickel	< 1	4
Iron	13	4
Chromium	< 1.5	4
Magnesium	3.6	4
Vanadium	< 0.6	4
Copper	< 0.6	4
Titanium	< 0.6	4
Barium	< 0.3	4

Non-Metal Content

Sulphur (Weight %)

max 0.3 1
0.04 5

Other

Reid Vapour Pressure (kPa)

(°C)
38 21 max 1

Freezing Point (°C)

-50 max 1
-60 5

References

1 Dukek 78
5 Esso 73

2 EETD 89

3 ESD 91

4 ESD 92

Fuel Oil No.1 (Jet Fuel, J.P.-1)

Kerosene
Kerosene
Range Oil

Mass and Weight

API Gravity (15/15°C)

45.4 1

Density (g/mL)

(°C)	
15	0.799 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
1.7	1.909 1
15	1.322 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
15	1.654 1

Pour Point (°C)

-43
to -49 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	23 to 32 1

Oil-Water (mN/m or dynes/cm)

(°C)	
20	47 to 49 1

Fire and Reactivity

Flash Point (°C)

35
to 63 2
37.8 (C.C.) 1

Auto Ignition Temperature (°C)

229 2

Flammability Limits (Volume %)

in air 0.7
to 5.0 1

Distillation

Boiling Range (°C)

200
to 260 1

Toxicity

Toxicity (mg/L)

Bluegill $\frac{24h TL_m}{2990 \#1}$ 1
1. Freshwater

Biological Oxygen Demand (days)

$\frac{(\%)}{53}$ 5 1

Sensation

Colour

Colourless
to light brown 1

Odour Threshold (ppm)

1 1

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	0.683 1

References

1 CHRIS 85

2 Curt 77

Fuel Oil No.1 (Kerosene)

Kerosine

Mass and Weight

API Gravity (15/15°C)

39.4
to 34.8 3
45.4 2

Density (g/mL)

(°C)	Weathering (Volume %)
	0
0	0.837
	to 0.847 3
15	0.827
	to 0.850 3
	max 0.8495 1
	0.7993 2
20	0.823
	to 0.847 3

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
1.7	1.909 2
15	1.322 2

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
	0
0	3.1
	to 5.0 3
15	2.1
	to 3.5 3
	1.6 2
20	1.9
	to 3.3 3
38	1.4
	to 2.2 1

Pour Point (°C)

-18 3
max -18 1
-45.6 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	23
	to 32 2

Oil-Water (mN/m or dynes/cm)

(°C)	
20	47
	to 49 2

Fire and Reactivity

Flash Point (°C)

	38	
	to 74	3
	min 38	1
	min 37.8 (C.C.)	2

Auto Ignition Temperature (°C)

229 3

Explosion Limits of Vapour in Air

Upper	5.0 % 3
	5.0 % 2
Lower	0.7 % 3
	0.7 % 2

Distillation

Distillation (°C)

10	max 215 1
90	max 288 1

Boiling Range (°C)

	174 3
	to 266 3
	200 2
	to 260 2

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Paraffins	35	3
Naphthenes	60	3
Aromatics	15	3

Toxicity

Toxicity (mg/L)

	<u>24h TL_m</u>
Bluegill	2990 #1 2
1. Freshwater	

Acute Toxicity of Water Soluble Fraction (mg/L)

	<u>48h LC₅₀</u>
Larval Rainbow Trout (freshwater)	1.63 #1 5
	1.60 #2 5
#1 Closed container	
#2 Open container	

Acute Toxicity, Oil in Water Emulsion (mg/L)

	<u>96h LC₅₀</u>
Fathead Minnow (freshwater)	56.7 µL/L #1 4
Frog Larvae (freshwater)	45.8 µL/L #1 4
1. Flowthrough apparatus	

Biological Oxygen Demand (days)

(%)	
<u>53</u>	5 2

Non-Metal Content

Sulphur (weight %)

max 0.5 1

Sensation

Colour

Colourless
to light brown 2

Other

Reid Vapour Pressure (kPa)

(°C)
37.8 0.69 2

References

1 ASTM D 396
5 Lockhart 87

2 CHRIS 85

3 Curl 77

4 Hedtke 82

Fuel Oil No.2

Also see Diesel Fuel Oil and Heating Fuel Oil.

Mass and Weight**API Gravity (15/15°C)**

min	30	4
	31.6	18

Density (g/mL)

(°C)	Weathering (Volume %)
	0
0	0.865
	to 0.908 7
	0.874 9
	0.849 14
15	0.855
	to 0.898 7
	0.866 9
	max 0.8757 4
16	0.8401 5
16.5	0.854
	to 0.897 7
	max 0.8762 3
20	0.840 14

Viscosity**Dynamic Viscosity (mPa.s or cP)**

(°C)	Weathering (Volume %)
	0
0	7.74 14
20	4.04 14

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
	0
0	1.77
	to 4.00 7
15	2.53
	to 6.13 7
38	2.0 4
	to 3.6 4
	1.53 7
	to 3.19 7
40	1.9 4
	to 3.4 4
	1.47 7
	to 3.01 7

Pour Point (°C)

-18
 to -34 5
 -20 12
 -7 7
 -27 14
 max -6 3

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	
0	29.0	9
15	27.4	9
20	26.2	14
	25.0 (estimated)	5

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)	
	0	
0	16.2	9
15	13.6	9
20	25.6	14

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)	
	0	
0	15.1	10
15	14.7	10
20	50 (estimated)	5

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)	
	0	
0	0	9
15	0	9

Emulsion Stability

(°C)	Weathering (Volume %)	
	0	
0	0	9
15	0	9

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
	0
0	N/A 9
15	N/A 9

Fire and Reactivity

Flash Point (°C)

	104	14
min	38	4
	91	9
	52	9
to	96	9
	55	12
	38	7
	37.8	5
to	51.7	5

Auto Ignition Temperature (°C)

257 17

Flammability Limits (Volume %)

in air 1.3
to 6.0 5

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	240 14	180
		to 360 12
5	254 14	
10	260 14	
15	267 14	
20	273 14	
25	279 14	
30	286 14	
35	292 14	
90		282
		to 338 3

Boiling Range (°C)

34 7
 to 185 7
 288 5
 to 338 5

Final Boiling Point (°C)

232 17

Solubility

Aqueous Solubility (mg/L)

	5 °C	20 °C	22 °C
Freshwater		3.12 14	
Diesel Fuel in Freshwater			2.8 21
Heating Oil in Freshwater			0.3 21
Distilled Water	9.3 16	2.7 15	3.2 15
Seawater	8.7 1	2.05 15	2.50 15

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	61.8	18
	61.8	3
	38.2	18
Aromatics	38.2	3
	25	7
Polars	0	18
Asphaltenes	0	18
	0.36	14
Paraffins	30	7
Naphthenes	45	7

Wax Content (Weight %)

2.9 14

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	24h LC50	48h LC50	96h LC50	TL _m	LD50
POLYCHAETA:					
Neanthes Arenaceodontata	> 8.7	20	3.2	20	2.7
Capitella Capitata	> 8.7	20	3.5	20	2.3
Nereis Vexillosa					> 3.36 #1 19
					> 8.19 #2 19
CRUSTACEA:					
Mysidopsis Almyra	2.6	1	0.9	1	
Palaemonetes Pugio	4.4	1	4.1	1	3.5
Penaeus Aztecus	5.0	1	5.0	1	4.9
Ligia Exotica	> 8.7	8	> 8.7	8	> 8.7
Lucifer Faxoni	8.9	13	4.6	13	3.2
Orchomene Pinguis					> 1.74 #1 19
					> 0.48 #2 19
Acanthomysis Pseudomacropsis					> 0.45 #2 19
					2:31 #1 19
Eualus Suckleyi					1.10 #1 19
					0.59 #2 1
Crangon Alaskensis					0.36 #1 19
					0.43 #2 19
Pargurus Hirsuticulus					> 3.36 #1 19
					> 8.19 #2 19
Paralithodes Camtschayica					1.02 #1 19
					0.81 #2 19
FISH:					
Menidia Beryllina	5.7	1	5.2	1	3.9
Fundulus Similis	5.6	1	4.7	1	3.9
Cyprinodon Variegatus	> 6.9	1	> 6.9	1	6.3
Oncorhynchus Gorbuscha					0.97 #1 19
					0.54 #2 19
Salvelinus Malma					0.15 #1 19
					0.72 #2 19
Myoxocephalus Polyacanthocephalus					1.31 #1 19
					2.41 #2 19
Platicthys Steelatus					> 0.97 #1 19
					> 1.72 #2 19
Pholis Laeta					> 0.92 #1 19
					> 1.72 #2 19
Juvenile American Shad					204 #3 5
MOLLUSKS:					
Chlamys Hericus					> 3.36 #1 19
					> 8.19 #2 19
Katharina Tunicata					> 3.36 #1 19
					> 8.19 #2 19
Mytilus Edulis					> 1.25 #1 19
					> 4.19 #2 19
Thais Lima					> 3.36 #1 19
					> 8.19 #2 19
Collisella Scutum					> 3.36 #1 19
					> 8.19 #2 19

Fuel Oil No.2

NERMERTEAN:

Paranemertes Peregrina > 3.36 #1 19
> 8.19 #2 19

ECHINODERMS:

Leptasterias Hexactis > 3.36 #1 19
> 8.19 #2 19

WATERFOWL:

Mallard > 20 mL/Kg 5

1. Total aromatics
2. Total hydrocarbons measured by IR spectrophotometry.
3. Saltwater

Acute Toxicity, Oil in Water Emulsion (mg/L)

	24h LC50	48h LC50	96h LC50
CRUSTACEA:			
Mysidopsis Almyra	1.6 1	1.3 1	
Palaemonetes Pugio	3.8 1	3.4 1	3.0 1
Penaeus Aztecus	9.4 1	9.4 1	9.4 1
Ligia Exotica	73.0 8	73.0 8	36.5 8
FISH:			
Menidia Beryllina	260 1	125 1	
Fundulus Sumilis	48 1	36 1	33 1
Cyprinodon Variegatus	250 1	200 1	93 1

Metal Content

Other Metals (ppm)

Nickel 0.5 18
Vanadium 1.5 18

Non-Metal Content

Nitrogen (Weight %)

0.024 18

Sulphur (Weight %)

max 0.5 3
0.32 18
0.36 11
0.16 (winter diesel) 11

Sensation

Colour

in water Dark blue purple 17

Odour Threshold (ppm)

0.082 17

Other

Reid Vapour Pressure (kPa)

(°C)

37.8

0.689 5

Compositional Analysis

Saturates		
n-Alkanes (C ₁₀ to C ₂)	8.07	6
Iso-Alkanes	22.3	6
1-Ring Cycloalkanes	17.5	6
2-Ring Cycloalkanes	9.4	6
3-Ring Cycloalkanes	4.5	6
Aromatics		
Benzenes	10.3	6
Indans and Tetralins	7.3	6
Dinaphtheno Benzenes	4.6	6
Naphthalene	0.2	6
Methylnaphthalenes	2.1	6
Dimethylnaphthalenes	3.2	6
Other Naphthalenes	0.4	6
Acenaphthenes	3.8	6
Acenaphthalenes	5.4	6
Benzothiophenes	0.9	6

References

- | | | | |
|---------------|----------------|----------------|--------------|
| 1 Anderson 74 | 2 ASTM 89 | 3 ASTM D 2007 | 4 ASTM D 396 |
| 5 CHRIS 85 | 6 Clark 77 | 7 Curl 77 | 8 Dillon 78 |
| 9 EETD 84 | 10 EETD 85 | 11 EETD 86 | 12 Fingas 79 |
| 13 Lee 78 | 14 Mackay 82b | 15 Maijanen 84 | 16 Murray 84 |
| 17 OHMTADS 81 | 18 Pancirov 74 | 19 Rice 79 | 20 Rossi 76 |
| 21 Suntio 86 | | | |

Fuel Oil No.2 (High Aromatic Content Heating Oil)

Mass and Weight

API Gravity (15/15°C)

33.7 1

Density (g/mL)

(°C)	
15.6	0.8558 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
	0
40	2.384 1
100	1.034 1

Pour Point (°C)

-29 1

Distillation

Distillation (°C)

(Vol%)	Vapour Temp
IBP	138 1
5	181 1
10	199 1
15	210 1
20	219 1
25	227 1
30	235 1
35	245 1
40	253 1
45	261 1
50	269 1
55	275 1
60	282 1
65	288 1
70	297 1
75	305 1
80	316 1
85	325 1
90	336 1
95	352 1
FBP	387 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	57.2	1
Aromatics	41.8	1

Metal Content

Other Metals (ppm)

Nickel	0.1	1
Vanadium	0.1	1
	to 0.3	1

Non-Metal Content

Nitrogen (Weight %)

0.009 1

Sulphur (Weight %)

0.12 1

References

¹ API 81

Fuel Oil No.2 (Typical Heating Fuel Oil)

Home heating oil

Mass and Weight

API Gravity (15/15°C)

32.1 1

Density (g/mL)

(°C)	
15.6	0.8641 1
20	0.8774 3

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
-1.1	2.788 3
15.5	2.134 3
21.1	1.965 3

Pour Point (°C)

-29 3

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	25 (estimated) 3

Oil-Water (mN/m or dynes/cm)

(°C)	
20	50 (estimated) 3

Fire and Reactivity

Flash Point (°C)

57.8 3

Distillation

Distillation (°C)

(Vol%)	Vapour Temp
IBP	116 1
5	171 1
10	194 1
15	207 1
20	216 1
25	226 1
30	233 1
35	243 1
40	251 1
45	258 1
50	267 1
55	273 1
60	280 1
65	287 1
70	297 1
75	306 1
80	317 1
85	327 1
90	339 1
95	356 1
FBP	399 1

Boiling Range (°C)

282
to 338 3

Solubility

Aqueous Solubility (mg/L)

		22 °C
Fresh Water	55.97 6	0.3 7
Seawater	50.92 6	

Toxicity

Toxicity (mg/L)

	24h TL _m	96h TL _m
Juvenile American Shad	200 #1 3	
Rainbow Trout eggs		20 #2 3
1. Freshwater		
2. Saltwater		

Fuel Oil No.2 (Typical Heating Fuel Oil)

Acute Toxicity of Water Soluble Fraction (mg/L)

	48h EC ₅₀	48h LC ₅₀
Daphnia Magna	1.9 6	2.18 6
	0.01 2	0.01 2
Artemia spp.	8.35 6	11.16 6
	0.04 2	0.05 2

Note: Results from (Maclean 88) obtained by fluorescence spectroscopy.
Results from (Bobra 88) obtained by purge-and-trap GC analysis.

Metal Content

Other Metals (ppm)

Nickel	< 0.1 1
	< 1 5
Vanadium	0.1
	to 0.2 1
	< 0.6 5
Molybdenum	< 0.6 5
Potassium	< 1.5 5
Zinc	< 0.6 5
Lead	< 3 5
Iron	< 3 5
Chromium	< 1.5 5
Magnesium	0.5 5
Copper	< 0.6 5
Titanium	< 0.6 5
Barium	< 0.3 5

Non-Metal Content

Nitrogen (Weight %)

0.014 1

Sulphur (Weight %)

0.19 1

Sensation

Colour

Light brown 3

Other

Reid Vapour Pressure (kPa)

(°C)

37.8	3.689	3
38	2.22	4

References

1 API 81
5 ESD 92

2 Bobra 88
6 MacLean 88

3 CHRIS 85
7 Suntio 86

4 ESD 91

Fuel Oil No.4

Residual Fuel Oil

It can be a high-boiling-distillate or a light residual of crude oil, or it can be prepared by blending 40% Fuel Oil No.2 and 60% Fuel Oil No.6. (CURL 77)

Mass and Weight

API Gravity (15/15°C)

24.9
to 23.5 4
25.0 3

Density (g/mL)

(°C)	Weathering (Volume %)
0	0
0	0.914
	to 0.922 4
	0.938 5
15	0.904
	to 0.912 4
	0.903 3
20	0.901
	to 0.909 4
	0.925 5
30	0.895
	to 0.902 4

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
10	47.2 5
20	22.7 5

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)	
	0	
10	40	
	to 101	4
15	33	
	to 79	4
20	27	
	to 60	4
30	18	
	to 38	4
38	5.8	1
	to 26.4	1
	2.0	1
	to 5.8 for No.4 Light	1
40	11	
	to 26	4

Note: Data obtained from a graph (Curl 77)

Pour Point (°C)

-29
to -9 3
max -6 1
-7 4
5 5

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)
20 32.1 5

Oil-Seawater (mN/M of dynes/cm)

(°C)
20 30.23 5

Emulsion

Emulsion Stability

Forms stable emulsion (Curl 77)

Fire and Reactivity

Flash Point (°C)

54	4
78	5
min 55	1
min 38 for No.4 Light	1
> 54 (C.C.)	3

Auto Ignition Temperature (°C)

263 4

Flammability Limits (Volume %)

in air 1.0 3
to 5.0 3

Distillation

Distillation (°C)

(Vol%)	Liquid Temp
IBP	245 5
5	257 5
10	269 5
15	281 5
20	293 5
25	305 5
30	317 5

Boiling Range (°C)

101
to > 588 3

Solubility

Aqueous Solubility (mg/L)

20

6.46 5

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 3.2 5

Wax Content (weight %)5.5⁵**Metal Content****Other Metals (ppm)**

Vanadium	35.0		2
Nickel	7.72		2
Chromium	44.1	ppb	2
Cobalt	32.8	ppb	2
Iron	0.226		2
Manganese	14.1	ppb	2
Zinc	0.263		2
Copper	0.0345		2

Sensation**Colour**Brown³**Other****Reid Vapour Pressure (kPa)**

(°C)	
37.8	0.689 (estimated) ³

References¹ ASTM D 396² Chiang 80³ CHRIS 85⁴ Curl 77⁵ Mackay 82b

Fuel Oil No.5

Fuel Oil No.5

Bunker B Fuel Oil
Heavy Fuel Oil No. 5
Light Fuel Oil No. 5
Navy Special
Residual Fuel Oil

Can be prepared by adding 20 to 25% Fuel Oil No.2 to 75 to 80% Fuel Oil No.6 (CURL 77).

Mass and Weight

API Gravity (15/15°C)

min 11.5⁵

Density (g/mL)

(°C)	Weathering (Volume %)
	0
0	0.932
	to 0.957 ⁴
15	0.923
	to 0.948 ⁴
16	0.935 ³
20	0.920
	to 0.945 ⁴
30	0.913
	to 0.938 ⁴

Note: Data obtained from a graph (Curl 77)

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Light	Heavy
10	200	> 473 ⁴
	to 473 ⁴	
15	152	> 313 ⁴
	to 313 ⁴	
20	123	> 233 ⁴
	to 233 ⁴	
25	100	165
	to 165 ⁴	to 327 ⁴
30	74	125
	to 125 ⁴	to 200 ⁴
38	26.4	65
	to 65 ¹	to 194 ¹
40	40	75
	to 75 ⁴	to 100 ⁴

Note: Data obtained from a graph (Curl 77)

Pour Point (°C)

max -9.4 5
-17.8 3

Fire and Reactivity

Flash Point (°C)

> 54 4
min 60 5
min 55 1
> 54.4 3

Flammability Limits (Volume %)

in air 1
to 5 3

Distillation

Boiling Range (°C)

218
to > 570 3

Metal Content

Other Metals (ppm)

Vanadium	152	2
Nickel	29.0	2
Chromium	1.076	2
Cobalt	0.198	2
Iron	24.0	2
Molybdenum	0.117	2
Manganese	0.248	2
Zinc	1.73	2
Copper	0.321	2

Sensation

Colour

Brown 3

Other

Reid Vapour Pressure (kPa)

(°C)

37.8

0.689 (estimated) ³

References

¹ ASTM D 396

² Chiang 80

³ CHRIS 85

⁴ Curl 77

⁵ Navy 77

Fulmar Crude Oil

U.K., North Sea

Mass and Weight

API Gravity (15/15°C)

39.3 2

Density (g/mL)

(°C)	
Unknown	0.8280 2

Viscosity

Kinematic Viscosity (mm²/sec or cst)

(°C)	
38	2.55 1

Pour Point (°C)

-12 1

Distillation

Yield on Crude

	Range, °C	Volume %
C ₄ and lighter		2.7 1
Gasoline	C ₅	19.5 1
	to 85	
Naphtha	85	19.5 1
	to 165	
Kerosene	165	15.7 1
	to 235	
Gas Oil	235	12.2 1
	to 300	
Gas Oil	300	9.5 1
	to 350	
Residuum	> 350	33.1 1

Non-Metal Content

Sulphur (Weight %)

0.26 1

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	26.0 2

References

1 Aalund 83c

2 MSD 88

Gas Oil (Cracked)**Mass and Weight**

Density (g/mL)

(°C)	
16	0.847 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	25 (estimated) 1

Oil-Water (mN/m or dynes/cm)

(°C)	
20	50 (estimated) 1

Fire and Reactivity

Flash Point (°C)

65.5 (C.C.) 1

Flammability Limits (Volume %)

in air	6.0
	to 13.5*1

Distillation

Boiling Range (°C)

190
to 399 1

Toxicity

Toxicity (mg/L)

	24h TL _m
Juvenile American Shad	90 #1 1
	91 #2 1

1. Freshwater
2. Saltwater

Biological Oxygen Demand (days)

(%)	
8	5 1

Sensation

Colour

Yellow
to brown 1

Odour Threshold (ppm)

0.25 1

References

1 CHRIS 85

Gas Turbine Fuel Oil

Grade 0-GT: Naphthas and others low flash distillates.

Grade 1-GT: Light distillates including some gas oil fractions.

Grade 2-GT: Heavier distillates than Grade 1-GT. Similar to No.2 fuel oil

Grade 3-GT: Residual fuel that meets low ash requirements.

Grade 4-GT: Similar to Grade 3-GT but with no ash restrictions. (ASTM D 2880)

Mass and Weight

API Gravity (15/15°C)

min 35 (1-GT) 1
min 30 (2-GT) 1

Density (g/mL)

(°C)		
15	max 0.850 (1-GT)	1
	max 0.876 (2-GT)	1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)		
0	0.8 (0-GT)	2
	3.9 (1-GT)	2
	8.0 (2-GT)	2
	150 (3-GT)	2
	150 (4-GT)	2
40	1.3	1
	to 2.4 (1-GT)	1
	1.9	1
	to 4.1 (2-GT)	1
	min 5.5 (3-GT)	1
	min 5.5 (4-GT)	1
50	max 638 (3-GT)	1
	max 638 (4-GT)	1

Pour Point (°C)

max -18 (1-GT) 1
max -6 (2-GT) 1

Fire and Reactivity

Flash Point (°C)

max 38	(1-GT)	1
max 38	(2-GT)	1
max 55	(3-GT)	1
max 66	(4-GT)	1

Distillation

Distillation (°C)

	Vapour Temp	
90	max 288	(1-GT) 1
	282	(2-GT) 1
	to 338	1

References

¹ ASTM D 2880

² Dukek 78

Gasoline (Casinghead)**Mass and Weight**

API Gravity (15/15°C)

79.3 ¹

Density (g/mL)

(°C)	
15	0.670 ¹

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
15	0.440 (estimated) ¹

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
15	0.657 (estimated) ¹

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	19 to 23 ¹

Oil-Water (mN/m or dynes/cm)

(°C)	
20	49 to 51 ¹

Fire and Reactivity

Flash Point (°C)

< -17.8 (O.C.) ¹

Flammability Limits (Volume %)

in air	1.3 to 7.1 ¹
--------	----------------------------

Gasoline (Casinghead)

Distillation

Boiling Range (°C)

14
to 135 1

Toxicity

Toxicity (mg/L)

	<u>24h TL_m</u>
Juvenile American Shad	90 #1 1
	91 #2 1

1. Freshwater
2. Saltwater

Biological Oxygen Demand (days)

(%)
8 5 1

Sensation

Colour

Colourless 1

Odour Threshold (ppm)

0.25 1

References

¹ CHRIS 85

Gasoline (leaded)

Motor spirit

Petrol

Straight run

Mass and Weight

API Gravity (15/15°C)

60	9
62.4	6
67.80	4
to 57.9 #1	4

1. Straight run

Density (g/mL)

(°C)	Weathering (Volume %)	
	0	
0	0.746	6
5	0.7501	11
15	0.709	
	to 0.746	#1 4
	0.729	6
20	0.7340	11

1. Straight Run

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)	
	0	
0	0.75	7
	0.519	#1 4
5	0.53	11
15	0.62	7
	0.44	#1 4
20	0.45	11

1. Straight Run

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)	
	0	
0	0.69	
	to 0.95	5
15	0.57	5
	to 0.80	5
	0.59	4
	to 0.62	#1 4

1. Straight Run

Gasoline (leaded)

Pour Point (°C)

N/A 9

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	
0	20.9	6
15	19.8	6
20	19	
	to 23	#1 4

1. Straight Run

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)	
	0	
0	19.8	6
15	18.6	7

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)	
	0	
0	19.7	6
15	18.0	6
20	49	
	to 51	#1 4

1. Straight Run

Fire and Reactivity

Flash Point (°C)

-43 13
-43 5
-40 9
-17.8 #1 (C.C.) 4

1. Straight Run

Auto Ignition Temperature (°C)

280 13
257 5

Explosion Limits of Vapour in Air

Upper		Lower	
7.6 %	5	1.4 %	5
7.1 % #1	4	1.3 % #1	4

1. Straight Run

Distillation

Distillation (°C)

(Vol%)		
10	50	
	to 70	1
50	77	
	to 121	1
90	185	
	to 190	1
FBP	225	1
Residuum	2 % max	1

Boiling Range (°C)

	14	
	to 135 #1	4
	30	4
	to 200	9

1. Straight Run

Final Boiling Point (°C)

38 13

Solubility

Aqueous Solubility (mg/L)

	22 °C			
Freshwater	169	10	240	14
Distilled Water	186.7 #2	12	98 #1	11
Seawater	132.4	10		
	#1. summer gasoline			
	#2. regular gasoline			

Gasoline (leaded)

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

		Straight-Run	Blended
Paraffins	50 5		
Naphthenes	40 5		
Aromatics	10 5		
Alkenes	< 30 5		
Saturates group		39.61 16	57.65 16
Aromatics group		46.24 16	32.56 16
Olefins group		14.15 16	7.03 16
Diolefins group			2.48 16
Benzene group			0.28 16

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	48h EC ₅₀	48h LC ₅₀	24h TL _m
Daphnia Magna	6.25 10 8.88 2	13.5 10 19.2 2	
Artemia spp.	19.2 10 27.8 2	21.3 10 30.9 2	
Juvenile Shad		91 15	90 #1 4 91 #2 4

1. Freshwater
2. Saltwater

Metal Content

Other Metals (ppm)

Molybdenum	< 0.6	8
Potassium	< 1.5	8
Zinc	0.5	8
Lead	1750	8
	1.1 g/L max	1
	1.1	4
Nickel	< 1	8
Iron	< 3	8
Chromium	< 1.5	8
Magnesium	< 1	8
Vanadium	< 0.6	8
Copper	< 0.6	8
Titanium	0.54	8
Barium	< 0.3	8

Non-Metal Content

Sulphur (Weight %)

max 0.15 1
0.07 6

Sensation

Odour Threshold (ppm)

Upper	Lower
0.01 13	0.005 13
	0.25 4

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	62
	to 103 1
	51 4

Compositional Analysis

isobutane	1.561	3
n-hexane	11.04	3
unknown	ND	3
n- & iso pentanes	8.320	3
2-pentanes	8.942	3
unknown	0.199	3
1-pentane	2.235	3
2-methylpentane	6.322	3
3-methylpentane	3.353	3
unknow (MW=86)	4.030	3
2-ethyl-1-butene	1.149	3
unknown	ND	3
methylcyclopentane	3.851	3
unknown (MW=100)	3.643	3
3-ethylpentane	2.736	3
isooctane	1.961	3
n-heptane	2.293	3
1-methyl-1-cyclohexane	1.022	3
benzene	3.879	3
unknown	0.355	3
unknown (MW=114)	1.916	3
unknown (MW=114)	1.380	3
unknown	ND	3
1,2-dimethylcyclohexane	0.643	3
2,4-dimethylheptane	1.801	3
unknown (MW=124)	0.466	3
toluene & 1,2-dichloroethane	4.457	3
4-methyloctane	0.766	3
4-n-propylheptane	0.536	3
n-nonane	0.796	3
ethylbenzene	1.239	3
p & m xylenes		
& 1,2-dibromomethane		
& phenylenediamine	3.985	3
3,4-dimethylheptane	0.114	3
o-xylene	1.571	3
2,6-dimethyloctane	0.266	3
n-propylbenzene	0.347	3
methyl ethyltoluene	1.723	3
cumene	1.118	3
1,2,4-trimethylbenzene		
& o-ethyltoluene	1.939	3
vinyl-2-ethyl hexyl ether	0.155	3
m-styrene & n-butylbenzene	1.403	3
dimethyl ethylbenzene	0.430	3
diethylbenzene	1.448	3
1,2,4,5-tetramethylbenzene	ND	3
n-dodecane	0.574	3
1,1-dimethyl ethylbenzene	1.000	3
ethyl styrene	0.589	3
2,6-dimethyl styrene	0.971	3
unknown	0.596	3

dimethyl isopropylbenzene 0.356 3
2,6-dimethylundecane 0.185 3

References

- | | | | |
|---------------|---------------|----------------|--------------|
| 1 ASTM D 439 | 2 Bobra 88 | 3 Bruell 84 | 4 CHRIS 85 |
| 5 Curl 77 | 6 EETD 84 | 7 EETD 85 | 8 ESD 92 |
| 9 Fingas 79 | 10 MacLean 88 | 11 Maijanen 84 | 12 Murray 84 |
| 13 OHMTADS 81 | 14 Suntio 86 | 15 Tagatz 61 | 16 Waters 82 |

Gasoline (unleaded)

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)

 0.514 4

Distillation

Distillation (°C)

(Vol%)		
10	50	1
	to 70	1
50	77	1
	to 121	1
90	185	1
	to 190	1
FBP	225	1
Residue	2 %,max	1

Solubility

Aqueous Solubility (mg/L)

		22 °C
Freshwater	306.6 6	112 7
Seawater	260.9 6	

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	48h EC50	48h LC50
Daphnia Magna	4.91 6 1.79 2	50.3 6 18.4 2
Artemia spp.	25.1 6 8.6 2	51.4 6 17.7 2
Larval Rainbow Trout		6.80 #1 5 5.40 #2 5

#1. Closed Container
 #2. Open Container

Metal Content

Other Metals (ppm)

Lead 0.013 g/L max 1

Non-Metal Content

Sulphur (Weight %)

max 0.10 1

Other Compositional Analysis

	Unleaded	Super	Unleaded
isobutane	2.241 3	1.180 3	
n-hexane	11.13 3	12.93 3	
unknown	0.511 3	ND 3	
n- & iso pentanes	8.936 3	6.144 3	
2-pentane	6.149 3	2.461 3	
unknown	2.657 3	1.677 3	
1-pentane	2.959 3	1.948 3	
2-methylpentane	5.392 3	4.325 3	
3-methylpentane	2.634 3	1.873 3	
unknown (MW=86)	1.912 3	1.488 3	
2-ethyl-1-butene	1.813 3	0.997 3	
unknown	0.841 3	ND 3	
nethylcyclopentane	3.011 3	2.971 3	
unknown (MW=100)	3.033 3	2.178 3	
3-ethylpentane	1.857 3	1.410 3	
isooctane	1.815 3	8.693 3	
n-heptane	1.230 3	0.247 3	
1-methyl-1-cyclohexane	1.368 3	0.199 3	
benzene	3.238 3	4.352 3	
unknown	0.367 3	ND 3	
unknown (MW=114)	1.616 3	3.800 3	
unknown (MW=114)	1.048 3	5.830 3	
unknown	ND 3	1.466 3	
1,2-dimethylcyclohexane	0.550 3	0.203 3	
2,4-dimethylheptane	1.300 3	0.631 3	
unknown (MW=124)	0.511 3	0.426 3	
toluene & 1,2-dichloroethane	4.792 3	5.966 3	
4-methyloctane	0.669 3	0.5165 3	
4-n-propylheptane	0.451 3	0.543 3	
n-nonane	0.663 3	0.402 3	
ethylbenzene	1.357 3	1.450 3	
p & m xylenes			
& 1,2-dibromomethane			
& phenylenediamine	4.751 3	5.166 3	
3,4-dimethylheptane	0.104 3	0.038 3	
o-xylene	1.856 3	2.244 3	
2,6-dimethyloctane	0.266 3	0.015 3	
n-propylbenzene	0.475 3	0.783 3	
methyl ethyltoluene	2.251 3	3.033 3	
cumene	1.354 3	1.897 3	
1,2,4-trimethylblenzene			
& o-ethyltoluene	2.365 3	3.019 3	
vinyl-2-ethyl hexyl ether	0.141 3	0.042 3	
m-styrene & n-butylbenzene	1.736 3	1.586 3	
dimethyl ethylbenzene	0.534 3	0.461 3	
diethylbenzene	1.741 3	1.200 3	
1,2,4,5-tetramethylbenzene	ND 3	0.133 3	
n-dodecane	0.757 3	0.216 3	
1,1-dimethyl ethylbenzene	1.323 3	0.924 3	

ethyl styrene	0.824 ³	0.441 ³
2,6-dimethyl styrene	1.369 ³	0.822 ³
unknown	0.964 ³	0.451 ³
dimethyl isopropylbenzene	0.520 ³	0.327 ³
2,6-dimethylundecane	0.229 ³	0.520 ³

References

¹ ASTM D 439
⁵ Lockhart 87

² Bobra 88
⁶ MacLean 88

³ Bruell 84
⁷ Suntio 86

⁴ CHRIS 85

Gasoline: Blending Stocks (Alkylates)

Mass and Weight

API Gravity (15/15°C)

67.8
to 57.2 1

Density (g/mL)

(°C)
15 0.709
to 0.749 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)
15 0.451 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)
15 0.636
to 0.602 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)
20 19
to 23 1

Oil-Water (mN/m or dynes/cm)

(°C)
20 49
to 51 1

Fire and Reactivity

Flash Point (°C)

< -17.8
to 22.8 (C.C.) 1

Flammability Limits (Volume %)

in air 1.1
 to 8.7 1

Distillation

Boiling Range (°C)

 14
 to 135 1

Toxicity

Toxicity (mg/L)

	<u>24h TL_m</u>
Juvenile American Shad	90 #1 1
	91 #2 1

1. Freshwater
2. Saltwater

Biological Oxygen Demand (days)

(%)
8 5 1

Sensation

Colour

Colourless 1

Odour Threshold (ppm)

0.25 1

References

1 CHRIS 85

Gasoline: Blending Stocks (Reformats)

Mass and Weight

Density (g/mL)

(°C)	
20	0.792 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
15	0.543 1
20	0.514 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
20	0.649 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	19 to 23 1

Oil-Water (mN/m or dynes/cm)

(°C)	
20	49 to 51 1

Fire and Reactivity

Flash Point (°C)

< -17.8 to 22.8 (C.C.) 1

Flammability Limits (Volume %)

1.1 to 8.7 1

Distillation

Boiling Range (°C)

14
to 135 1

Toxicity

Toxicity (mg/L)

	24h TL _m
Juvenile American Shad	90 #1 1
	91 #2 1
#1. Freshwater	
#2. Saltwater	

Biological Oxygen Demand (days)

(%)
8 5 1

Sensation

Colour

Colourless 1

Odour Threshold (ppm)

0.25 1

References

1 CHRIS 85

Gasoline: Polymer

Mass and Weight

API Gravity (15/15°C)

67.8
to 57.2 1

Density (g/mL)

(°C)
15 0.709
to 0.749 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)
1.7 0.519 (estimated) 1
15 0.440 (estimated) 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)
15 0.620
to 0.587 (estimated) 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)
20 19
to 23 1

Oil-Water (mN/m or dynes/cm)

(°C)
20 49
to 51 1

Fire and Reactivity

Flash Point (°C)

-17.8
to 22.8 (C.C.) 1

Flammability Limits (Volume %)

in air 1.3
to 7.1 1

Distillation**Boiling Range** (°C)

14
to 135 1

Toxicity**Toxicity** (mg/L)

	24h TL _m
Juvenile American Shad	90 #1 1
	91 #2 1

1. Freshwater
2. Saltwater

Biological Oxygen Demand (days)

(%)
 $\frac{8}{5} 1$

Sensation**Colour**

Colourless 1

Odour Threshold (ppm)

0.25 1

References

1 CHRIS 85

Gorm Crude Oil

Gorm Crude Oil

Denmark, North Sea

Mass and Weight

API Gravity (15/15°C)

33.9 2

Density (g/mL)

(°C)

Unknown 0.8560 2

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)

38 5.40 1

Pour Point (°C)

-37 2

-35 1

Distillation

Yield on Crude

	Range, °C	Volume %
C ₄ and lighter		1.6 1
Light Gasoline	C ₅	19.7 1
	to 149	
Naphtha	149	10.0 1
	to 204	
Kerosene	204	12.1 1
	to 260	
Diesel Oil	260	15.9 1
	to 243	
Gas Oil	343	15.0 1
	to 435	
Heavy Gas Oil	435	10.8 1
	to 538	
Residuum	> 538	14.9 1

Non-Metal Content

Sulphur (Weight %)

0.23 2

References

1 Aalund 83c

2 NSD 88

Granite Point Crude Oil

Offshore Cook Inlet, Alaska.

Mass and Weight

API Gravity (15/15°C)

42.8 1

Density (g/mL)

(°C)
15.6 0.812 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
37.8 3.4 1

Pour Point (°C)

< -15 1

Distillation

Distillation (°C)

(Vol%)	Volume
IBP	27 1
6.0	50 1
9.1	75 1
17.7	100 1
27.1	125 1
33.5	150 1
40.0	175 1
45.1	200 1
50.6	225 1
56.1	250 1
63.3	275 1

Non-Metal Content

Carbon Residue - Ramsbottom (weight %)

1.1 1

Nitrogen (Weight %)

0.039 1

Sulphur (Weight %)

0.02 ¹

Sensation

Colour

Brownish green ¹

References

¹ Coleman 78

Gulf Alberta Light and Medium Crude Oil

Alberta, Canada

Mass and Weight

API Gravity (15/15°C)

35.1 1
35.1 2

Density (g/mL)

(°C)	
Unknown	0.8490 2
21	0.8486 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
38	4.86 2
40	4.86 1

Pour Point (°C)

-27.5 1

Distillation

Yield on Crude

	Range, °C	Volume %
Naphtha	C5 to 190	30.60 1
Kerosene	190 to 177	14.20 1
Distillate	277 to 343	8.53 1
Gas Oil	343 to 565	31.43 1
Residuum	> 565	15.2 1

Metal Content

Other Metals (ppm)

Nickel 10.10 1
Vanadium 9.00 1
Vanadium/Nickel 1.12 2

Non-Metal Content

Hydrogen Sulfide - Existent (mg/m³)

58.1 ¹

Sulphur (Weight %)

9800 ppm ¹

Other

Reid Vapour Pressure (kPa)

(°C)

37.8

36.4 ¹

References

¹ Aalund 83c

² NSD 88

Gulfaks Crude Oil

Norway, North Sea

Mass and Weight

API Gravity (15/15°C)

28.6 1

29.3 3

Density (g/mL)

(°C)	Weathering (Volume %)			
	0	8.4	18.0	27.7
15.5	0.882 4	0.893 4	0.905 4	0.914 4

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)			
	0	8.4	18.0	27.7
6	28 4	47 4	120 4	444 4
13	20 4	33 4	72 4	241 4

Kinematic Viscosity (mm²/sec or cst)

(°C)	
37.8	10.14 1
20	16.5 3

Pour Point (°C)

	Weathering (Volume %)			
	0	8.4	18.0	27.7
< -34 4	-26 4	-15 4	-9 4	
-45 1				
-57 3				

Interfacial Tensions

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)			
	0	8.4	18.0	27.7
13	13 4	13 4	15 4	17 4

Emulsion

Emulsion Formation Tendency

Forms emulsions with relatively low stability and viscosity. (Daling 91)
 18.0% and 27.7% weathered fractions formed fairly stable emulsions.
 (Daling 88)

Emulsion Stability

Forms emulsions with relatively low stability and viscosity. (Daling 91)
 Weathered oils of 18.0% and 27.7% form fairly stable emulsions. (Daling
 88)

Water Content of Emulsion (Volume %)

	Weathering (Volume %)		
(°C)	8.4	18.0	27.7
13	Unstable 4	43.0 4	69 4

Dispersibility

Chemical Dispersibility (% Dispersed)

Relatively high dispersibility with Finasol OSR-5. (Daling 91)

Fire and Reactivity

Flash Point (°C)

	Weathering (Volume %)		
	8.4	18.0	27.7
	32 2	71 2	106 2

Distillation

Yield on Crude

	Range, °C	Volume %	Weight %
Gasoline	C5	1.42 3	1.07 3
	to 65		
Light Naphtha	65	1.76 3	1.46 3
	to 90		
Naphtha	90	9.18 3	8.08 3
	to 150		
Naphtha	150	5.06 3	4.62 3
	to 180		
Heavy Naphtha	180	11.40 3	10.84 3
	to 240		
Heavy Naphtha	240	16.64 3	16.54 3
	to 320		
Gas Oil	320	10.64 3	10.84 3
	to 375		
Gas Oil	375	4.44 3	4.60 3
	to 420		
Heavy Gas Oil	420	20.97 3	22.01 3
	to 525		
Heavy Gas Oil	525	4.69 3	5.00 3
	to 565		
Residuum	> 565	12.62 3	14.19 3

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

	Weathering (Volume %)			
	0	8.4	18.0	27.7
Saturates				52.1 4
Aromatics				40.0 4
Polars				6.8 4
Asphaltenes				1.0 4
Asphaltenes "hard"	0.02 4	0.02 4	0.03 4	0.03 4
Asphaltenes "soft"	0.49 4	0.52 4	0.58 4	0.65 4

Wax Content (Weight %)

	Weathering (Volume %)			
	0	8.4	18.0	27.7
	1.60 4	1.72 4	1.90 4	2.14 4

Metal Content

Other Metals (ppm)

Nickel	1	3
Vanadium	2	3

Non-Metal Content

Sulphur (Weight %)

0.44	1
0.44	3

Salt Content

Salt (g/m³)

17	3
----	---

Other

Acid Number (mg KOH/g)

0.23 (total)	3
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References

1 Aalund 83c

2 Brandvik 91

3 Corbett 90

4 Daling 88

Heavy Reformate Crude Oil

Mass and Weight

API Gravity (15/15°C)

10.1 1

Density (g/mL)

(°C)	
0	0.9347 1
15	0.9226 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
0	5293 #1 1 13467 #2 1
15	1321 #1 1 3498 #2 1

#1. Shear rate 10/s

#2. Shear rate 1/s

Pour Point (°C)

28 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
0	N/M 1
15	N/M 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	
0	N/M 1
15	N/M 1

Oil-Water (mN/m or dynes/cm)

(°C)	
0	N/M 1
15	N/M 1

Emulsion

Emulsion Formation Tendency

(°C)	
0	0 1
15	1.0 1

Emulsion Stability

(°C)	
0	0 1
15	1.0 1

Water Content of Emulsion (Volume %)

(°C)	
0	N/A 1
15	58.4 1

Fire and Reactivity

Flash Point (°C)

> 90 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 0.2 1

Wax Content (Weight %)

11.9 1

Metal Content

Other Metals (ppm)

Molybdenum	<	0.6	1
Potassium	<	1.5	1
Zinc	<	0.6	1
Lead	<	4	1
Nickel	<	1	1
Iron	<	4	1
Chromium	<	1.5	1
Magnesium		10.6	1
Vanadium	<	0.6	1
Copper	<	0.6	1
Titanium		1.2	1
Barium	<	0.3	1

References

1 ESD 92

Hibernia Crude Oil

Offshore, East Coast, Canada

Mass and Weight

Density (g/mL)

For Fv < 23.0% & T between 0 and 15°C
 $DEN = 0.877086 + 0.001632 Fv - 0.000791 T$
 the density of oil at T and Fv (g/mL)
 is the volume percent of oil weathered
 T is the oil temperature (°C)

DEN is
 Fv

(°C)	Weathering (Volume %)		
	0	18.2	23
0	0.8773	2	0.9070 2
	0.843	5	0.9142 2
5	0.841	5	
	0.840	5	
10	0.878 (B-27)	8	
	0.844 (C-96)	8	
15	0.8648	2	0.8957 2
	0.839	5	0.9024 2
20	0.827	5	
	0.870 (B-27)	8	
25	0.837 (C-96)	8	
	0.836	5	
30	0.862 (B-27)	8	
	0.830 (C-96)	8	

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		
	0	18.2	23
0		94000 3	294000 3
5	148	5	
10	72.4	5	
15	49.0	5	270.5 3
	240 (B-27)	8	5100 3
20	33.2	5	
	80 (B-27)	8	
25	90 (C-96)	8	
	25.6	5	
30	25 (B-27)	8	
	30 (C-96)	8	

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)	
	18.2	23.0
0	N/M 3	N/M 3
15	302 3	5652 3

Hibernia Crude Oil

Pour Point (°C)

Weathering		(Volume %)	
0		18.2	23.0
12	2	15 2	18 2
6	5		
9	(B-27) 8		
18	(C-96) 8		

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering		(Volume %)	
	0		18.2	23.0
0	29.0 2		N/M 2	N/M 2
15	27.2 2		28.8 2	30.6 2

Oil-Seawater (mN/M or dynes/cm)

(°C)	Weathering		(Volume %)	
	0		18.2	23.0
0	24.2 2		N/M 2	N/M 2
15	21.0 2		19.5 2	32.7 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering		(Volume %)	
	0		18.2	23.0
0	26.4 2		N/M 2	N/M 2
15	23.4 2		22.0 2	38.7 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering		(Volume %)	
	0		18.2	23.0
0	1.0 3		1.0 3	0.0 3
15	1.0 2		1.0 3	1.0 3

Emulsion Stability

(°C)	Weathering		(Volume %)	
	0		18.2	23.0
0	1.0 3		1.0 3	0.0 3
15	1.0 2		1.0 3	1.0 3

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	18.2	23.0
0	75.0 ³	52.6 ³	N/A ³
15	88.7 ²	75.3 ³	67.7 ³

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	10 ⁴
Dasic	7 ⁴
EN 700	7 ⁴

Fire and Reactivity

Flash Point (°C)

-10²

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	147 ²	43 ²
5	175 ²	99 ²
10	206 ²	120 ²
15	238 ²	138 ²
20	270 ²	171 ²
25	297 ²	199 ²

Weathering

T_O = 420.0
 T_G = 596.4 (EETD 85)

Solubility

Aqueous Solubility (mg/L)

	22 °C	
Fresh Water	8.3 ⁷	23.3 ⁹
Salt Water		18.7 ⁹
Seawater	10.6 ⁷	

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	79.3	5
Aromatics	14.5	5
Polars	3.52	5
Asphaltenes	2.68	5
	1.2 (B-27)	8
	3.2 (C-96)	8

Wax Content (Weight %)

	8.47	6
	9.7 (B-27)	8
	7.4 (C-96)	8

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	48h EC50		48h LC50	
Daphnia Magna	1.08	7	5.49	7
	3.0	1	15.4	1
Artemia spp.	6.34	7	7.73	7
	11.1	1	13.5	1

Note: Results from (Maclean 88) obtained by fluorescence spectroscopy.
Results from (Bobra 88) obtained by purge-and-trap GC analysis.

References

- | | | | |
|--------------|--------------|--------------|-----------|
| 1 Bobra 88 | 2 EETD 85 | 3 EETD 86 | 4 EETD 89 |
| 5 Mackay 82a | 6 Mackay 82b | 7 MacLean 88 | 8 Ross 89 |
| 9 Suntio 86 | | | |

Hibernia Crude Oil (EPA 86)

Newfoundland, Canada

Oil sample received from EPA Ohmsett, 1986.

Mass and Weight**API Gravity (15/15°C)**28.3 ¹**Density (g/mL)**

(°C)	Weathering (Volume %)		
	0	8.8	17.7
0	0.8970 ¹	0.9131 ¹	0.9246 ¹
15	0.8849 ¹	0.9011 ¹	0.9138 ¹

Viscosity**Dynamic Viscosity (mPa.s or cP)**

(°C)	Weathering (Volume %)		
	0	8.8	17.7
0	10185 ¹	110500 ¹	N/M ¹
15	44.2 ¹	207 ¹	1471 ¹

Kinematic Viscosity (mm²/sec or cst)

(°C)	Weathering (Volume %)		
	0	8.8	17.7
0	11354 ¹	N/M ¹	N/M ¹
15	91.6 ¹	229.7 ¹	1610 ¹

Pour Point (°C)

	Weathering (Volume %)		
	0	8.8	17.7
15 ¹	18 ¹	21 ¹	

Interfacial Tensions**Air-Oil (mN/M or dynes/cm)**

(°C)	Weathering (Volume %)		
	0	8.8	17.7
0	N/M ¹	N/M ¹	N/M ¹
15	26.2 ¹	26.5 ¹	27.0 ¹

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		
	0	8.8	17.7
0	N/M 1	N/M 1	N/M 1
15	13.5 1	16.7 1	19.1 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		
	0	8.8	17.7
0	N/M 1	N/M 1	N/M 1
15	16.2 1	16.8 1	20.9 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	8.8	17.7
0	1.0 1	1.0 1	1.0 1
15	1.0 1	1.0 1	1.0 1

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	8.8	17.7
0	1.0 1	1.0 1	1.0 1
15	1.0 1	0 1	1.0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	8.8	17.7
0	71.8 1	47.1 1	23.3 1
15	88.5 1	N/A 1	65.0

Dispersibility

Chemical Dispersibility (% Dispersed)

	% Effectiveness
C9527	10 2
CRX-8	10 2
ENER 700	5 2
Dasic	5 2

Natural Dispersibility (% Dispersed)

(°C)	
15	4 3

Fire and Reactivity

Flash Point (°C)

-14 1

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	137 1	34.5 1
5	217 1	85 1
10	252 1	115 1
15	282 1	139 1
20	311 1	160 1
25	336 1	185 1
30	359 1	210 1
35	382 1	234 1
40	400 1	253 1
45	417 1	267 1
50	428 1	284 1
55	440 1	325 1

WeatheringT_O = 439.1T_G = 786.5 (EETD 86)**Solubility**

Aqueous Solubility (mg/L)

	22 °C
Fresh Water	23.3 4
Salt Water	18.7 4

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	82.1 1
Aromatics	13.5 1
Polars	2.0 1
Asphaltenes	2.4 1
	3.6 2

Non-Metal Content

Sulphur (Weight %)

Weathering		(Volume %)	
0		8.8	
0.65	1	0.64	1

References

1 EETD 86

2 EETD 89

3 Fingas 90a

4 Suntio 86

Hondo Crude Oil

California, U.S.A

Mass and Weight**Density (g/mL)**

(°C)	Weathering (Volume %)		
	0	16.7	32.2
0	0.9461 1	0.9780 1	0.9976 1
15	0.9356 1	0.9674 1	0.9881 1

Viscosity**Dynamic Viscosity (mPa.s or cP)**

(°C)	Weathering (Volume %)		
	0	16.7	32.2
0	3507 1	172600 #1 1 110500 #2 1	83080200 #3 1
15	735 1	9583 1	449650 1

1. shear rate of 1s⁻¹
2. shear rate of 10s⁻¹
3. shear rate of 0.001s⁻¹

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	16.7	32.2
0	3707 1		
15	786 1	9905 1	455065 1

Pour Point (°C)

	Weathering (Volume %)		
	0	16.7	32.2
-15 1	3 1	21 1	

Interfacial Tensions**Air-Oil (mN/M or dynes/cm)**

(°C)	Weathering (Volume %)		
	0	16.7	32.2
0	30.6 1	N/M 1	N/M 1
15	29.2 1	30.3 1	N/M 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		
	0	16.7	32.2
0	26.6 1	N/M 1	N/M 1
15	15.8 1	22.8 1	N/M 1

Hondo Crude Oil

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		
	0	16.7	32.2
0	28.3 1	N/M 1	N/M 1
15	22.5 1	29.8 1	N/M 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	16.7	32.2
0	0 1	0 1	0 1
15	0 1	0 1	0 1

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	16.7	32.2
0	0 1	0 1	0 1
15	0 1	0 1	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	16.7	32.2
0	N/A 1	N/A 1	N/A 1
15	N/A 1	N/A 1	N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	2 1
Dasic	0 1
EN 700	1 1

Fire and Reactivity

Flash Point (°C)

Weathering	(Volume %)	
	0	32.2
0	16.7	32.2
-5 1	71.2 2	> 90 2

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	100 1	52 1
5	137 1	85 1
10	216 1	112 1
15	269 1	163 1
20	314 1	191 1
25	354 1	210 1
30	381 1	227 1
35	395 1	231 1
40	403 1	238 1
45	409 1	238 1
50	414 1	243 1

Weathering

T_G = 1193.8
 T_O = 358.3 (ESD 91)

Solubility

Aqueous Solubility (mg/L)

Freshwater 20.91 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 12.4 1

Wax Content (Weight %)

6.2 1

Metal Content

Other Metals (ppm)

	Weathering (Volume %)		
	0	16.6	32.2
Strontium	2.3 2	< 0.6 2	0.6 2
Potassium	< 1.5 2	< 1.5 2	< 1.5 2
Zinc	0.5 2	< 0.6 2	< 0.6 2
Lead	< 4 2	< 3 2	< 3 2
Nickel	75 2	80.4 2	88 2
Iron	30.5 2	3.3 2	3 2
Chromium	< 1.5 2	2.3 2	< 1.5 2
Magnesium	5.4 2	5.6 2	9.1 2
Vanadium	196 2	218 2	228 2
Copper	< 0.6 2	0.7 2	1.5 2
Titanium	1.6 2	2.0 2	2.0 2
Barium	0.3 2	0.3 2	0.3 2
Selenium			< 15 2
Cobalt			< 1 2
Manganese			< 0.3 2
Calcium			99.5 2
Aluminum			7.8 2
Strontium			0.94 2
Cadmium			< 0.5 2
Tin			< 15 2
Mercury			< 15 2

References

¹ ESD 91

² ESD 92

Hutton Crude Oil

U.K.

Mass and Weight

API Gravity (15/15°C)

30.5 1

Density (g/mL)

(°C)

Unknown 0.8730 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)

38 10.9 1

Metal Content

Other Metals (ppm)

Nickel/Vanadium 4.75 1

Non-Metal Content

Sulphur (Weight %)

0.65 1

References

1 NSD 88

IF-30 Bunker Fuel Oil

IF-30 Bunker Fuel Oil

High density refinery product which consists of Gasoils (approximately 35%) and Bunker C (65%).

Mass and Weight

API Gravity (15/15°C)

19.7 1

Density (g/mL)

(°C)	Weathering	(Volume %)	
	0	3.0	11.7
15.5	0.935 1	0.940 1	0.953 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering	(Volume %)	
	0	3.0	11.7
13	236 1	314 1	966 1

Pour Point (°C)

Weathering	(Volume %)	
0	3.0	11.7
-6 1	0 1	6 1

Interfacial Tensions

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering	(Volume %)	
	0	3.0	11.7
13	26 1	26 1	30 1

Emulsion

Emulsion Formation Tendency

Forms emulsions with high stability and high viscosity.
(Daling 91)

Dispersibility

Chemical Dispersibility (% Dispersed)

High chemical dispersibility. (Daling 91)

Fire and Reactivity

Flash Point (°C)

Weathering		(Volume %)
0	3.0	11.7
84 1	99 1	130 1

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
3.0	270 1	200 1
11.7	305 1	250 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Weathering		(Volume %)
0	3.0	11.7
Saturates		19.0 1
Aromatics		63.4 1
Polars		12.1 1
Asphaltenes		5.5 1
Asphaltenes "Hard"	4.06 1	4.15 1
Asphaltenes "Soft"	3.87 1	3.96 1
		4.46 1
		4.75 1

Wax Content (Weight %)

Weathering		(Volume %)
0	3.0	11.7
2.49 1	2.54 1	7.74 1

References

¹ Daling 91

Interprovincial Crude Oil

Canada

Mass and Weight

API Gravity (15/15°C)

36.4 ¹

Density (g/mL)

(°C)
Unknown 0.8430 ¹

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
38 4.80 ¹

Pour Point (°C)

2.0 ¹

Non-Metal Content

Sulphur (Weight %)

0.42 ¹

References

¹ NSD 88

Iranian Heavy Crude Oil

Iran

Mass and Weight

API Gravity (15/15°C)

30.0 2
31.0 3

Density (g/mL)

(°C)	Weathering (Volume %)		24.8
	0	13.7	
Unknown	0.8710 3		
0	0.8883 2	0.9168 2	0.9372 2
15	0.8756 2	0.9046 2	0.9247 2

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		24.8
	0	13.7	
0	42.84 2	273.8 2	5579 #1 2 15963 #2 2
15	20.37 2	70.39 2	254.5 2

#1. Shear rate 10/s
#2. Shear rate 1/s

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		24.8
	0	13.7	
0	48.2 2	298.6 2	
15	23.3 2	77.81 2	275.2 2
38	9.40 3		

Pour Point (°C)

	Weathering (Volume %)		24.8
	0	13.7	
-22 2	-2 2		1 2
-21 3			

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	24.8
0	26.4 2	N/M 2
15	26.1 2	29.5 2

Iranian Heavy Crude Oil

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)	
	0	24.8
0	18.3 2	N/M 2
15	22.5 2	23.2 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)	
	0	24.8
0	19.0 2	N/M 2
15	22.5 2	24.7 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	13.7	28.4
0	1.0 2		
15	1.0 2	1.0 2	1.0 2

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	13.7	28.4
0	1.0 2		
15	1.0 2	1.0 2	1.0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	13.7	28.4
0	89.7 2		
15	89.8 2	89.7 2	87.9 2

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	10 1
Dasic	5 1
EN 700	10 1
CRX-8	10 1

Fire and Reactivity

Flash Point (°C)

Weathering	(Volume %)	
0	13.7	24.8
-14.5 2	42.9 2	> 90 2

Solubility

Aqueous Solubility (mg/L)

Freshwater 25.2 2

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 3.4 2

Wax Content (Weight %)

4.3 2
4.40 3

Metal Content

Other Metals (ppm)

Molybdenum	< 0.6	2
Potassium	< 1.5	2
Zinc	< 0.6	2
Lead	< 3	2
Nickel	22.6	2
Iron	6.0	2
Chromium	< 1.5	2
Magnesium	8.8	2
Vanadium	81	2
Copper	0.6	2
Titanium	< 0.6	2
Barium	< 0.3	2
Selenium	< 15	2
Cobalt	< 1	2
Manganese	< 0.3	2
Calcium	82.6	2
Aluminum	5.4	2
Strontium	< 0.2	2
Cadmium	< 0.5	2
Tin	< 15	2
Mercury	< 15	2
Vanadium/Nickel	2.93	3

Non-Metal Content

Sulphur (Weight %)

1.62³

References

¹ ESD 91

² ESD 92

³ HSD 88

Issungnak Crude Oil

Northwest Territories, Canada

Mass and Weight

API Gravity (15/15°C)

35.0 3

Density (g/mL)

For Fv < 25.0% & T between 0 and 15°C

$$\text{DEN} = 0.861749 + 0.001289 \text{ Fv} - 0.001213 \text{ T}$$

Where: DEN is density of oil at T and Fv (g/mL)

Fv is volume percent of oil weathered

T is oil temperature (°C)

(°C)	Weathering (Weight %)			15.1 (Vol%)	25.0 (Vol%)
	0	4	12		
0	0.8636 2			0.8806 2	0.8897 2
15	0.849 1			0.8682 2	0.8773 2
20	0.8284 6	0.8459 6	0.8469 6		

Viscosity

Kinematic Viscosity (mm²/sec or cst)

(°C)	Weathering (Weight %)		
	0	4	12
-10	DNF 6	DNF 6	DNF 6
0	199.4 6	DNF 6	DNF 6
15	3.652 6	6.008 6	6.248 6
25	3.005 6	4.564 6	4.566 6

Note: DNF = did not flow

Pour Point (°C)

	Weathering (Weight %)			15.1 (Vol%)	25.0 (Vol%)
	0	4	12		
	5 6	6 6	7 6	11 2	13 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		
	0	15.1	25.0
0	31.3 2	N/M 2	N/M 2
15	26.2 2	27.7 2	28.5 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		
	0	15.1	25.0
0	28.2 2	N/M 2	N/M 2
15	16.8 2	17.0 2	12.5 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		
	0	15.1	25.0
0	30.7 2	N/M 2	N/M 2
15	16.7 2	23.4 2	21.5 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	15.1	25.0
0	1.0 3	1.0 3	1.0 3
15	0 2	0.30 3	1.0 3

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	15.1	25.0
0	1.0 3	1.0 3	1.0 3
15	0 2	0.25 3	0.40 3

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	15.1	25.0
0	90.0 3	63.6 3	86.7 3
15	N/A 3	66.7 3	50 3

Dispersibility

Chemical Dispersibility (% Dispersed)

EN 700 50 4

Natural Dispersibility (% Dispersed)

(°C)	
15	8 7

Fire and Reactivity

Flash Point (°C)

Weathering (Weight %)		
0	4	12
-10 6	-16 6	48 6

Fire Point (°C)

Weathering (Weight %)		
0	4	12
-10 5	-16 5	57 5

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp	Liquid Temp (15.1%)	Vapour Temp (15.1)
IBP	175 2	59 2	230 2	129 2
5	189 2	112 2	244 2	152 2
10	212 2	126 2	259 2	164 2
15	237 2	145 2	274 2	174 2
20	256 2	164 2	285 2	224 2
25	270 2	207 2	296 2	232 2
30	283 2	226 2	309 2	233 2
35	295 2	237 2		
40	305 2	255 2		

Weathering

T_O = 448.0
 T_G = 325.0 (EETD 85)

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	91.5 3
Aromatics	2.7 3
Polars	0.3 3
Asphaltenes	0.4 3
	0.5 4

Non-Metal Content

Sulphur (Weight %)

Weathering (Volume %)		
0	15.1	25.0
0.08 3	0.07 3	0.10 3

References

1 EETD 84

5 Engelhardt 84

2 EETD 85

6 Esso 83

3 EETD 86

7 Fingas 90a

4 EETD 89

Isthmus Blend Crude Oil

Mexico

Mass and Weight

API Gravity (15/15°C)

33.0 1
32.7 4

Density (g/mL)

(°C)	
15	0.861 4

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
	0
10	16.05 4
15.9	22.9 1
20	10.65 4
	5.5 2
37.8	7.1 3
39	6.81 1

Pour Point (°C)

-16 3
-27 4
-16 2

Distillation

Yield on Crude

	Weight %	Volume %
Gas to C ₄	0.7 4	0.85 4
Lt. Distillate to 149°C	14.55 4	17.5 4
Kerosene 149-232°C	16.5 4	17.95 4
Gas Oil 232-342°C	19.5 4	19.8 4
Residuum above 342°C	48.75 4	43.9 4

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Paraffins	12	vol %	1
Aromatics	1.4	vol %	1
Naphthenes	3.6	vol %	1
Asphaltenes	0.9		4
	1.5		2

Metal Content

Other Metals (ppm)

Vanadium	21.1	3
	30.0	4
Nickel	3.0	3
	5.0	4

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

	3.5	3
	4.2	4

Sulphur (Weight %)

	1.56	1
	1.7	3
	1.61	4

Other

Reid Vapour Pressure (kPa)

(°C)		
37.8	22.8	1
	38.6	3
	38.6	2

References

1 McCaslin 79

2 NSD 88

3 Perez 79

4 PetroCan 80

Khafji

Al Faiha

Divided Zone between Kuwait and Saudi Arabia

Mass and Weight

API Gravity (15/15°C)

28.0 1
28.5 2

Density (g/mL)

(°C)	
Unknown	0.8840 2
15	0.8872 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
10	56.72 1
27.0	21.3 2
30	21.33 1
37.8	21.0 1

Pour Point (°C)

-35 2
< -48 1

Fire and Reactivity

Flash Point (°C)

< -35.0 (C.C) 1

Distillation

Distillation (°C)

(Vol%)	
6	100 1
12.5	140 1
15.5	160 1
22.0	200 1
26.0	220 1
28.5	240 1
33.0	270 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

4.32 1
4.32 2

Wax Content (Weight %)

2.7 1
4.80 2

Metal Content

Other Metals (ppm)

Aluminum	0.6	1
Calcium	< 1	1
Chromium	< 1	1
Cobalt	< 1	1
Copper	1	1
Iron	3	1
Lead	< 1	1
Magnesium	< 1	1
Manganese	< 1	1
Molybdenum	< 1	1
Nickel	16	1
Potassium	< 1	1
Silicon	< 1	1
Sodium	1	1
Tin	< 6	1
Vanadium	55	1
Zinc	< 1	1

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

8.04 1

Nitrogen (Weight %)

0.110 1

Sulphur (Weight %)

2.85 2
2.70 1

Salt Content

Salt (g/m³)

25.8 1

Other

Ash (Weight %)

0.012 1

Reid Vapour Pressure (kPa)

(°C)

37.8

37.2 1

Compositional Analysis

	<u>Volume %</u>
Ethane	0.08 1
Propane	0.71 1
iso-Butane	0.33 1
Butane	1.43 1
iso-Pentane	0.94 1
Pentane	1.64 1

References

1 Caltex 92

2 NSD 88

Koakoak 0-22 Crude Oil

Beaufort Sea, Canada

Mass and Weight

API Gravity (15/15°C)

28.1 1

Density (g/mL)

(°C)	
15.6	0.8887 1
21	0.8858 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
20	19.98 1
30	12.91 1
40	8.890 1

Pour Point (°C)

-48 1

References

1 Dome 84

Koakoak 0-22A Crude Oil

Beaufort Sea, Canada

Mass and Weight

API Gravity (15/15°C)

29.5 1

Density (g/mL)

(°C)	
15.6	0.8785 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
20	10.323 1
30	6.836 1
40	5.022 1

Pour Point (°C)

< 60 1

References

1 Dome 84

Kopanoar 2I-44 Crude Oil

Beaufort Sea, Canada

Mass and Weight

API Gravity (15/15°C)

29.3 1

Density (g/mL)

(°C)

15.6

0.8685 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
20	12.60 1
30	8.87 1
40	6.774 1

Pour Point (°C)

-21.6 1

References

1 Dome 84

Kopanoar Crude Oil

Beaufort Sea, Canada

Mass and Weight**API Gravity (15/15°C)**

25.7 1

Density (g/mL)

(°C)	Weathering (Weight %)		11.6
	0	3.7	
16	0.8992 1	0.9002 1	0.9012 1
20	0.900 2	0.901 2	0.902 2

Viscosity**Dynamic Viscosity (mPa.s or cP)**

(°C)	Weathering (Weight %)		11.6
	0	3.7	
0	57 1	75 1	104 1
15	33 1	41 1	54 1
25	17.5 1	24 1	30 1

Pour Point (°C)

Weathering (Weight %)	11.6
-37 1	-19 1

Fire and Reactivity**Flash Point (°C)**

Weathering (Weight %)	11.6
75 1	118 1

Fire Point (°C)

Weathering (Weight %)	11.6
85 2	125 2

Distillation**Initial Boiling Point (°C)**

84 2

Solubility

Aqueous Solubility (mg/L)

Weathering		(Weight %)	
0		3.7	11.6
10.4	2	8.9	3.0
			2

References

¹ Engelhardt 84

² Mackay 80a

Kopanoar M-13 Crude Oil

Beaufort Sea, Canada

Mass and Weight

API Gravity (15/15°C)

30.9 ¹

Density (g/mL)

(°C)	
15.6	0.8939 ¹

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
10	61.4 ¹
20	33.97 ¹
30	21.67 ¹
40	14.38 ¹

Pour Point (°C)

2.7 ¹

References

¹ Dome 84

Kopanoar M-13A Crude Oil

Beaufort Sea, Canada

Mass and Weight

API Gravity (15/15°C)

26.7 1

Density (g/mL)

(°C)	
21	0.8938 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
0	219.8 1
4.4	128.0 1
10	74.85 1
15.4	43.21 1
20	40.12 1
30	28.46 1

Pour Point (°C)

-17.5 1

Hydrocarbon Group

Wax Content (Weight %)

0.22 1

References

¹ Dome 84

Kuparuk Crude Oil

North Slope, Alaska

Blended with Sadlerochit Crude to produce North Slope Crude. Trans Alaska pipeline to Valdez terminal.

Mass and Weight

API Gravity (15/15°C)

23.0 1
28.2 2

Density (g/mL)

(°C)	
15.6	0.886 2
21	0.9150 1

ViscosityKinematic Viscosity (mm²/sec or cSt)

(°C)	
15.6	79.98 1

Pour Point (°C)

-55 1

Distillation

Distillation (°C)

(Vol%)	
IBP	69 2
3.3	100 2
9.2	125 2
12.4	150 2
17.1	175 2
21.8	200 2
26.2	225 2
31.6	250 2
38.0	275 2

Kuparuk Crude Oil

Yield on Crude

	Range, °C	Volume %
< C ₅		2.12 1
Light Gasoline	C ₅	1.60 1
	to 65	
Naphtha	65	14.5 1
	to 193	
Distillate	193	26.9 1
	to 343	
Residuum	> 343	56.0 1

Metal Content

Other Metals (ppm)

Nickel	19 1
Vanadium	57 1

Non-Metal Content

Hydrogen Sulfide - Existent (mg/m³)

< 361 1

Carbon Residue - Ramsbottom (Weight %)

7.37 1
5.5 2

Nitrogen (Weight %)

1980 ppm 1
0.160 2

Sulphur (Weight %)

0.65 2
1.76 1

Sensation

Colour

Brownish black 2

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	17.88 ¹

References

¹ Aalund 83

² Coleman 78

Kuwait Crude Oil

Kuwait

Mass and Weight

API Gravity (15/15°C)

30.6 1

Density (g/mL)

(°C)	Weathering (Volume %)		
	0	9.6	20.9
0	0.8833 1	0.9064 1	0.9279 1
15	0.8722 1	0.8977 1	0.9165 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		
	0	9.6	20.9
0	89.5 1	1250 1	29000 1
15	22.2 1	55.5 1	182 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	9.6	20.9
0	72.0 1	1379 1	31254 1
15	28.2 1	61.8 1	199 1

Pour Point (°C)

Weathering (Volume %)		
0	9.6	20.9
-18 1	-9 1	3 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		
	0	9.6	20.9
0	28.0 1	29.6 1	31.4 1
15	27.8 1	27.9 1	30.5 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		
	0	9.6	20.9
0	13.4 1	21.1 1	24.5 1
15	22.9 1	18.2 1	18.5 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		
	0	9.6	20.9
0	29.1 1	24.8 1	27.3 1
15	28.6 1	21.1 1	27.0 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	9.6	20.9
0	1.0 1	1.0 1	0.0 1
15	1.0 1	1.0 1	1.0 1

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	9.6	20.9
0	1.0 1	1.0 1	0 1
15	1.0 1	1.0 1	1.0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	9.6	20.9
0	90.0 1	90.0 1	N/A 1
15	90.0 1	90.0 1	90.0 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	5 2
CRX-8	5 2

Fire and Reactivity

Flash Point (°C)

< 25 1

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	119 1	39 1
5	172 1	97 1
10	205 1	130 1
15	236 1	153 1
20	267	181 1
25	301 1	208 1
30	333 1	239 1
35	366 1	264 1
40	392 1	296 1
45	412 1	312 1
50	424 1	325 1
55	434 1	335 1
60	441 1	341 1
65	446 1	342 1
70	451 1	
75	458 1	

Weathering

T_O = 402.1

T_G = 700.6 (EETD 86)

Non-Metal Content

Sulphur (Weight %)

Weathering (Volume %)	
9.6	20.9
2.69 1	3.18 1

References

1 EETD 86

2 EETD 87

Kuwait Crude Oil (Literature Values)

Mass and Weight

API Gravity (15/15°C)

31.1 6
 31.1 5
 31.4 9
 31.2 8

Density (g/mL)

(°C)	Weathering (Volume %)		38.1
	0	9	
15	0.870 5		
16	0.8692 6	0.895 3	0.955 3
unknown	0.869 4		

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Weight %)				
	0	15.1	19.5	26.7	33.0
10	19 6	97 6	163 6	865 6	2279 6

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
38	10.0 8
	10.6 4
50	7.6 5
	7.6 6

Pour Point (°C)

-20 6
 -20 5
 -20 11
 -18 8
 -20 4
 -17 4

Kuwait Crude Oil (Literature Values)

Distillation

Distillation (°C)

(Wt%)	
8.3	5
	to 100 6
9.1	100
	to 160 6
12.4	160
	to 250 6
16.0	250
	to 350 6
54.2	> 350 6

Solubility

Aqueous Solubility (mg/L)

Distilled Water	35.3	7
Seawater	21.72	1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Naphtha < 204°C	22.7	9
Saturates	34.0	9
	54.3	10
	54.58	10
	42.4	10
	56.7	10
	43.5	10
	50.2	2
	34.2	9
	25.7	10
	30.06	10
Aromatics	40.4	10
	24.3	10
	41.6	10
	28.4	2
	17.9	9
	17.9	10
	11.57	10
	14.8	10
	17.9	10
	13.8	10
Polars	17.0	2
	3.5	9
	2.6	10
	3.5	10
	1.1	10
	3.5	2
	1.45	6
	0.80	8
Asphaltenes		

Wax Content (Weight %)

5.5	6
3.9	8

Metal Content

Other Metals (ppm)

Nickel	7.7	9
Vanadium	28	9

Non-Metal Content

Nitrogen (Weight %)

0.14 ⁹

Sulphur (Weight %)

2.44 ⁹

2.53 ⁵

2.50 ⁸

Other

Reid Vapour Pressure (kPa)

(°C)

37.8

37.2 ⁸

References

1 Anderson 74

2 Clark 77

3 Curl 77

4 Fina 82

5 HMSO 76

6 Lynch 81

7 Murray 84

8 NSD 88

9 Pancirov 74

10 Waters 82

11 Wheeler 78

La Rosa Crude Oil

Venezuela

Mass and Weight

API Gravity (15/15°C)

25.3 ³
25.3 ⁴

Density (g/mL)

(°C)	Weathering (Volume %)
	0
0	0.923 1
5	0.921 1
10	0.917 1
15	0.914 1
20	0.911 1
25	0.908 1

Note: DEN = 0.923 - 0.000617 T

Where: DEN is the density of fresh oil at T (g/mL)
T is oil temperature (°C)

(Mackay 82a)

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
0	640 1
5	423 1
10	282 1
15	180 1
20	135 1
25	104 1

Note: VISC = exp((6046/(T + 273)) - 15.7)

Where: VISC is the viscosity of fresh oil at T (mPa.s)
T is oil temperature (°C)

(Mackay 82a)

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
	0
0	693 1
5	459 1
10	308 1
15	197 1
20	148 1
25	115 1
50	24 4

Pour Point (°C)

-30 1
-46 4

Solubility

Aqueous Solubility (mg/L)

Seawater 19.97 2

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates 66.1 1
Aromatics 23.2 1
Polars 4.48 1
Asphaltenes 6.23 1

Wax Content (Weight %)

9.9 1

Non-Metal Content

Sulphur (Weight %)

1.76 4
1.73 3

Other

Reid Vapour Pressure (kPa)

(°C)
37.8 27.2 4

References

1 Mackay 82a

2 McAuliffe 77

3 Nelson 69

4 NSD 88

Lago Medio Crude Oil

Venezuela

Mass and Weight

API Gravity (15/15°C)

32.6 10

31.5 11

Density (g/mL)

$$\text{DEN} = 0.880 + 0.00167 \text{ Fv} - 0.00056 \text{ T}$$

Where: DEN is density at Fv & T (g/mL)

Fv is volume fraction weathered

T is oil temperature (°C)

(°C)	Weathering (Volume %)		
	0	8.9	14.8
0	0.880 3	0.898 3	0.906 3
15	0.872 3	0.891 3	0.897 3

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		
	0	8.9	14.8
0	4355 3	7800 3	16500 3
15	41.1 3	83.6 3	265 3

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	8.9	14.8
0	4949 11	8686 11	18212 11
15	47.1 11	93.8 11	295 11
38	9.2 11		

Pour Point (°C)

-26 10

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		
	0	8.9	14.8
0	N/M 3	N/M 3	N/M 3
15	28.2 3	27.5 3	29.6 3

Lago Medio Crude Oil

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		
	0	8.9	14.8
0	N/M 3	N/M 3	N/M 3
15	12.4 3	14.4 3	17.1 3

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		
	0	8.9	14.8
0	N/M 3	N/M 3	N/M 3
15	23.2 3	23.7 3	20.5 3

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	8.9	14.8
0	0.9 3	1.0 3	1.0 3
15	1.0 4	1.0 4	1.0 4

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	8.9	14.8
0	0.92 3	0.9 3	1.0 3
15	1.0 4	1.0 4	1.0 4

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	8.9	14.8
0	89.1 3	84.9 3	73.4 3
15	88.5 4	87.2 4	86.1 4

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	5	5
Dasic	5	5
EN 700	10	5
CRX-8	10	5

Natural Dispersibility (% Dispersed)

(°C)	
15	4 8

Fire and Reactivity

Flash Point (°C)

57 3

Distillation**Weathering**T₀ = 458.0T_G = 615.0 (Stiver 82)**Solubility**

Aqueous Solubility (mg/L)

	22 °C		
Fresh Water	12.10	9	8.40
Seawater	9.79	9	
Distilled	25.5	1	
	0.61	#1 1	
#1 Weathered (Wt%)	22.3%		

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 4.53 5

Wax Content (Weight %)

10.2 6

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	48h LC ₅₀		48h EC ₅₀	
Daphnia Magna	7.7	1	3.22	9
	> 24.1	9	2.2	2
	> 8.4	2		
	> 0.6	#1 1		
Artemia spp.	9.79	9	8.68	9
	6.7	2	6.0	2

#1 Weathered (Wt%) 22.3%

Note: Results from (Maclean 88) obtained by fluorescence spectroscopy.
Results from (Bobra 88) obtained by purge-and-trap GC analysis.

Metal Content

Other Metals (ppm)

Molybdenum	<	0.6	7
Potassium	<	1.5	7
Zinc	<	0.6	7
Lead	<	3	7
Nickel		5.6	7
Iron	<	3	7
Chromium	<	1.5	7
Magnesium		3.8	7
Vanadium		163	7
Copper	<	0.6	7
Titanium	<	0.6	7
Barium	<	0.3	7
Nickel/Vanadium		10.23	11
Cadmium	<	0.5	7
Selenium		22	7
Cobalt	<	1	7
Manganese	<	0.31	7
Calcium		420	7
Aluminum	<	5	7
Strontium		0.2	7
Tin	<	15	7
Mercury	<	15	7

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

4.36 10

Sulphur (Weight %)

1.23 10

1.17 11

Other

Reid Vapour Pressure (kPa)

(°C)

37.8

15.5 3

36.1 11

References

1 Bobra 83

5 EETD 89

9 MacLean 88

2 Bobra 88

6 ESD 91

10 McCaslin 79

3 EETD 84

7 ESD 92

11 NSD 88

4 EETD 85

8 Fingas 90a

Lagotreco Crude Oil

1961 Production sample from Bachaquero/Puerto Miranda export terminal.

Mass and Weight

API Gravity (15/15°C)

27.3 1

Density (g/mL)

(°C)	
15	0.891 1

ViscosityKinematic Viscosity (mm²/sec or cSt)

(°C)	
21	34.8 1
38	17.5 1

Pour Point (°C)

-48 1

Distillation

Yield on Crude

	Weight %	VOL %
Gas	0.34 1	0.48 1
But. Gasoline to 149°C	11.22 1	13.62 1
Kerosene 149-232°C	11.21 1	12.38 1
Gas Oil 232-343°C	19.16 1	19.76 1
Residuum above 343°C	58.07 1	53.76 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 2.0 1

Wax Content (Weight %)

5.2 1

Metal Content

Other Metals (ppm)

Vanadium	127	1
Nickel	12	1

Non-Metal Content

Hydrogen Sulfide - Existent (mg/m³)

NIL Wt% 1

Carbon Residue - Ramsbottom (Weight %)

5.3 1

Sulphur (Weight %)

1.41 1

Salt Content

Salt (g/m³)

3 1

Other

Ash (Weight %)

0.026 1

Water Content of Oil (Volume %)

0.5 1

References

¹ PetroCan 72

Leduc Woodbend Crude Oil

Alberta, Canada

Mass and Weight

API Gravity (15/15°C)

39.7	2
39.8	1

Density (g/mL)

(°C)	
<hr/>	
Unknown	0.8270 2
	0.826 1

ViscosityKinematic Viscosity (mm²/sec or cSt)

(°C)	
<hr/>	
37.8	3.8 1
38.0	4.0 2

Fire and Reactivity

Flash Point (°C)

< -15 1

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

7.6 1

Sulphur (Weight %)

0.28	2
0.30	1

Sensation

Colour

Brownish green 1

References

1 Bland 67

2 NSD 88

Light Sour Blend Crude Oil

Light Sour Blend Crude Oil

Saskatchewan

Blend of light, moderately low sulphur crudes from fields in Saskatchewan. Sample from pipeline blend delivered to Trafalgar Refinery, September 1970.

Mass and Weight

API Gravity (15/15°C)

35.9 2

Density (g/mL)

(°C)	
20	0.8415 2

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
21	6.80 2
38	4.13 2

Pour Point (°C)

-12 2

Distillation

Yield on Crude

	Weight %	Volume %
Gas	0.95 2	1.20 2
But. Gasoline to 149°C	21.40 2	24.95 2
Kerosene 149-232°C	14.80 2	15.60 2
Gas Oil 232-343°C	21.20 2	20.95 2
Residuum above 343°C	41.65 2	37.30 2

Solubility

Aqueous Solubility (mg/L)

Distilled Water 72.1 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 1.0 ²

Wax Content (Weight %)

6.2 ²

Metal Content

Other Metals (ppm)

Vanadium 7 ²

Nickel 5 ²

Non-Metal Content

Hydrogen Sulfide - Existent (mg/m³)

0.02 Wt% ²

Carbon Residue - Ramsbottom (Weight %)

2.9 ²

Sulphur (Weight %)

1.0 ²

Other

Water Content of Oil (Volume %)

< 0.01 ²

References

¹ Murray 84

² PetroCan 72

Lloydminster Crude Oil

Alberta and Saskatchewan, Canada

Mass and Weight

API Gravity (15/15°C)

16.2 3
20.7 1

Density (g/mL)

(°C)	Weathering (Weight %)		
	0	10	20
0	0.910 2		
5	0.908 2		
10	0.906 2		
15	0.902 2		
20	0.900 2	0.923 2	0.937 2
21	0.9289 1		
25	0.897 2		

Notes: 0.90 @ room temp (Twardus 80)

DEN = 0.910 - 0.00053 T

DEN is density of fresh oil at T (g/mL)

T is oil temperature (°C)

(Mackay 82a)

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)	
	0	
0	180 2	
	126 5	
5	113 2	
10	80.1 2	
	86.1 5	
15	62.7 2	
20	47.6 2	
	52.3 5	
25	35.6 2	

Note: $VISC = \exp((5100/(T + 273)) - 13.6)$

Where: VISC is the viscosity of fresh oil at T (mPa.s)

exp is exponential base e

T is oil temperature (°C)

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)	
	0	
0	198	2
5	124	2
10	88.4	2
15	69.5	2
20	52.9	2
25	39.7	2
40	101.00	1

Pour Point (°C)

	Weathering (Weight %)		
	0	10	20
	-36 2	-36 2	-21 2
	-52 5		
	-32 1		

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
Room Temp.	25 5

Oil-Water (mN/m or dynes/cm)

(°C)	
Room Temp.	31.2 5

Fire and Reactivity

Flash Point (°C)

11 (o.c.) 5

Fire Point (°C)

17 5

Combustion Results

easily ignited, 6.1 Vol% residue 5

Lloydminster Crude Oil

Distillation

Distillation (°C)

(Vol%)	
0	40 5
10	110 5
20	190 5
30	260 5
40	290 5
50	335 5
60	345 5
70	356 5
80	371 5
90	380 5

Yield on Crude

	Range	Volume %
Naphtha	C5	19.50 1
	to 190	
Kerosene	190	9.80 1
	to 277	
Distillate	277	9.50 1
	to 343	
Gas Oil	343	25.20 1
	to 565	
Residuum	> 565	36.00 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

	Weathering (Weight %)		
	0	10	20
Saturates	68.4 2	66.0 2	62.7 2
Aromatics	22.3 2	22.2 2	24.0 2
Polars	3.75 2	3.18 2	3.36 2
Asphaltenes	5.58 2	8.68 2	9.87 2

Wax Content (Weight %)

	Weathering (Weight %)		
	0	10	20
	5.47 2	9.36 2	11.1 2

Metal Content

Other Metals (ppm)

Nickel	52.70	1
Vanadium	10.50	1

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

9.18 1

Sulphur (Weight %)

31500 ppm 1

Other

Reid Vapour Pressure (kPa)

(°C)		
37.8	30.3	4
	30.3	1

References

1 Aalund 83c
5 Twardus 80

2 Mackay 82a

3 Nelson 69

4 NSD 88

Lubricating Oil (Extreme Pressure Gear Oil)

API 6L-5 Service
Hydraulic Oil 30
SAE 140

Mass and Weight

API Gravity (15/15°C)

14 5
22 5
25 5

Density (g/mL)

(°C)	Weathering (Volume %)
	0
0	0.8925 2
15	0.8827 2
	0.8900 7

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
0	4060 2
15	975 2

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
	0
0	4549 2
15	1104 2
37.8	432 5
	442 5
	710 5
	780 5
98.9	25
	to 42.7 5
100	12.0 7

Pour Point (°C)

-7 5
-9 5
-15 5
-15 7

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
	0
0	30.1 2
15	29.7 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)
	0
0	3.6 2
15	2.8 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
	0
0	4.2 2
15	3.4 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
	0
0	1.0 2
15	1.0 2

Emulsion Stability

(°C)	Weathering (Volume %)
	0
0	1.0 2
15	1.0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
	0
0	30.6 2
15	57.9 2

Dispersibility

Natural Dispersibility (% Dispersed)

(°C)	0
0	23.6 2
15	21.6 2

Fire and Reactivity

Flash Point (°C)

193	5
199	5
266	5
235 (O.C.)	7

Distillation

Boiling Range (°C)

320
to 615 7

Solubility

Aqueous Solubility (mg/L)

		22 °C
Fresh Water	2.3 6	0.8 8
Seawater	1.66 6	

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 0.41 3

Wax Content (Weight %)

1.64 3

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	48h EC ₅₀	48h LC ₅₀
Daphnia Magna	0.92 ⁶ 0.31 ¹	> 2.38 ⁶ > 0.80 ¹
Artemia spp.	> 1.66 ⁶ > 0.64 ¹	> 1.66 ⁶ > 0.64 ¹

Note: Results from (Maclean 88) obtained by fluorescence spectroscopy.
Results from (Bobra 88) obtained by purge-and-trap
GC analysis.

Metal Content

Other Metals (ppm)

Molybdenum	< 0.6	4
Potassium	10.1	4
Zinc	488	4
Lead	< 3	4
Nickel	< 1	4
Iron	< 4	4
Chromium	< 1.5	4
Magnesium	235	4
Vanadium	0.6	4
Copper	11.4	4
Titanium	< 0.6	4
Barium	22.4	4

Non-Metal Content

Sulphur (Weight %)

1.10²

Sensation

Colour

Yellow Oil⁷

References

¹ Bobra 88
⁵ Esso 73

² EETD 86
⁶ MacLean 88

³ EETD 89
⁷ MSDS 90

⁴ ESD 92
⁸ Suintio 86

Lubricating Oil (Used Crankcase Oil)

Lubricating Oil (Used Crankcase Oil)

Used motor oil 10W30

Mass and Weight

API Gravity (15/15°C)

28.3 2

Density (g/mL)

(°C)	Weathering (Volume %)
0	0
0	0.8945 2
15	0.8848 2
15.6	0.906 5

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	0
0	452.1 2
15	175.2 2

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
0	0
0	505.4 2
15	198.0 2
37.8	29.0 5
99	6.09 5

Pour Point (°C)

-36 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	31.6 2
15	31.0 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	24.2 2
15	21.0 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
	0
0	27.1 2
15	24.4 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
	0
0	1.0 2
15	1.0 2

Emulsion Stability

(°C)	Weathering (Volume %)
	0
0	1.0 2
15	0.70 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
	0
0	57.9 2
15	72.8 2

Dispersibility

Chemical Dispersibility (% Dispersed)

	% Effectiveness
C9527	33 3
CRX-8	31 3
ENER 700	36 3
Dasic	29 3

Natural Dispersibility (% Dispersed)

(°C)	
15	17 4

Fire and Reactivity

Flash Point (°C)

58.5 5

Lubricating Oil (Used Crankcase Oil)

Solubility

Aqueous Solubility (mg/L)

		22 °C
Fresh Water	19.1 6	0.6 7
Seawater	12.83 6	

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	86.3 8
	76.6 5
Aromatics	12.9 8
	4.1 5
Polars	0.8 8
	3.8 5
Asphaltenes	0 8
Volatiles	3.2 5

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	48h EC ₅₀	48h LC ₅₀	96h LC ₅₀
Daphnia Magna	4.65 6	4.87 6	
	0.15 1	0.16 1	
Artemia spp.	> 12.8 6	> 12.8 6	
	> 0.48 1	> 0.48 1	
Juvenile American Flayfish			362 #1 5
			9.5 #2 5

Note: Results from (Maclean 88) and (Hedtke 80) obtained by fluorescence spectroscopy. Results from (Bobra 88) obtained by purge-and-trap GC analysis.

1. Static test
2. Flowthrough test

Acute Toxicity, Oil in Water Emulsion (mg/L)

	96h LC ₅₀
Juvenile American Flayfish	4.85 #1 5
	0.827 #2 5

1. Static test
2. Flowthrough test

Metal Content

Other Metals (ppm)

Aluminum	15
Copper	18
Iron	220
Lead	18500
Silicon	17
Antimony	6
Sodium	59 5
Calcium	688
Barium	177
Zinc	1360
Magnesium	410

Non-Metal Content

Nitrogen (Weight %)

0.090 5

Sulphur (Weight %)

0.29 2

0.54 5

References

1 Bobra 88

5 Hedtke 80

2 EETD 86

6 MacLean 88

3 Fingas 90

7 Surtio 86

4 Fingas 90a

8 Waters 78

Lubricating Oil (Virgin Crankcase Oil)

10W30

5W30

Crankcase Oil

Motor Oil

Transmission Oil

Mass and Weight

API Gravity (15/15°C)

29.4

Density (g/mL)

(°C)	Weathering (Volume %)	
	0	
0	0.8892	3
15	0.8784	3
	0.89 (10W30)	7
	0.88 (5W30)	6
20	0.9004 (estimated)	2

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)	
	0	
-28.9	20000	
	to 30500	4
-17.8	1200	
	to 4100	4
0	727.4	3
15	224.5	3

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)	
	0	
0	818.0	3
15	255.6	3
37.8	79	
	to 86	4
98.9	9.6	
	to 12.9	4
100	10.40 (5W30)	6
	10.30 (10W30)	7

Pour Point (°C)

-37	4
-39 (10W30)	7
-42 (5W30)	6

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
	0
0	30.2 3
15	29.9 3
20	36
	to 37.5 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)
	0
0	18.2 3
15	16.6 3

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
	0
0	19.8 3
15	18.6 3
20	33
	to 54 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
	0
0	1.0 3
15	1.0 3

Emulsion Stability

(°C)	Weathering (Volume %)
	0
0	1.0 3
15	0.89 3

Lubricating Oil (Virgin Crankcase Oil)

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	0
0	58.6 3
15	72.2 3

Dispersibility

Natural Dispersibility (% Dispersed)

(°C)	0
0	4.7 3
15	0 3

Fire and Reactivity

Flash Point (°C)

199 (C.C)	4
188 (C.C)	4
200 (C.C) (5W30)	6
200 (C.C) (10W30)	7
149	2

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	377 3	157 3
5	397 3	336 3
10	400 3	351 3
15	402 3	355 3
20	404 3	356 3
25	405 3	358 3
30	407 3	360 3
35	409 3	361 3
40	411 3	362 3
45	414 3	363 3
50	417 3	364 3
55	419 3	365 3
60	422 3	366 3
65	426 3	367 3
70	430 3	368 3
75	434 3	369 3
80	439 3	370 3

Boiling Range (°C)

290	6
to 325 (5W30)	6
284	7
to 615 (10W30)	7

Solubility

Aqueous Solubility (mg/L)

		22 °C
Fresh Water	0.99 5	0.2 8
Seawater	1.43 5	

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	73.7 9
Aromatics	25.4 9
Polars	0.9 9
Asphaltenes	0 9

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	48h EC ₅₀	48h LC ₅₀
Daphnia Magna	0.30 5	0.38 5
	0.04 1	0.05 1
Artemia spp.	0.08 5	0.44 5
	0.008 1	0.049 1

Note: Results from (Maclean 88) obtained by fluorescence spectroscopy.
 Results from (Bobra 88) obtained by purge-and-trap GC analysis.

Non-Metal Content

Sulphur (Weight %)

0.37 3

Sensation

Colour

3.0 4
 4.0 4

Lubricating Oil (Virgin Crankcase Oil)

Other

Reid Vapour Pressure (kPa)

(°C)

37.8

0.689 (estimated) ²

References

1 Bobra 88
5 MacLean 88
9 Waters 78

2 CHRIS 85
6 MSDS 89

3 EETD 86
7 MSDS 90

4 Esso 73
8 Suntio 86

Magnus Crude Oil

U.K., North Sea

Contributor to Ninian system to Sullom Voe, Shetland Islands. (Aalund 83c)

Mass and Weight

API Gravity (15/15°C)

39.3 1

Density (g/mL)

(°C)	
Unknown	0.828 2

ViscosityKinematic Viscosity (mm²/sec or cSt)

(°C)	
21.1	4.56 1
38	3.1 2

Pour Point (°C)

-3 1
-3 2**Distillation**

Yield on Crude

	Range, °C	Weight %	Volume %
C ₁ -C ₄		3.15 1	
Gasoline	C ₅	9.8 1	
	to 95		
Naphtha	95	16.75 1	
	to 175		
Naphtha	C ₅	21.45 1	24.25 1
	to 149		
Kerosene	149	15.0 1	15.5 1
	to 232		
Gas Oil	232	21.4 1	20.9 1
	to 342		
Gas Oil	342	4.4 1	4.15 1
	to 369		
Gas Oil	369	21.15 1	19.45 1
	to 509		
Residuum	> 342	39.0 1	35.15 1
Residuum	> 509	13.45 1	11.55 1

Metal Content

Other Metals (ppm)

Nickel/Vanadium 2.00 ³

Non-Metal Content

Sulphur (Weight %)

0.28 ¹

References

¹ Aalund 83c

² Fina 82

³ NSD 88

Marine Diesel Fuel Oil

MDO is a heavy gas oil usually used for marine purposes only. Typically used by medium speed and medium/high speed marine diesel engines. Also used in the larger slow speed and medium speed propulsion engine which normally burn residual fuel

(Clark 88). Data from Clark (1988) are for a typical straight-run, all distillate Marine Diesel Fuel of Venezuelan origin. Data from (Burnett 85) are mean values for worldwide samples of commercial marine fuels.

Mass and Weight

API Gravity (15/15°C)

31.3 ²
36.4 ⁴

Density (g/mL)

(°C)	Weathering (Volume %)			
	unknown	0	6.7	33.7
15	0.862 ³			
15.5		0.8422 ⁴	0.8432 ⁴	0.856 ⁴

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		
	0	6.7	33.7
13	3.9 ¹	5.8	10.9

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
40	7.3 ³ 6.1 ²

Pour Point (°C)

	Weathering (Volume %)			
	unknown	0	6.7	33.7
-15 ³		< -30 ⁴	-30 ⁴	-24 ⁴
-5 ²				

Interfacial Tensions

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		
	0	6.7	33.7
13	20	17	17

Emulsion

Emulsion Formation Tendency

An emulsion is formed but it is not stable. (Daling 91)

Dispersibility

Chemical Dispersibility (% Dispersed)

Relatively high dispersibility. (Daling 91)

Fire and Reactivity

Flash Point (°C)

		Weathering (Volume %)		
		0	6.7	33.7
82.2 (C.C.)	3	86	4	110
98.3	2			
64	4			

Distillation

Distillation (°C)

IBP	201	3
	185.6	1
50	314	3
FBP	> 380	3
	426.7	1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

		Weathering (Volume %)		
		0	6.7	33.7
Aromatics	43.3	2		30.7
Asphaltenes	0.01	2		0.05
Saturates				68.2
Polars				1.3
Asphaltenes "Hard"	0.05	4	0.06	4
Asphaltenes "Soft"	0.07	4	0.08	4
				0.08
				0.11

Wax Content (Weight %)

		Weathering (Volume %)		
		0	6.7	33.7
	< 0.05	4	< 0.05	4
				< 0.05

Metal Content

Other Metals (ppm)

Copper	0.4	2
Sodium	1.2	2
Calcium	0.8	2
Vanadium	5	2

Non-Metal Content

Sulphur (Weight %)

0.92 3
1.12 2

Other

Cetane Number

38 3

Diesel Number

43 3

Ash (Weight %)

0.01 2

References

1 ASTM D 86

2 Burnett 85

3 Clark 88

4 Daling 91

Marine Gas Oil

Note: Data from (Burnett 85) are mean values for worldwide samples of commercial marine fuels.

Mass and Weight

API Gravity (15/15°C)

34.2 2

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
40 3.71 2

Pour Point (°C)

-11 2

Fire and Reactivity

Flash Point (°C)

81.1 2

Distillation

Initial Boiling Point (°C)

204 1

Final Boiling Point (°C)

365 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Aromatics	38.2 2
Asphaltenes	0.00 2

Metal Content

Other Metals (ppm)

Copper	0.4	2
Sodium	1.2	2
Calcium	0.8	2
Vanadium	< 5	2

Non-Metal Content

Sulphur (Weight %)

0.42 2

Sensation

Appearance

Clear and bright 2

Other

Ash (Weight %)

0.02 2

Cloud Point (°C)

-1 2

Aniline Point (°C)

68.2 2

References

1 ASTM D 86

2 Burnett 85

Marine Gas Oil (Heavy)

Mass and Weight

API Gravity (15/15°C)

32.0 2

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
40 5.8 2

Pour Point (°C)

-4 2

Fire and Reactivity

Flash Point (°C)

99 2

Distillation

Initial Boiling Point (°C)

218 1

Final Boiling Point (°C)

384 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Aromatics	40.6 2
Asphaltenes	0.00 2

Metal Content

Other Metals (ppm)

Copper	0.4 2
Sodium	1.1 2
Calcium	0.9 2
Vanadium	< 5 2

Non-Metal Content

Sulphur (weight %)

0.5 ²

Other

Ash (weight %)

0.02 ²

Aniline Point (°C)

67.3 ²

References

¹ ASTM D 86

² Burnett 85

Marine Intermediate Fuel Oil

EETD 89 data are for Interfuel 380 sample received from Irving Oil,
St. John, N.B.

Mass and Weight

API Gravity (15/15°C)

14.6 1

Density (g/mL)

(°C)	Weathering (Volume %)
0	0.9907 2
5	0.9872 2
10	0.9827 2
15	0.9787 2
20	0.9752 2
25	0.9712 2

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	64000 2
5	31450 2
10	16000 2
15	8200 2
20	5250 2
25	4000 2

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
40	198 1
100	25.0 1

Pour Point (°C)

6 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
15	33.6 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering	(Volume %)
15	0	35.5 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering	(Volume %)
15	0	N/M 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering	(Volume %)
15	0	0 2

Emulsion Stability

(°C)	Weathering	(Volume %)
15	0	0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering	(Volume %)
15	0	N/A 2

Fire and Reactivity

Flash Point (°C)

83.9 1

Solubility

Aqueous Solubility (mg/L)

Freshwater 2.31 3

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

	Weathering	(Volume %)
Asphaltenes	0	12.5
	10.3 1	9.9 2
	6.2 2	

Metal Content

Other Metals (ppm)

Molybdenum	<	0.6	4
Potassium	<	1.5	4
Zinc		1.1	4
Lead	<	3	4
Nickel		29.5	4
Iron		29.5	4
Chromium	<	1.5	4
Magnesium		10.2	4
Vanadium		76.4	4
		150	1
Copper	<	0.6	4
		0.5	1
Titanium		0.6	4
Barium		1.4	4
Sodium		33	1
Calcium		15	1
		380	4
Cadmium	<	0.5	4
Selenium	<	15	4
Cobalt		1.4	4
Manganese	<	0.3	4
Aluminum		51.7	4
Strontium		0.3	4
Tin	<	15	4
Mercury	<	15	4

Non-Metal Content

Sulphur (Weight %)

	Weathering	(Volume %)
	0	12.5
2.7	1	2.6
2.6	2	

Other

Ash (Weight %)

0.04 1

References

¹ Burnett 85

² EETD 89

³ ESD 91

⁴ ESD 92

Maureen Crude Oil

U.K., North Sea

Mass and Weight

API Gravity (15/15°C)

35.8 1

Viscosity

Pour Point (°C)

7.0 1

Distillation

Yield on Crude

	Range, °C	Volume %
C ₁ -C ₄		2.6 1
Naphtha	15.5	27.9 1
	to 204	
Kerosene	204	12.3 1
	to 260	
Gas Oil	260	15.6 1
	to 343	
Topped Crude	> 343	41.6 1

Non-Metal Content

Sulphur (Weight %)

0.55 1

References

1 Aalund 83c

Maya Crude Oil

Maya Crude Oil

Gulf of Campeche, Mexico

Mass and Weight

API Gravity (15/15°C)

21.7 4
22 3

Density (g/mL)

(°C)
15 0.923 4

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
10 522 4
20 267 4
222 3
40 69.8 4

Pour Point (°C)

-15 4
-18 3

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527 0 1
Dasic 0 1
EN 700 5 1
CRX-8 0 1

Distillation

Yield on Crude

	Weight %	Volume %
Gas	0.8 4	0.9 4
But. Gasoline to 149°C	9.65 4	12.45 4
Kerosene 149-232°C	9.75 4	11.35 4
Gas Oil 232-343°C	14.65 4	15.75 4
Residuum above 343°C	65.15 4	59.55 4

Solubility

Aqueous Solubility (mg/L)

Freshwater 20.4 2

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 8.5 4

Wax Content (Weight %)

2 4

Metal Content

Other Metals (ppm)

Nickel	53	4
	45.5	1
Vanadium	271	4
	257	1
Cadmium	< 0.5	1
Selenium	< 15	1
Cobalt	< 1	1
Manganese	< 0.3	1
Calcium	102	1
Aluminum	9.0	1
Strontium	< 0.2	1
Molybdenum	1.2	1
Potassium	< 1.5	1
Zinc	< 0.6	1
Lead	< 3	1
Iron	< 3	1
Chromium	< 1.5	1
Magnesium	16.7	1
Copper	< 0.6	1
Titanium	< 0.6	1
Barium	< 0.3	1
Tin	< 15	1
Mercury	< 15	1

Non-Metal Content

Hydrogen Sulfide - Existent (mg/m³)

NIL Wt%

Maya Crude Oil

Carbon Residue - Ramsbottom (Weight %)

11.6 4

Sulphur (Weight %)

3.40 4

Other

Reid Vapour Pressure (kPa)

(°C)		
37.8	32.0	3
	32.49	1

References

1 ESD 91

2 ESD 92

3 MSD 88

4 PetroCan 81

Mayogiak Crude Oil

Beaufort Sea, Canada

Mass and Weight

API Gravity (15/15°C)

32.4 1

Density (g/mL)

For F < 12% & T at 20°C:

$$\text{DEN} = 0.863686 + 0.001809 F$$

Where: DEN is density of oil at T and F (g/mL)

F is percent of oil weathered

T is oil temperature (°C)

(°C)	Weathering (Volume %)		
	0	4	12
20	0.8625 2	0.8727 2	0.8848 2

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	4	12
-10	752.1 2	1023	DNF 2
0	67.27 2	98.35 2	414.3 2
15	17.04 2	29.88 2	56.37 2
25	9.702 2	18.33 2	30.41 2

Note: DNF = did not flow

Pour Point (°C)

	Weathering (Volume %)		
	0	4	12
-30 2		-26 2	-18 2

Fire and Reactivity

Flash Point (°C)

	Weathering (Volume %)		
	0	4	12
-12 2		47 2	66 2

Fire Point (°C)

	Weathering (Volume %)		
	0	4	12
-12 2		64 2	76 2

Distillation

Distillation (°C)

	Weathering (Weight %)					
	0		4		12	
Initial	-2	2	55	2	146	2
50	318	2	336	2	376	2
Final	555	2	554	2	558	2
Final Vol.	94 %	2	88 %	2	83 %	2

References

¹ EETD 89

² Engelhardt 84

McArthur River Crude Oil

Offshore Cook Inlet, Alaska

Mass and Weight

API Gravity (15/15°C)

35.4 1

Density (g/mL)

(°C)	
15.6	0.848 1

Viscosity

Kinematic Viscosity (mm²/sec or cst)

(°C)	
25	11.6 1
37.8	8.5 1

Pour Point (°C)

-7 1

Distillation

Distillation (°C)

(Vol%)	
IBP	26 1
2.4	50 1
4.9	75 1
10.8	100 1
16.9	125 1
22.0	150 1
27.2	175 1
32.1	200 1
37.2	225 1
42.4	250 1
47.4	275 1

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

2.1 1

Nitrogen (Weight %)

0.137 1

Sulphur (Weight %)

0.08 1

Sensation

Colour

Brownish black 1

References

1 Coleman 78

Menemota Crude Oil**Mass and Weight**

API Gravity (15/15°C)

19.7 2

Density (g/mL)

(°C)	
15	0.936 2

ViscosityKinematic Viscosity (mm²/sec or cSt)

(°C)	
40	91.7 2
100	13.1 2

Pour Point (°C)

< -30 2

Distillation

Distillation (°C)

(Vol%)	
IBP	62 1
10	180 1
20	255 1
29	300 1

Yield on Crude

	Weight %	Volume %
Straight-Run Gasoline up to 65°C	1.78 2	2.64 2
Naphtha 65-150°C	5.70 2	7.15 2
Kerosene 150-250°C	10.46 2	11.88 2
Gas Oil 250-370°C	18.28 2	19.07 2
Residuum above 370°C	63.79 2	59.26 2

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 5.7 2

Wax Content (Weight %)

2.51 2

Metal Content

Other Metals (ppm)

Vanadium	390	2
Nickel	49	2
Sodium	1	2
Iron	< 1	2
Copper	< 1	2
Chromium	0	2

Non-Metal Content

Hydrogen Sulfide - Existent (mg/m³)

< 1 2

Sulphur (Weight %)

2.32 2

Other

UOP K Characterization Factor

11.7 2

Acid Number (mg KOH/g)

1.03 2

Ash (Weight %)

0.07 2

Reid Vapour Pressure (kPa)

(°C)
37.8 < 0.15 2

References

1 ASTM D 86

2 PetroCan 82

Methyl Tertiary Butyl Ether (MTBE)**Mass and Weight**

API Gravity (15/15°C)

58.8 2

Density (g/mL)

(°C)	Weathering (Volume %)
	0
12	0.7488 5
15	0.7456 5
16	0.74 2
20	0.7404 5

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
20	0.35 2

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
20	0.47 5

Fire and Reactivity

Flash Point (°C)

-28 5
-26 2

Auto Ignition Temperature (°C)

460 5
435 2

Explosion Limits of Vapour in Air

min 1.65 5
max 8.4 5

Methyl Tertiary Butyl Ether (MTBE)

Distillation

Final Boiling Point (°C)

55.3 5
55.2 2

Solubility

Aqueous Solubility (mg/L)

	20 °C	
Freshwater	40	
	to 43 g/L	5
	43 g/L	2

Toxicity

Toxicity (mg/L)

	LC0	24h LC50	96h LC50	LC100
Golden Orfes	1000 5			2000 5
Nitocra Spinipes			> 10000 5	
Rainbow Trout			1300 1	
			1483 4	
Alburnus Alburnus		1700 2		
		to 1800 ppm #1 2		
Flathead Minnow			760 3	
1. Static system				

Sensation

Odour Threshold (ppm)

Terpene like 5

Other

Reid Vapour Pressure (kPa)

(°C)		
25	33	5
	53.7	2
38	55	5

Freezing Point (°C)

-109 5

Water Content of Oil (Volume %)

< 0.05 wt% 2

References

1 Alpha 89

2 Counterspil 91

3 CRCS 86

4 Hebron 89

5 NESTE 89

Middle Ground Shoal Crude Oil

Offshore Cook Inlet, Alaska.

Mass and Weight

API Gravity (15/15°C)

41.5 1

Density (g/mL)

(°C)	
15.6	0.818 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
25	4.7 1
37.8	4.3 1

Pour Point (°C)

< -15 1

Distillation

Distillation (°C)

(Vol%)	
IBP	26 1
2.1	50 1
5.9	75 1
13.4	100 1
22.8	125 1
32.1	150 1
37.4	175 1
42.1	200 1
47.8	225 1
53.3	250 1
58.1	275 1

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

1.5 1

Nitrogen (Weight %)

0.047 1

Sulphur (Weight %)

0.07 1

Sensation

Colour

Brownish black 1

References

¹ Coleman 78

Mineral Oil

Mineral Oil

Liquid Petroleum
White Oil

Mass and Weight

Density (g/mL)

(°C)	
20	0.8205 ¹

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	27 ¹

Oil-Water (mN/m or dynes/cm)

(°C)	
20	47 ¹

Fire and Reactivity

Flash Point (°C)

193 (o.c.) ¹

Sensation

Colour

colourless ¹

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	0.689 (estimated) ¹

References

¹ CHRIS 85

Mineral Seal Oil

300 Oil
 Long time burning oil
 Mineral Colza Oil
 Signal Oil

Mass and Weight

API Gravity (15/15°C)

42.0
 to 40.0 ¹

Density (g/mL)

(°C)	
15	0.8103
	to 0.8243 ¹

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
15	7.119 (estimated) ¹

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
15	8.786
	to 8.636 (estimated) ¹

Pour Point (°C)

-12.2 ¹**Interfacial Tensions**

Air-Oil (mN/M or dynes/cm)

(°C)	
20	25 (estimated) ¹

Oil-Water (mN/m or dynes/cm)

(°C)	
20	47
	to 50 ¹

Fire and Reactivity

Flash Point (°C)

76.7
to 135 (O.C.)¹

Distillation

Final Boiling Point (°C)

> 260¹

Sensation

Colour

Colourless
to light brown¹

Odour Threshold (ppm)

1¹

Other

Reid Vapour Pressure (kPa)

(°C)
37.8 0.689 (estimated)¹

References

¹ CHRIS 85

Mixed Sour Blend Crude Oil

Alberta and Saskatchewan, Canada

Blend of light, moderately low sulphur crude from fields in Alberta and Saskatchewan. Sample from pipeline blend delivered to Trafalgar Refinery, December 1974.

Mass and Weight

API Gravity (15/15°C)

38.6 1

Density (g/mL)

(°C)	
20	0.828 1

Viscosity

Pour Point (°C)

-6 1

Distillation

Yield on Crude

	Weight %	Volume %
Gas	1.0 1	1.55 1
But. Gasoline to 149°C	19.55 1	22.45 1
Kerosene 149-232°C	16.1 1	16.85 1
Gas Oil 232-343°C	21.65 1	21.35 1
Residuum above 343°C	41.7 1	37.8 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 0.3 1

Metal Content

Other Metals (ppm)

Vanadium	< 2 1
Nickel	2 1

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

1.9 1

Sulphur (Weight %)

0.46 1

References

1 PetroCan 75

Montrose Crude Oil

U.K. North Sea

Mass and Weight

API Gravity (15/15°C)

40.7 2

40.1 1

Density (g/mL)

(°C)

Unknown	0.8220 2
---------	----------

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)

20	4.96 1
----	--------

38	3.27 1
----	--------

40	3.17 2
----	--------

Pour Point (°C)

-6 2

-9 1

Distillation

Yield on Crude

	Range, °C	Volume %
C ₁ -C ₄		2.2 1
Gasoline	C ₅	12.3 1
	to 93	
Naphtha	93	15.0 1
	to 160	
Kerosene	160	8.9 1
	to 204	
Gas Oil	204	25.4 1
	to 343	
Residuum	> 343	36.6 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 0.15 2

Metal Content

Other Metals (ppm)

Nickel	2	1
Vanadium	2	1

Non-Metal Content

Sulphur (Weight %)

0.23 1

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	27.6 1

References

1 Aalund 83c

2 MSD 88

Motor Fuel Anti-Knock Compounds

Containing Lead Alkyls

Mass and Weight

Density (g/mL)

(°C)	
15	1.499
	to 1.698 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
15	7.119 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
15	4.192
	to 4.749 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	20 1

Oil-Water (mN/m or dynes/cm)

(°C)	
20	45 1

Fire and Reactivity

Flash Point (°C)

31.7
to 129.4 (O.C.) 1

Distillation

Initial Boiling Point (°C)

> 93 1

Sensation

Colour

red, orange, or blue ¹

Other

Reid Vapour Pressure (kPa)

$\frac{(\text{°C})}{37.8} \quad 0.85 \text{ }^1$

References

¹ CHRIS 85

Murban Crude Oil

Abu Dhabi, U.A.E.

Mass and Weight

API Gravity (15/15°C)

39.2 2

Density (g/mL)

(°C)	Weathering (Weight %)		
	0	10	20
0	0.838 3		
5	0.832 3		
10	0.830 3		
15	0.828 3		
20	0.824 3	0.842 3	0.855 3
25	0.822 3		

Notes: DEN = 0.837 - 0.000606 T

Where: DEN is oil density of oil at T (g/mL)

T is oil temperature (°C)

(Mackay 82a)

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)	
	0	
0	40.1 3	
5	22.1 3	
10	11.9 3	
15	6.97 3	
20	4.37 3	
25	3.90 3	

Notes: VISC = $\exp((7960/(T + 273)) - 25.6)$

Where: VISC is the viscosity of fresh oil at T (mPa.s)

exp is exponential base e

T is oil temperature (°C)

(Mackay 82a)

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)	
	0	
0	47.9 3	
5	26.6 3	
10	14.3 3	
15	8.42 3	
20	5.30 3	
25	4.74 3	
40	2.70 3	

Murban Crude Oil

Pour Point (°C)

Weathering (Weight %)		
0	10	20
-3 3	0 3	15 3
-12 6		
-24 5		

Interfacial Tensions

Oil-Seawater (mN/M of dynes/cm)

Weathering (Weight %)			
(°C)	0	10	20
Unknown	16.3 3	16.4 3	14.3 3

Solubility

Aqueous Solubility (mg/L)

Double Distilled Water	28.62 1
Seawater	27.87 4

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Weathering (Weight %)			
	0	10	20
Saturates	81.4 3	76.3 3	74.3 3
Aromatics	16.6 3	17.5 3	19.4 3
Polars	1.27 3	2.05 3	2.12 3
Asphaltenes	0.75 3	4.14 3	4.20 3

Wax Content (Weight %)

Weathering (Weight %)		
0	10	20
5.68 3	6.83 3	7.45 3

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

Daphnia Magna	$\frac{48h LC_{50}}{7.4 1}$
---------------	-----------------------------

Metal Content

Other Metals (ppm)

Nickel/Vanadium 0.14 ⁵

Non-Metal Content

Sulphur (Weight %)

0.78 ⁵

References

1 Bobra 83

2 EETD 89

3 Mackay 82a

4 McAuliffe 77

5 NSD 88

6 Wheeler 78

Murchison Crude Oil

Murchison Crude Oil

U.K. and Norway, North Sea

Contributor to Brent system at Sullom Voe, Shetland Islands.

Mass and Weight

API Gravity (15/15°C)

38.0 2

Density (g/mL)

(°C)
Unknown 0.8510 2

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
38 3.60 1

Pour Point (°C)

7.0 2

Distillation

Yield on Crude

	Range, °C	Volume %
C ₁ -C ₄		3.0 1
Naphtha	30	31.2 1
	to 191	
Kerosene	191	13.5 1
	to 271 1	
Heavy Distillate	271	21.4 1
	to 371 1	
Gas Oil	371	21.0 1
	to 549 1	
Residuum	> 549	11.9 1

Hydrocarbon Group

Wax Content (Weight %)

4.70 2

Metal Content

Other Metals (ppm)

Nickel	0.7	1
Vanadium	2.5	1

Non-Metal Content

Sulphur (Weight %)

0.27 2

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	62.0 1

References

1 Aalund 83c

2 NSD 88

Naphtha (Coal Tar)

Naphtha (Coal Tar)

Mixture of Benzene, Toluene, Xylenes

Mass and Weight

Density (g/mL)

(°C)	
20	0.858
	to 0.878 ¹

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
15	7.119 (estimated) ¹
20	5.770 (estimated) ¹

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
20	0.672
	to 0.657 (estimated) ¹

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	20 (estimated) ¹

Oil-Water (mN/m or dynes/cm)

(°C)	
20	45 (estimated) ¹

Fire and Reactivity

Flash Point (°C)

41.67 ¹

Distillation

Boiling Range (°C)

93
to 260 ¹

Sensation

Colour

Colourless
to pale yellow ¹

Odour Threshold (ppm)

4.68 ¹

Other

Reid Vapour Pressure (kPa)

(°C)

37.8 0.896 ¹

References

¹ CHRIS 85

Naphtha (Mineral Spirits)

Light Petrol
Petroleum Spirits
Shell Sol 140
Stoddard Solvent
Varsol
White Spirits

Mass and Weight

API Gravity (15/15°C)

48.8
to 50.6 3

Density (g/mL)

(°C)	Weathering (Volume %)
0	0
0	0.8040 2
15	0.7930 2
20	0.7786 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	0
0	1.4 2
15	1.1 2
25	0.85
	to 1.165 3

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
0	0
0	1.78 2
15	1.43 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	26.2 2
15	24.7 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	43.2 2
15	43.1 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	44.4 2
15	43.9 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
0	0
0	0 2
15	0 2

Emulsion Stability

(°C)	Weathering (Volume %)
0	0
0	0 2
15	0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	0
0	N/A 2
15	N/A 2

Fire and Reactivity

Flash Point (°C)

41
to 57 (C.C.) 3
41 3
to 138 (C.C.) 4

Flammability Limits (Volume %)

in air 0.8 1
to 5.0 1

Naphtha (Mineral Spirits)

Distillation

Boiling Range (°C)

Mineral Spirits	150 to 200	1
	154 to 202	5
Stoddard Solvent	160 to 210	5

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

composed of	Minerals Spirits		Stoddard Solvent	
	C ₉ TO C ₁		C ₉ to C ₁₁	
Paraffins	20 to 65	5	30 to 50	5
Naphthenes	15 to 55	5	30 to 40	5
Aromatics	10 to 30	5	10 to 20	5

Toxicity

Biological Oxygen Demand (days)

(%)	
8	5 1

Non-Metal Content

Sulphur (Weight %)

1 ppm 3

Sensation

Colour

+30 3
Colourless 1

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	0.896 1

References

1 CHRIS 85
5 NIOSH 77

2 EETD 86

3 Esso 73

4 Gulf TS 83

Naphtha (Petroleum Ether)

Benzin
Benzine
Canadol
Light ligroin
Petroleum benzin
Skelly solvent

Mass and Weight**Vapour Density**2.5⁴**API Gravity (15/15°C)**89.3²**Density (g/mL)**

(°C)	Weathering (Volume %)
0	0
0	0.6547 ²
15	0.6404 ²

Viscosity**Dynamic Viscosity (mPa.s or cP)**

(°C)	Weathering (Volume %)
0	0
0	0.30 ²
15	0.25 ²

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
0	0
0	0.45 ²
15	0.39 ²

Interfacial Tensions**Air-Oil (mN/M or dynes/cm)**

(°C)	Weathering (Volume %)
0	0
0	18.2 ²
15	17.5 ²

Naphtha (Petroleum Ether)

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	44.8 2
15	43.8 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	45.5 2
15	44.4 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
0	0
0	0 2
15	0 2

Emulsion Stability

(°C)	Weathering (Volume %)
0	0
0	0 2
15	0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	0
0	N/A 2
15	N/A 2

Fire and Reactivity

Flash Point (°C)

-49 1
< -18 3

Auto Ignition Temperature (°C)

288 1
288 3

Flammability Limits (Volume %)

Upper 5.9 3
Lower 1.1 3

Distillation

Boiling Range (°C)

30 1
to 60 1
35 4
to 60 4

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Primarily pentane and i-hexane 4
no aromatics 4

Other

Freezing Point (°C)

-73 1

References

1 CCD 77

2 EETD 86

3 NFPA 78

4 NIOSH 77

Naphtha (Rubber solvent)

Naphtha (Rubber solvent)

Benzine
Lacquer diluent
Light Spirits
Losol
Tolu-sol

Mass and Weight

API Gravity (15/15°C)

58.7 TO 67.5 3

Density (g/mL)

(°C)			
Unknown	0.711	TO 0.744	3
	0.74	TO 0.771	7
	0.7038	TO 0.7398	4

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)	
	0	
25	0.40	
	to 0.50	2

Fire and Reactivity

Flash Point (°C)

-23
to -4 (C.C.) 3
-4 5
< 20 4
-5 5

Distillation

Boiling Range (°C)

Rubber Solvent 45
to 125
Light Spirits 95
to 110 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

composed of	C ₅
	to C ₈ hydrocarbons
Paraffins	70
	to 90 6
Naphthalenes	11
	to 22 6
Aromatics	9
	to 22 6

Non-Metal Content

Sulphur (Weight %)

1 ppm 3

Other

Aniline Point (°C)

50
to 54 3

References

1 ASTM 62
5 ISH 77

2 EETD 86
6 MPT 75

3 Esso 73
7 NIOSH 77

4 Gulf TS 83

Naphtha (Solvent)

Naphtha (Solvent)

Light Naphtha
Petroleum solvent

Mass and Weight

Density (g/mL)

(°C)	
20	0.848
	to 0.868 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
15	7.119 1
20	5.770 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
20	6.804
	to 6.647 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	19
	to 23 1

Oil-Water (mN/m or dynes/cm)

(°C)	
20	39
	to 51 1

Fire and Reactivity

Flash Point (°C)

> 37.8 (C.C.) 1

Flammability Limits (Volume %)

in air 0.8
to 5.0 1

Distillation

Boiling Range (°C)

130
to 155 ¹

Sensation

Colour

Colourless ¹

Other

Reid Vapour Pressure (kPa)

(°C)
37.8 0.855 (estimated) ¹

References

¹ CHRIS 85

Naphtha (Stoddard Solvent)

Dry Cleaner Naphtha
Petroleum solvent
Spotting-naphtha

Mass and Weight

Density (g/mL)

(°C)	
20	0.778 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
15	7.119 (estimated) 1
20	5.770 (estimated) 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
20	7.416 (estimated) 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	19 to 23 1

Oil-Water (mN/m or dynes/cm)

(°C)	
20	39 to 51 1

Fire and Reactivity

Flash Point (°C)

43.3 (C.C.) 1

Flammability Limits (Volume %)

in air 0.8
to 5.0 1

Distillation

Boiling Range (°C)

160
to 199 ¹

Sensation

Colour

Colourless ¹

Other

Reid Vapour Pressure (kPa)

(°C)

37.8 0.689 ¹

References

¹ CHRIS 85

Naphtha (Varnish Makers and Painters Naphtha)

Benzine
Dry Cleaning Naphtha and Spotting Naphtha
High Boiling Petroleum Ether
Light Naphtha
Ligroin
Naphtha 76
Petroleum Solvent

Mass and Weight

Vapour Density

4.3 7
4.1 7

Density (g/mL)

(°C)
20 0.749 3

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)
15 7.119 3
20 5.770 3

Kinematic Viscosity (mm²/sec or cSt)

(°C)
20 7.704 3

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C) Weathering (Volume %)
0
20 19
to 23 3

Oil-Water (mN/m or dynes/cm)

(°C) Weathering (Volume %)
0
20 39 2
to 51 2

Fire and Reactivity

Flash Point (°C)

-2		
to 29		7
-8		1
-7		1
-6.7		3
to 12.8		3
< 20	(C.C.)	5
12	(C.C.)	4

Auto Ignition Temperature (°C)

232 7

Burning Rate (mm/min)

4.0 3

Flammability Limits (Volume %)

Upper	6.0	7
	6.0	1
	6.7	7
	6.7	3
Lower	0.9	7
	0.9	1
	0.9	3
	1.0	7

Distillation

Boiling Range (°C)

93	3
to 149	3
95	7
to 160	7
100	1
to 140	1
100	6
to 140	6

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

composed of	C7
	to C1
Paraffins	45
	to 60 8
Naphthalenes	30
	to 45 8
Aromatics	5
	to 13 8

Sensation

Colour

Colourless 3

Other

Reid Vapour Pressure (kPa)

(°C)
37.8 0.827 3

References

1 Alliance 80
5 Gulf TS 83

2 CHRIS 78
6 MPT 75

3 CHRIS 85
7 NFPA 78

4 Esso 73
8 NIOSH 77

Nektoralik K-59 Crude Oil

Beaufort Sea, Canada

Mass and Weight

API Gravity (15/15°C)

26.1 1

Density (g/mL)

(°C)	Weathering (Volume %)
0	0
0	0.9166 2
15	0.9060 2
15.6	0.9541 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	0
10	21 1
20	12.90 1
30	9.80 1
40	6.78 1

Pour Point (°C)

2.8 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	28.5 2
15	29.0 2

Oil-Seawater (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	3.4 2
15	41.6 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	14.8 2
15	15.1 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
0	0
15	1.0 2
	0 2

Emulsion Stability

(°C)	Weathering (Volume %)
0	0
15	1.0 2
	0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	0
15	88.0 2
	N/A 2

Distillation

Distillation (°C)

(Vol%)	
5	121 1
10	160 1
15	198 1
20	238 1
25	254 1
30	277 1
35	287 1
40	298 1
45	304 1
50	312 1
55	321 1
60	338 1
65	342 1
70	343 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 0.40 2

Non-Metal Content

Sulphur (Weight %)

0.17 1

0.17 2

Salt Content

Salt (g/m³)

total: 0.5992 1

References

¹ Dome 84

² EETD 89

Nektoralik K-59A Crude Oil

Beaufort Sea, Canada

Mass and Weight

API Gravity (15/15°C)

39.9 1

Density (g/mL)

(°C)	
Unknown	0.8257 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
20	1.396 1
30	1.205 1
40	1.020 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
	0
20	1.695 1
30	1.475 1
40	1.260 1

Pour Point (°C)

-39 1

Distillation

Distillation (°C)

(Vol%)	
5	90 1
10	101 1
15	111 1
20	120 1
25	131 1
30	140 1
35	153 1
40	170 1
45	186 1
50	201 1
55	217 1
60	231 1
65	243 1
70	254 1
75	267 1
80	280 1
85	294 1
90	313 1
95	323 1

Non-Metal Content

Sulphur (Weight %)

0.0067 1

Salt Content

Salt (g/m³)

total: 32.075 1

References

¹ Dome 84

Nerlerk M-98A Crude Oil

Beaufort Sea, Canada

Mass and Weight

API Gravity (15/15°C)

22.3 1

Density (g/mL)

(°C)	Weathering (Volume %)
0	0
0	0.9195 2
15	0.9095 2
15.6	0.9227 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	0
20	89.6 1
30	50.3 1
40	30.0 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	29.3 2
15	29.0 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	5.2 2
15	11.0 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	17.9 2
15	15.6 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
0	0
0	0.44 2
15	0 2

Emulsion Stability

(°C)	Weathering (Volume %)
0	0
0	0.44 2
15	0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	0
0	79.0 2
15	N/A 2

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 0.40 2

Wax Content (Weight %)

1.70 3

Non-Metal Content

Sulphur (Weight %)

0.14 2

References

1 Dome 84

2 EETD 89

3 ESD 91

Nerlerk M-98B Crude Oil

Beaufort Sea, Canada

Mass and Weight

API Gravity (15/15°C)

24.3 ¹

Density (g/mL)

(°C)	
15.6	0.9114 ¹

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
20	54.3 ¹
30	30.6 ¹
40	19.4 ¹

References

¹ Dome 84

Nerlerk M-98C Crude Oil

Beaufort Sea, Canada

Mass and Weight

API Gravity (15/15°C)

26.4 ¹

Density (g/mL)

(°C)	
15.6	0.8981 ¹

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
20	12.7 ¹
30	8.84 ¹
40	6.34 ¹

References

¹ Dome 84

Ninian Blend Crude Oil

U.K., North Sea

Ninian system to Sullom Voe, Shetland Islands.

Mass and Weight

API Gravity (15/15°C)

35.6 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
40 5.61 1

Pour Point (°C)

2 1

Distillation

Yield on Crude

	Range, °C	Volume %
C ₁ -C ₄		2.6 1
Light Gasoline	C ₅	19.9 1
	to 149	
Naphtha	149	9.3 1
	to 204	
Kerosene	204	11.1 1
	to 260	
Diesel Oil	260	14.0 1
	to 343	
Gas Oil	343	13.1 1
	to 435	
Heavy Gas Oil	435	14.0 1
	to 538	
Residuum	> 538	16.0 1

Non-Metal Content

Sulphur (Weight %)

0.43 1

References

¹ Aalund 83c

Ninian Crude Oil

U.K., North Sea

Mass and Weight

API Gravity (15/15°C)

35.1 5
36.1 2

Density (g/mL)

(°C)	Weathering (Volume %)		
	0	15.3	30.2
0	0.8547 2 0.8400 5	0.8774 2	0.9009 2
15	0.8435 2	0.8655 2	0.8889 2
16	0.8393 4 0.8400 5		0.8889 2

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		
	0	15.3	30.2
0	13.5 2	15110 #1 2 1854 #2 2	70000 #1 2 7000 #2 2
15	7.69 2	15.9 2	62.0 2

1. shear rate 1s⁻¹
2. shear rate 10s⁻¹

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	15.3	30.2
0	15.5 2		
15	9.12 2	18.4 2	70.2 2
38	6.9 5		
40			
50	7.5 4		

Pour Point (°C)

	Weathering (Volume %)		
	0	15.3	30.2
	6 4	6 2	15 2
	7 5		
	-9 2		

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		30.2
	0	15.3	
0	26.2 2	N/M 2	N/M 2
15	25.8 2	28.1 2	31.5 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		30.2
	0	15.3	
0	21.6 2	N/M 2	N/M 2
15	21.0 2	19.9 2	12.4 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		30.2
	0	15.3	
0	23.5 2	N/M 2	N/M 2
15	22.1 2	20.4 2	22.8 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	15.3	30.2
0	1.0 2	1.0 2	0 2
15	0 2	0.28 2	1.0 2

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	15.3	30.2
0	0.94 2	1.0 2	0 2
15	0 2	0 2	1.0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	15.3	30.2
0	79.0 2	88.5 2	N/A 2
15	N/A 2	N/A 2	79.6 2

Fire and Reactivity

Flash Point (°C)

Weathering		(Volume %)
0		15.3
-20	2	29.4
		30.2
		> 90
		3

Distillation

Distillation (°C)

(Vol%)	Liquid Temp		Vapour Temp	
IBP	95.5	2	30.8	2
5	149	2	91	2
10	173	2	110	2
15	198	2	126	2
20	224	2	146	2
25	254	2	168	2
30	283	2	209	2
35	315	2	239	2
40	342	2	259	2
45	367	2	276	2

Weathering

T_G = 556.2
 T_O = 388.8 (ESD 91)

Solubility

Aqueous Solubility (mg/L)

Freshwater 49.61 2
 1. freshwater

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 0.5 4
 1.0 2

Wax Content (Weight %)

8 4
 5.30 5
 6.2 2

Metal Content

Other Metals (ppm)

	Weathering (Volume %)		
	0	15.2	30.2
Molybdenum	< 0.6 3	< 0.6 3	< 0.6 3
Potassium	< 1.5 3	< 1.5 3	< 1.5 3
Zinc	< 0.6 3	< 0.6 3	< 0.6 3
Lead	< 3 3	< 3 3	< 3 3
Nickel	< 1 3	< 1 3	1.3 3
Iron	4.2 3	4.9 3	6.6 3
Chromium	< 1.5 3	< 1.5 3	< 1.5 3
Magnesium	< 1 3	< 1 3	< 1 3
Vanadium	4.0 3	4.9 3	6.4 3
Copper	< 0.6 3	< 0.6 3	< 0.6 3
Titanium	< 0.6 3	0.5 3	< 0.6 3
Barium	< 0.3 3	< 0.3 3	< 0.3 3
Nickel/Vanadium	5.00 5		
Cadmium	< 0.5 3		
Selenium	< 15 3		
Cobalt	< 1 3		
Manganese	< 0.3 3		
Calcium	44.6 3		
Aluminum	< 5 3		
Strontium	< 0.2 3		
Tin	< 15 3		
Mercury	< 15 3		

Non-Metal Content

Sulphur (Weight %)

0.41 5

Other

Reid Vapour Pressure (kPa)

(°C)
37.8
37.2 5

References

¹ Aalund 83c

² ESD 91

³ ESD 92

⁴ Lynch 81

⁵ NSD 88

Norman Wells Crude Oil

Northwest Territories, Canada

Mass and Weight

API Gravity (15/15°C)

38.4³

Density (g/mL)

Fw < 20.4% & T between 0 and 25°C

$$\text{DEN} = 0.846161 + 0.001732 \text{ Fw} - 0.000783 \text{ T}$$

Where: DEN is density of oil at T and Fw (g/mL)

Fw is weight percent of oil weathered

T is oil temperature (°C)

(°C)	Weathering (Weight %)		
	0	12	20.4
0	0.845	12	0.864 12
	0.840	11	
	0.8581	4	
5	0.841	12	
10	0.839	12	
15	0.832	3	0.855 11
	0.834	12	
	0.832	11	0.873 11
20	0.832	12	
	0.829	12	
25	0.829	12	0.844 11
			0.863 11

Viscosity

Dynamic Viscosity (mPa.s or cP)

$$\text{VISC} = \exp(2.26 - 2461.7 T / (273(T+273)))$$

Where: VISC is dynabic viscosity af oil at T (mPa.s)

exp is exponential base e

T is oil temperature (°C)

(°C)	Weathering (Weight %)		42.3
	0	20.4	
-25	22 11	99 11	
-15	18 11	69 11	
0	8.76 12	40 11	300 11
	14.2 17		
	11 11		
5	7.11 12		
10	5.81 12	28 11	180 11
	8.68 17		
15	9 11		
	5.05 12	25 11	150 11
20	7.9 11		
	4.39 12		
25	5.9 17		
	3.93 12	15 11	80 11
	6.1 11		

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Weight %)		42.3
	0	20.4	
0	10.37 12	46 11	34 11
	13.1 11		
5	8.45 12		
10	6.93 12		
15	6.06 12	29 11	172 11
	9.5 11		
20	5.28 12		
25	4.74 12	18 11	93 11

Pour Point (°C)

Weathering (Weight %)					
0	10	12	20	20.4	36.7
< -50 12	< -50 12	-34 11	< -50 12	-26 11	-12 11
-85 17					
-50 11					

Notes: Pour Point = -51 + 1.50 E - 0.012 E²

Where: E = Wt% evaporated (Mackay 75)

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Weight %)		42.3
	0	20.4	
0	24.9	3	
5	23.7	11	29.8 11
15	23.6	3	
25	22.7	11	28.5 11

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)	
	0	
0	16.5	3
15	16.4	3

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)	
	0	
0	20.5	4
15	20.1	4

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)	
	0	
0	0	3
15	0	3

Emulsion Stability

(°C)	Weathering (Volume %)	
	0	
0	0	3
15	0	3

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)	
	0	
0	N/A	3
15	N/A	3

Dispersibility

Chemical Dispersibility (% Dispersed)

EN 700	65 6
Dasic	20 6

Natural Dispersibility (% Dispersed)

(°C)	
15	5 9

Fire and Reactivity

Flash Point (°C)

3 3

Fire Point (°C)

< 13.5 17

Distillation

Distillation (°C)

(Vol%)	
0	60 12
10	118 12
20	145 12
30	174 12
40	223 12
50	280 12

Note: Data obtained from a curve (Mackay 75)

Weathering

T_O = 379.8

T_G = 516.1 (EETD 84)

Solubility

Aqueous Solubility (mg/L)

	Weathering (Weight %)											
	0	6	12	20.4	29	36	43.2					
	32.2	11	23.18	11	14.59	11	7.33	11	2.27	11		
	60.1	15										
	8.57	13										
22 °C in distilled water	33.5	14										
20 °C in distilled water	33.0	14										
20 °C in salt water	28.0	14										
5 °C in distilled water	30.0	14										
5 °C in salt water	25.5	14										
22 °C in fresh water	25.5	16										
Room Temp., distilled	32.3	1	27.0	1	14.6	1	7.3	1	0.68	1	0.14	1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

	Weathering (Weight %)					
	0	10	20			
Saturates	85.1	12	82.2	12	80.0	12
	86.3	5				
Aromatics	11.4	12	11.5	12	13.1	12
	11.1	5				
Polars	2.32	12	3.45	12	4.13	12
	1.6	5				
Asphaltenes	1.13	12	2.88	12	3.20	12
	1.0	5				
	1.15	6				
	0.3	7				

Wax Content (Weight %)

	Weathering (Weight %)					
	0	10	20			
	1.76	12	2.29	12	1.90	12

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	Weathering Wt%	48h EC50	48h LC50
Daphnia Magna	0	3.4 1	9.0 1
			18.5 2
	6		10.8 1
	12		6.0 1
	20.4		4.4 1
	36.7		0.49 1
	43.2		0.12 1
Artemia spp.		3.61 13	4.34 13
		8.59 2	10.3 2
Larval Rainbow trout			10.4 #1 10
			11.6 #2 10

Note: Results from (Maclean 88) obtained by fluorescence spectroscopy.
 Results from (Bobra 88) obtained by purge-and-trap GC analysis.
 #1 Closed Container
 #2 Open Container

Metal Content

Other Metals (ppm)

Molybdenum	< 0.6 8
Potassium	< 1.5 8
Zinc	< 0.6 8
Lead	< 3 8
Nickel	3.3 8
Iron	< 3 8
Chromium	< 1.5 8
Magnesium	< 1 8
Vanadium	8.7 8
Copper	< 0.6 8
Titanium	< 0.6 8
Barium	< 0.3 8

Non-Metal Content

Sulphur (Weight %)

0.37 5

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	36.2 3

References

- | | | | |
|---------------|----------------|--------------|---------------|
| 1 Bobra 83 | 2 Bobra 88 | 3 EETD 84 | 4 EETD 85 |
| 5 EETD 86 | 6 EETD 89 | 7 ESD 91 | 8 ESD 92 |
| 9 Fingas 90a | 10 Lockhart 87 | 11 Mackay 75 | 12 Mackay 82a |
| 13 MacLean 88 | 14 Maijanen 84 | 15 Murray 84 | 16 Suntio 86 |
| 17 Twardus 80 | | | |

North Cormorant Crude Oil

U.K., North Sea

Contributor to Brent system at Sullom Voe, Shetland Islands.

Mass and Weight

API Gravity (15/15°C)

34.9 1

Density (g/mL)

(°C)	
15	0.850 1

Viscosity

Pour Point (°C)

12.0 1

Distillation

Yield on Crude

	Range, °C	Volume %
C ₁ -C ₄		2.6 1
Gasoline	C ₅	7.0 1
	to 85	
Naphtha	85	14.5 1
	to 165	
Kerosene	165	11.7 1
	to 235	
Gas Oil	235	12.5 1
	to 300	
Gas Oil	300	9.4
	to 350	
Residuum	> 350	42.7 1

Non-Metal Content

Sulphur (Weight %)

0.71 1

References

1 Aalund 83c

North East Texas Crude Oil

Texas, U.S.A.

Mass and Weight

API Gravity (15/15°C)

27.0 1

Density (g/mL)

(°C)	
Unknown	0.8900 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
38	27.0 1

Non-Metal Content

Sulphur (Weight %)

2.50 1

References

1 NSD 88

North Slope Crude Oil

North Slope, Alaska

Mass and Weight

API Gravity (15/15°C)

26.8 1

Density (g/mL)

(°C)	Weathering (Volume %)		
	0	9.1	16.2
0	0.9037 2	0.9203 2	0.9342 2
15	0.8936 2	0.9086 2	0.9225 2
15.5	0.893 1		

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)	
	0	9.1
15	23 2	66 2

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
38	16.0 5

Pour Point (°C)

-21 5
-8 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		
	0	9.1	16.2
0		29.6 2	31.1 2
15	28.1 2	29.1 2	29.7 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		
	0	9.1	16.2
0	23.8 2	27.6 2	24.2 2
15	27.4 2	26.6 2	24.9 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		
	0	9.1	16.2
0	26.1 2	28.7 2	25.7 2
15	29.4 2	27.7 2	25.1 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	9.1	16.2
0	1.0 2	1.0 2	1.0 2
15	1.0 2	1.0 2	1.0 2

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	9.1	16.2
0	1.0 2	1.0 2	1.0 2
15	1.0 2	0 2	0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	9.1	16.2
0	89.0 2	74.0 2	60.0 2
15	85.0 2	N/A 2	N/A 2

Dispersibility

Chemical Dispersibility (% Dispersed)

	Weathering (Volume %)		
	0	9.1	16.2
C9527		10 2	5 2
CRX-8		15 2	10 2
Dasic	15 2	10 2	0
EN 700		10 2	5 2

Natural Dispersibility (% Dispersed)

(°C)	Weathering (Volume %)		
	0	9.1	16.2
15	3	3	

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp	
IBP	151 2	42 2	
5	200 2	98 1	
		98 2	
10	233 2	131 1	
		127 2	
15	267 2	161 1	
		147 2	
20	298 2	193 1	
		172 2	
25		216 1	
30	351 2	241 1	
		216 2	
35		262 1	
40	399 2	282 1	
		238 2	
45	413 2	301 1	
		247 2	
50	421 2	323 1	
		258 2	
55	426 2	342 1	
		265 2	
60	433 2	361 1	
		272 2	
65		380 1	
70	445 2	400 1	
		282 2	
75		419 1	
80		439 1	
85		461 1	
90		484 1	
95		511 1	
FBP		539 1	151

Weathering

$T_O = 430.6$

$T_G = 722.0$ (EETD 89)

Solubility

Aqueous Solubility (mg/L)

Freshwater 27.98 3

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

	Weathering		(Volume %)	
	0		9.1	16.2
Asphaltenes	2.1	3	2.64	2
	2.04	2		5.07
				2

Wax Content (Weight %)

6.7 3

Metal Content

Other Metals (ppm)

	Weathering		(Volume %)	
	0		20.2	
Molybdenum	<	0.6 4	<	0.6 4
Potassium	<	1.5 4	<	1.5 4
Zinc	<	0.6 4	<	0.6 4
Lead	<	3 4	<	3 4
Nickel		7.2 4		14.7 4
		21 1		
Iron		7.8 4		14.2 4
Chromium	<	1.5 4		1.9 4
Magnesium		10.5 4		1.6 4
Vanadium		21.2 4		33.9 4
		9.4 1		
	to	9.7 1		
Copper	<	0.6 4	<	0.6 4
Titanium	<	0.6 4	<	0.6 4
Barium	<	0.3 4	<	0.3 4
Cadmium	<	0.5 4		
Tin	<	15 4		
Selenium		24.7 4		
Cobalt	<	1 4		
Manganese	<	0.3 4		
Calcium		111 4		
Aluminum	<	5 4		
Strontium	<	0.2 4		
Mercury	<	15 4		

Non-Metal Content

Nitrogen (Weight %)

0.20 1

North Slope Crude Oil

Sulphur (Weight %)

		Weathering	(Volume %)	
0			9.1	16.2
1.04	1	1.19	2	1.3 2
1.15	2			

Other

Reid Vapour Pressure (kPa)

(°C)		
37.8	20.0	5
	19.02	3
	23.1	2

References

1 API 81
5 NSD 88

2 EETD 89

3 ESD 91

4 ESD 92

Oseberg Crude Oil

Oseberg, Norway, North Sea

Medium density North Sea Crude (Daling 91)
 ESSO Petroleum Dartmouth Refinery

Mass and Weight

API Gravity (15/15°C)

33.7 2
 34.4 4
 32.3 3

Density (g/mL)

(°C)	Weathering (Volume %)					
	0	14.0	14.6	27.5	27.8	36.9
0	0.8633 4	0.8951 4		0.9069 4		
13	0.863 3		0.8890 3		0.9060 3	0.9190 3
15	0.8522 4	0.8839 4		0.8961 4		

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)					
	0	14.0	14.6	27.5	27.8	36.9
0	21.6 4	104 4		535 #1 4		
13	15 3		33 3		67 3	254 3
15	10.0 4	28.8 4		69.7 4		

1. shear rate of 50s⁻¹

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	14.0	27.5
0	25.0 4	116 4	
15	11.8 4	32.6 4	77.8
20	8.52 2		

Pour Point (°C)

	Weathering (Volume %)					
	0	14.0	14.6	27.5	27.8	36.9
-6 2	0 4	9 3	3 4	12 3	21 3	
-6 3						
-9 4						

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		
	0	14.0	27.5
0	27.6 4	27.6 4	N/M 4
15	26.2 4	27.8 4	29.1 4

Oil-Seawater (mN/M or dynes/cm)

(°C)	Weathering (Volume %)					
	0	14.0	14.6	27.5	27.8	36.9
0	22.0 4	22.7 4		N/M 4		
13	21 3		25 3		26 3	28 3
15	20.2 4	21.2 4		19.9 4		

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		
	0	14.0	27.5
0	22.7 4	24.8 4	N/M 4
15	22.6 4	22.7 4	22.5 4

Emulsion

Emulsion Formation Tendency

Forms emulsions with relatively high stability and high viscosity at 13 C. (Daling 91)

(°C)	Weathering (Volume %)		
	0	14.0	27.5
0	1.0 4	1.0 4	1.0 4
15	0.95 1	1.0 4	1.0 4

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	14.0	27.5
0	1.0 4	1.0 4	1.0 4
15	0.20 4	1.0 4	1.0 4

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	14.0	27.5
0	89.4 4	87.7 4	78.7 4
15	96.2 4	87.3 4	85.4 4

Dispersibility

Chemical Dispersibility (% Dispersed)

EN 700 20 4

Dasic 10 4

Relatively high chemical dispersibility (Daling 91)

Fire and Reactivity

Flash Point (°C)

Weathering (Volume %)

0	14.0	14.6	27.5	27.8	36.9
-24 4	51.2 5	51 1	> 90 5	94 1	126 1

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	84 4	30 4
5	156 4	72 4
10	196 4	122 4
14.6	197 1	150 1
15	222 4	150 4
20	250 4	175 4
25	278 4	198 4
27.8	254 1	200 1
30	303 4	228 4
35	329 4	247 4
36.9	305 1	250 1
40	353 4	276 4
45	379 4	303 4
50	402 4	316 4

Weathering

T_G = 636.7

T_O = 394.2 (ESD 91)

Yield on Crude

	Range, °C	Weight %	Volume %
Gasoline	C5	5.46 2	6.83 2
	to 90		
Light Naphtha	90	11.62 2	13.05 2
	to 160		
Heavy Naphtha	160	3.47 2	3.77 2
	to 180		
Gas Oil	180	10.66 2	11.17 2
	to 240		
Gas Oil	240	17.61 2	17.62 2
	to 320		
Gas Oil	320	10.34 2	9.96 2
	to 375		
Heavy Gas Oil	375	6.36 2	6.01 2
	to 420		
Heavy Gas Oil	420	16.9 2	15.56 2
	to 525		
Residuum	> 525	16.01 2	13.69 2

Solubility

Aqueous Solubility (mg/L)

	Weathering	(Volume %)
	0	14.0
Room Temp	37.62	7.45

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

	Weathering	(Volume %)		
	0	14.6	27.8	36.9
Saturates				35.5 3
Aromatics				51.6 3
Polars				10.4 3
Asphaltenes	1.1 4			2.4 3
Asphaltenes "Hard"	0.73 3	0.83 3	0.95 3	1.09 3
Asphaltenes "Soft"	1.93 3	2.19 3	2.51 3	2.87 3

Wax Content (Weight %)

4.6 4

Metal Content

Other Metals (ppm)

	Weathering (Volume %)		
	0	14.0	27.5
Molybdenum	< 0.6 5	< 0.6 5	< 0.6 5
Potassium	< 1.5 5	< 1.5 5	< 1.5 5
Zinc	< 0.6 5	1.0 5	< 0.6 5
Lead	< 3 5	< 3 5	< 3 5
Nickel	3.8 5	4.1 5	5.2 5
	4.0 2		
Iron	4.2 5	4.5 5	2.6 5
Chromium	< 1.5 5	< 1.5 5	< 1.5 5
Magnesium	1.0 5	< 1 5	2.8 5
Vanadium	2.7 5	2.9 5	3.3 5
	< 2 2		
Copper	< 0.6 5	< 0.6 5	< 0.6 5
Titanium	< 0.6 5	< 0.6 5	< 0.6 5
Barium	< 0.3 5	< 0.3 5	< 0.3 5
Cadmium	< 0.5 5		
Sodium	< 2 2		
Selenium	< 15 5		
Cobalt	< 1 5		
Manganese	< 0.3 5		
Calcium	58 5		
Aluminum	< 5 5		
Strontium	< 0.2 5		
Tin	< 15 5		
Mercury	< 15 5		

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

2.6 2

Sulphur (Weight %)

0.31 2

Salt Content

Salt (g/m³)

NaCl: 5.0 2

Other

Acid Number (mg KOH/g)

total: 0.22 ²

Reid Vapour Pressure (kPa)

(°C)	
37.8	26.4

References

1 Brandvik 91

2 Corbett 89

3 Daling 91

4 ESD 91

5 ESD 92

Panuke Crude Oil

Canadian Eastcoast Offshore

Data for separator oil sample 87/08/07, Petro-Canada Incorporated.

Mass and Weight

API Gravity (15/15°C)

56.9 5

Density (g/mL)

(°C)	Weathering (Volume %)		
	0	32.1	47.4
0	0.7865 1	0.8130 1	0.8277 1
15	0.7757 1	0.8021 1	0.8168 1
	0.7507 5		

Relative Molecular Mass

122.94 5

ViscosityKinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	32.1	47.4
1	1.87 1	3.34 1	4.77 1
15	1.47 1	2.43 1	3.45 1

Pour Point (°C)

Weathering (Volume %)	
0	47.4
32.1	47.4
-36 1	-18 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	32.1	47.4
0	0 1	0 1	0 1
15	0 1	0 1	0 1

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	32.1	47.4
0	0 1	0 1	0 1
15	0 1	0 1	0 1

Panuke Crude Oil

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	32.1	47.4
0	N/A 1	N/A 1	N/A 1
15	N/A 1	N/A 1	N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

Dasic	40 1
EN 700	95 1

Natural Dispersibility (% Dispersed)

Weathering (Volume %)			
0	32.1	47.4	53.2
13 4	8 4	6 4	5 4

Fire and Reactivity

Flash Point (°C)

Weathering (Volume %)		
0	32.1	47.4
-30 1	32 1	64 1

Fire Point (°C)

Weathering (Volume %)		
0	32.1	47.4
-30 1	38 1	69 1

Distillation**Distillation (°C)**

(Vol%)	Liquid Temp	Vapour Temp
IBP	104 2	36 2
5	113 2	57 2
10	127 2	78 2
15	136 2	82 2
20	146 2	83 2
25	156 2	71 2
30	168 2	66 2
35	181 2	65 2
40	196 2	86 2
45	211 2	89 2
50	226 2	90 2
55	241 2	98 2
60	257 2	106 2
65	270 2	118 2
70	290 2	131 2
75	306 2	138 2

Hydrocarbon Group**Hydrocarbon Group Analysis (Weight %)**

	Weathering (Volume %)			
	0	32.1	47.4	53.2
Asphaltenes	0.29 1	0.34 1	0.52 1	0.40 1

Wax Content (Weight %)

1.8 2

Metal Content**Other Metals (ppm)**

Molybdenum	< 0.6 3
Potassium	< 1.5 3
Zinc	< 0.6 3
Lead	< 3 3
Nickel	< 1 3
Iron	< 3 3
Chromium	< 1.5 3
Magnesium	< 1 3
Vanadium	< 0.6 3
Copper	< 0.6 3
Titanium	< 0.6 3
Barium	< 0.3 3

Non-Metal Content

Sulphur (Weight %)

Weathering	(Volume %)		
0	32.1	47.4	53.2
0.04 1	0.02 1	0.04 1	0.02 1

Other Compositional Analysis

	Mole Fraction	Mass Fraction	Volume Fraction
N ₂	0.0001 5	0.0000 5	0.0000 5
CO ₂	0.0013 5	0.0005 5	0.0004 5
H ₂ S	0.0000 5	0.0000 5	0.0000 5
C ₁	0.0131 5	0.0017 5	0.0043 5
C ₂	0.0024 5	0.0006 5	0.0012 5
C ₃	0.0153 5	0.0055 5	0.0081 5
iC ₄	0.0255 5	0.0121 5	0.0161 5
C ₄	0.0420 5	0.0198 5	0.0255 5
iC ₅	0.0518 5	0.0304 5	0.0365 5
C ₅	0.0552 5	0.0324 5	0.0385 5
C ₆	0.0931 5	0.0655 5	
C ₇	0.0918 5	0.0751 5	
C ₈	0.0959 5	0.0893 5	
C ₉	0.0559 5	0.0585 5	
C ₁₀	0.0615 5	0.0714 5	
C ₁₁	0.0432 5	0.0551 5	
C ₁₂	0.0358 5	0.0498 5	
C ₁₃	0.0298 5	0.0449 5	
C ₁₄	0.0267 5	0.0432 5	
C ₁₅	0.0240 5	0.0416 5	
C ₁₆	0.0190 5	0.0351 5	
C ₁₇	0.0140 5	0.0274 5	
C ₁₈	0.0126 5	0.0262 5	
C ₁₉	0.0105 5	0.0230 5	
C ₂₀	0.0075 5	0.0173 5	
C ₂₁	0.0054 5	0.0131 5	
C ₂₂	0.0046 5	0.0117 5	
C ₂₃	0.0029 5	0.0076 5	
C ₂₄	0.0022 5	0.0061 5	
C ₂₅	0.0018 5	0.0052 5	
C ₂₆	0.0012 5	0.0035 5	
C ₂₇	0.0008 5	0.0025 5	
C ₂₈	0.0005 5	0.0018 5	
C ₂₉	0.0005 5	0.0016 5	
C ₃₀₊	0.0006 5	0.0030 5	
Aromatics			
C ₆ H ₁₀	0.0003 5	0.0002 5	
C ₇ H ₈	0.0020 5	0.0015 5	
C ₈ H ₁₀	0.0157 5	0.0136 5	
C ₈ H ₁₀	0.0087 5	0.0076 5	
C ₉ H ₁₂	0.0070 5	0.0069 5	
Naphthenes			
C ₅ H ₁₀	0.0042 5	0.0024 5	
C ₆ H ₁₂	0.0186 5	0.0128 5	
C ₆ H ₁₂	0.0311 5	0.0213 5	
C ₇ H ₁₄	0.0639 5	0.0512 5	

References

1 EETD 89
5 PetroCan 88

2 ESD 91

3 ESD 92

4 Fingas 90a

Parentis Crude Oil

North Sea

Mass and Weight

API Gravity (15/15°C)

32.5 1

Density (g/mL)

(°C)
Unknown 0.8630 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
20 9.90 1

Non-Metal Content

Sulphur (Weight %)

0.39 1

References

1 NSD 88

Pembina Crude oil

Alberta, Canada

Mass and Weight

API Gravity (15/15°C)

32.7 ¹

Density (g/mL)

(°C)	
Unknown	0.8620 ¹

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
38	5.20 ¹

Non-Metal Content

Sulphur (Weight %)

0.83 ¹

References

¹ NSD 88

Penetrating Oil

Preservative Oil
Water Displacing Oil

Mass and Weight

Density (g/mL)

(°C)	
20	0.8945 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
15	31.340 1
20	25.560 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
20	28.575 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
24	29.8 1

Oil-Water (mN/m or dynes/cm)

(°C)	
22	5.5 1

Fire and Reactivity

Flash Point (°C)

146 1

Sensation

Colour

Yellowish 1

Penetrating Oil

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	5.267 ¹

References

¹ CHRIS 85

Piper Crude Oil

U.K., North Sea

Mass and Weight

API Gravity (15/15°C)

35.2 1
35.0 2

Density (g/mL)

(°C)	
15	0.849 1 0.8500 2

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
50	3.55 1

Pour Point (°C)

-9 1
-9 2

Distillation

Distillation (°C)

(Wt%)	
8.4	5 to 100 1
17.6	100 to 160 1
11.9	160 to 250 1
17.9	250 to 350 1
44.2	> 350 1

Hydrocarbon Group

Wax Content (Weight %)

4 1

Metal Content

Other Metals (ppm)

Nickel/Vanadium 4.14 ²

Non-Metal Content

Sulphur (Weight %)

0.92 ¹

1.04 ²

References

¹ HMSO 76

² NSD 88

Pitas Point Crude Oil

California

Mass and Weight**API Gravity (15/15°C)**

38.0 1

Density (g/mL)

(°C)	Weathering (Volume %)		47.1
	0	23.6	
0	0.8443 1	0.8646 1	0.8791 1
15	0.8341 1	0.8537 1	0.8688 1

Viscosity**Dynamic Viscosity (mPa.s or cP)**

(°C)	Weathering (Volume %)		47.1
	0	23.6	
0	2.7 1	3.29 1	6.26 1
15	1.90 1	2.45 1	4.30 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		47.1
	Fresh	23.6	
0	3.18 1	3.81 1	7.12 1
15	2.24 1	2.87 1	4.94 1

Pour Point (°C)

Weathering (Volume %)		47.1
0	23.6	
< -60 1	< -65 1	< -51 1

Interfacial Tensions**Air-Oil (mN/M or dynes/cm)**

(°C)	Weathering (Volume %)		47.1
	0	23.6	
0	25.9 1	27.5 1	24.5 1
15	26.3 1	27.1 1	26.4 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		47.1
	0	23.6	
0	2.0 1	3.4 1	4.2 1
15	7.3 1	8.9 1	3.7 1

Pitas Point Crude Oil

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		47.1
	0	23.6	
0	7.6 1	7.4 1	7.5 1
15	10.5 1	10.4 1	8.3 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		47.1
	0	23.6	
0	0 1	0 1	0 1
15	0 1	0 1	0 1

Emulsion Stability

(°C)	Weathering (Volume %)		47.1
	0	23.6	
0	0 1	0 1	0 1
15	0 1	0 1	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		47.1
	0	23.6	
0	N/A 1	N/A 1	N/A 1
15	N/A 1	N/A 1	N/A 1

Fire and Reactivity

Flash Point (°C)

Weathering (Volume %)	
	0
17 1	46.4 2

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	160 1	63 1
5	167 1	134 1
10	172 1	145 1
15	177 1	152 1
20	182 1	156 1
25	186 1	160 1
30	193 1	164 1
35	199 1	169 1
40	207 1	172 1
45	215 1	177 1
50	223 1	182 1
55	234 1	187 1
60	245 1	194 1
65	257 1	200 1
70	269 1	205 1
75	284 1	204 1

Weathering

T_G = 156.0

T_O = 424.4 (ESD 91)

Solubility

Aqueous Solubility (mg/L)

Fresh water 27.03 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 0 1

Wax Content (Weight %)

0.2 1

Metal Content

Other Metals (ppm)

	Weathering (Volume %)	
	0	23.6
Molybdenum	< 0.6 2	< 0.6 2
Potassium	< 1.5 2	< 1.5 2
Zinc	3.3 2	4.1 2
Lead	< 3 2	< 3 2
Nickel	< 1 2	< 1 2
Iron	10.3 2	12.8 2
Chromium	< 1.5 2	< 1.5 2
Magnesium	< 1 2	< 1 2
Vanadium	< 0.6 2	< 0.6 2
Copper	< 0.6 2	< 0.6 2
Titanium	0.6 2	1.3 2
Barium	0.6 2	0.75 2

Other

Reid Vapour Pressure (kPa)

(°C)
37.8
6.93 1

References

1 ESD 91

2 ESD 92

Platform Irene Crude Oil

California

Mass and Weight

API Gravity (15/15°C)

11.2 1

Density (g/mL)

(°C)	Weathering (Volume %)
0	0
0	0.9968 1
15	0.9907 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	0
0	63181 #1 1
15	75995 1

1. at shear rate of 10/s

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)
0	0
0	
15	76708.4 1

Pour Point (°C)

12 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	N/M 1
15	37.2 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	N/M 1
15	N/M 1

Platform Irene Crude Oil

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	N/M 1
15	N/M 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
0	0
0	0 1
15	0 1

Emulsion Stability

(°C)	Weathering (Volume %)
0	0
0	0 1
15	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	0
0	N/A 1
15	N/A 1

Fire and Reactivity

Flash Point (°C)

-2 1

Solubility

Aqueous Solubility (mg/L)

Fresh water 10.97 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 8.7 1

Wax Content (Weight %)

2.0 1

Metal Content**Other Metals (ppm)**

Molybdenum	<	0.6	2
Potassium	<	1.5	2
Zinc		5.1	2
Lead	<	3	2
Nickel		60.5	2
Iron		44	2
Chromium		2.3	2
Magnesium		237	2
Vanadium		238	2
Copper		0.8	2
Titanium		1.1	2
Barium		53.6	2
Selenium	<	15	2
Cobalt	<	1	2
Manganese		0.56	2
Calcium		291	2
Aluminum		14	2
Strontium		9.96	2
Cadmium	<	0.5	2
Tin	<	15	2
Mercury	<	15	2

Other**Water Content of Oil (Volume %)**

43.2 1

References

1 ESD 91

2 ESD 92

Port Hueneme Crude Oil

California

Mass and Weight

API Gravity (15/15°C)

14.8 1

Density (g/mL)

(°C)	Weathering (Volume %)		
	0	4.2	8.4
0	0.9756 1	0.9843 1	0.9888 1
15	0.9662 1	0.9745 1	0.9787 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		
	0	4.2	8.4
0	22510 1	54155 1	157767 1
15	4131 1	7833 1	20987 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	fresh	4.2	8.4
0	23073 1	55018.8 1	159554 1
15	4276 1	8038 1	21444 1

Pour Point (°C)

Weathering (Volume %)		
0	4.2	8.4
-9 1	-9 1	0 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		
	0	4.2	8.4
0	32.6 1	N/M 1	N/M 1
15	30.8 1	30.0 1	31.1 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		
	0	4.2	8.4
0	30.8 1	N/M 1	N/M 1
15	23.2 1	28.4 1	28.6 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		
	0	4.2	8.4
0	35.6 1	N/M 1	N/M 1
15	30.2 1	30.1 1	32.6 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	4.2	8.4
0	0 1	0 1	0 1
15	0 1	0 1	0 1

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	4.2	8.4
0	0 1	0 1	0 1
15	0 1	0 1	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	4.2	8.4
0	N/A 1	N/A 1	N/A 1
15	N/A 1	N/A 1	N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	0 1
Dasic	0 1
EN 700	0 1
CRX-8	0 1

Fire and Reactivity

Flash Point (°C)

Weathering (Volume %)	Flash Point (°C)	
	0	8.4
-11.0 1	> 90 2	> 90 2

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	161.9 1	73 1
5	322 1	178 1
10	362 1	225 1
15	390 1	260 1
20	407 1	277 1
25	417 1	290 1
30	425 1	305 1
35	430 1	320 1
40	434 1	328 1
45	441 1	333 1
50	446 1	332 1
55	449 1	329 1
60	457 1	313 1

Weathering

T_G = 4170

T_O = 435.6 (ESD 91)

Solubility

Aqueous Solubility (mg/L)

Freshwater 2.62 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 9.9 1

Wax Content (Weight %)

4.6 1

Metal Content

Other Metals (ppm)

	Weathering (Volume %)		
	0	8.4	14.6
Molybdenum	0.6 2	1.7 2	0.6 2
Potassium	< 1.5 2	< 1.5 2	< 1.5 2
Zinc	0.6 2	0.6 2	0.4 2
Lead	< 3 2	< 3 2	< 3 2
Nickel	68 2	79 2	73 2
Iron	16 2	19.7 2	15.6 2
Chromium	< 1.5 2	< 1.5 2	< 1.5 2
Magnesium	3.1 2	20.3 2	3.3 2
Vanadium	253 2	288 2	260 2
Copper	< 0.6 2	< 0.6 2	< 0.6 2
Titanium	0.6 2	1.1 2	0.6 2
Barium	< 0.3 2	0.7 2	< 0.3 2
Selenium	< 15 2		
Cobalt	< 1 2		
Manganese	< 0.3 2		
Calcium	48.8 2		
Aluminum	6.8 2		
Strontium	0.62 2		
Cadmium	< 0.5 2		
Tin	< 15 2		
Mercury	< 15 2		

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	9.20

References

1 ESD 91

2 ESD 92

Primer Asphalt

Primer Asphalt

Shell Special Primer Asphalt

Mass and Weight

API Gravity (15/15°C)

18.6 1

Density (g/mL)

(°C)	Weathering (Volume %)
0	0
0	0.9526 1
15	0.9421 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	0
0	12700 1
15	3280 1

Pour Point (°C)

-17 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	28.8 1
15	28.3 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	26.8 1
15	24.7 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
0	0
0	28.9 1
15	27.8 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
0	0 1
15	1.0 1

Emulsion Stability

(°C)	Weathering (Volume %)
0	0 1
15	1.0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	N/A 1
15	55.1

Dispersibility

Natural Dispersibility (% Dispersed)

(°C)	
0	0 1
15	0 1

Fire and Reactivity

Flash Point (°C)

16 1

References

1 EETD 85

Prudhoe Bay Crude Oil

Prudhoe Bay Crude Oil

North Slope, Alaska

Mass and Weight

API Gravity (15/15°C)

27.0 16
27.0 3
27.8 2

Density (g/mL)

For Fw < 24.1% and T between 0 and 25°C
DEN = 0.913841 + 0.001582 Fw - 0.000955 T
DEN is density of oil at T and Fw (g/mL)
Fw is weight percent of oil weathered
T is oil temperature (°C)

(°C)	Weathering (Weight %)								
	0	7.3	9.1	9.8	11.2	24.1			
0	0.915	10							
	0.909	9							
	0.9037	2							
5	0.911	9		0.925	7	0.950	7		
10	0.910	9							
15	0.905	9		0.916	7	0.937	7	0.937	7
	0.899	7							
	0.8883	2							
15.6	0.893	3							
20	0.902	9	0.902	9		0.910	8		
	0.901	9							
	0.884	8							
25	0.881	15							
	0.900	9		0.905	7		0.928	7	
	0.888	7							

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Weight %)				
	0	7.3	9.8	11.2	24.1
-20	180	7	540	7	
-15	135	7	420	7	4000
-8	1000	11			
-2	170	11			
0	68	7	108	8	205
	500	10			204
	50	8			8
	19	11			
5	577	9			
	196	9			
10	140	15			
	103	9			
15	80	15			
	96	10			
20	33	7	62	8	102
	26	8			105
25	68.4	7			8
	50	15			
30	45.7	9			
	34.9	10			
35	20	7	37	8	55
	17	8			61
40	35.3	9			8

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Weight %)	
	0	9.8
0	630	9
5	216	9
10	113	9
15	37	7
	75.5	9
20	50.7	9
25	23	7
	39.2	9
38	14.0	2

Prudhoe Bay Crude Oil

Pour Point (°C)

		Weathering (Weight %)										
		0	7.3	9.8	11.2	18.2	24.1					
	0	9	-16	8	-27	7	-3	8	-18	7	-11	7
	-27	8										
	-9.5	11										
	-42	7										
	-9.1	16										
	-2	10										
	-9.4	3										

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

		Weathering (Volume %)	
		0	
(°C)	0	30.4	4
	15	28.3	4
	20	30.1	10

Oil-Seawater (mN/M or dynes/cm)

		Weathering (Volume %)	
		0	
(°C)	0	15.0	4
	15	9.7	4
	20	27.0	10

Oil-Water (mN/m or dynes/cm)

		Weathering (Volume %)	
		0	
(°C)	0	17.6	4
	15	16.9	4

Emulsion

Emulsion Formation Tendency

Forms fairly stable emulsion. (Mackay 82b)

Fire and Reactivity

Flash Point (°C)

		Weathering (Weight %)				
		0	7.3	11.2		
	30 (O.C.)	8	71 (O.C.)	8	84 (O.C.)	8

Note: Flash Point = 70.0(1 + 3.7 F)

Where: F = volume fraction evaporated (Mackay 82b)

Fire Point (°C)

Weathering (Weight %)		
0	7.3	11.2
35 8	86 8	91 8

Distillation

Distillation (°C)

(Vol%)	Vapour Temp	Liquid Temp
IBP	50 7	166 10
	27 3	
	67 8	
2.1	75 3	
4.7	100 3	
5.0		206 10
8.2	125 3	
10	168 7	246 10
11.8	150 3	
15.0		286 10
15.5	175 3	
19.0	200 3	
20	235 7	327 10
23.3	225 3	
28.1	250 3	
30	290 7	
33.1	275 3	
40	328 7	

Note: Data from (Mackay 75) and (Mackay 82b) obtained from curve

Weathering

T_O = 439.0

T_G = 804.0 (Mackay 82b)

Solubility

Aqueous Solubility (mg/L)

	Weathering (Weight %)					
	0	7.3	9.8	11.2	18.2	24.4
	41.7	8 15.0	8 4.89	7 7.6	8	
	29.25	7				
	23.90	13				
20 °C	29.2	10				
22 °C in fresh water	25.5	14				
22 °C in salt water	20.5	14				
Room, distilled	29.3	1	4.91	1	0.153	1 0.102 1
Solubility = 29.2 exp(-12.0 Fv)						Where:
Fv = volume fraction evaporated (Mackay 82b)						
exp = exponential base						
Note: (Bobra 83) solubility measured in double distilled water at room temperature						

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	61.2	2
	86.9	9
	78.3	5
Aromatics	35.6	2
	9.94	9
	17.6	5
	25.3	2
Polars	2.9	2
	1.6	9
	2.5	5
Asphaltenes	1.2	2
	1.53	9
	2.4	10
	1.6	5
Paraffins	27.3	2
Naphthenes	36.8	2
Others	10.6	

Wax Content (Weight %)

	3.86	9
	4.5	10
Wax =	0.045/(1 - F)	
Where:	Wax = wax content (mass fraction)	
	F = volume fraction evaporated (Mackay 82b)	

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	Weathering Wt%	48h LC ₅₀	96h LC ₅₀
Daphnia Magna	0	9.4	1
	9.8	3.9	1
	18.2	0.15	1
	24.4	0.10	1
Arctic Char			2.17 #1 12
Arctic Grayling			2.04 #1 12
Chinook Salmon			1.47 #1 12
Coho Salmon			1.45 #1 12
Dolly Varden			1.25 #1 12
Slimy Sculpin			3.00 #1 12
Sockeye Salmon			1.79 #1 12
3-Spine Stickleback			6.89 #1 12
#1. freshwater			

Metal Content

Other Metals (ppm)

Nickel	10	2
Vanadium	20	2
Iron	4	2

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

4.7 16

Nitrogen (Weight %)

0.230 3

Sulphur (Weight %)

0.82 3
0.82 16

Sensation

Colour

Brownish black 16

References

- | | | | |
|--------------|---------------|--------------|--------------|
| 1 Bobra 83 | 2 Clark 77 | 3 Coleman 78 | 4 EETD 85 |
| 5 EETD 86 | 6 Fingas 90a | 7 Mackay 75 | 8 Mackay 80a |
| 9 Mackay 82a | 10 Mackay 82b | 11 Martin 77 | 12 Moles 79 |
| 13 Rice 76 | 14 Suntio 86 | 15 USCG 71 | 16 USCG 72 |

Ragusa Crude Oil

North Sea

Mass and Weight

API Gravity (15/15°C)

19.8 ¹

Density (g/mL)

(°C)	
Unknown	0.9350 ¹

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
38	277.0 ¹

Non-Metal Content

Sulphur (Weight %)

2.30 ¹

References

¹ NSD 88

Rainbow Light and Medium Crude Oil

Alberta, Canada

Mass and Weight

API Gravity (15/15°C)

40.7 1

Density (g/mL)

(°C)	
21	0.8210 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
40	3.77 1
38	3.8 2

Pour Point (°C)

2.5 1

Distillation

Yield on Crude

	Range, °C	Volume %
Naphtha	C5	38.70 1
	to 190	
Kerosene	190	13.00 1
	to 277	
Distillate	277	11.50 1
	to 343	
Gas Oil	343	31.65 1
	to 565	
Residuum	> 565	5.15 1

Hydrocarbon Group

Wax Content (Weight %)

20.40 1

Metal Content

Other Metals (ppm)

Nickel	0.85	1
Vanadium	0.50	1

Non-Metal Content

Hydrogen Sulfide - Existent (mg/m³)

10.2 1

Carbon Residue - Ramsbottom (Weight %)

1.65 1

Sulphur (Weight %)

5000 ppm 1

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	33.9 1

References

1 Aalund 83c

2 NSD 88

Rangeland-South Light and Medium Crude Oil

Alberta, Canada

Mass and Weight

API Gravity (15/15°C)

39.5 1

Density (g/mL)

$\frac{(\text{°C})}{21} \quad 0.8267 \text{ 1}$

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

$\frac{(\text{°C})}{40} \quad 2.67 \text{ 1}$

Pour Point (°C)

-40 1

Distillation

Yield on Crude

	Range, °C	Volume %
Naphtha	C ₅	38.75 1
	to 190	
Kerosene	190	15.50 1
	to 277	
Distillate	277	8.55 1
	to 343	
Gas Oil	343	33.20 1
	to 565	
Residuum	> 565	4.0 1

Hydrocarbon Group

Wax Content (Weight %)

12.44 1

Metal Content

Other Metals (ppm)

Nickel	1.20	¹
Vanadium	1.40	¹

Non-Metal Content

Hydrogen Sulfide - Existent (mg/m³)

20.1 ¹

Carbon Residue - Ramsbottom (Weight %)

0.69 ¹

Sulphur (Weight %)

7520 ppm ¹

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	39.3 ¹

References

¹ Aalund 83c

Redwater Crude Oil

Alberta, Canada

Mass and Weight

API Gravity (15/15°C)

34.7 2
34.8 1

Density (g/mL)

(°C)	
Unknown	0.8510 2

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
37.8	4.5 1
38.0	6.20 2

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

12.7 1

Sulphur (Weight %)

0.54 2
0.55 1

References

1 Bland 67

2 NSD 88

Road Oil

Liquid Asphalt
Petroleum Asphalt
Slow Curing Asphalt

Mass and Weight

Density (g/mL)

(°C)	
25	0.9970
	to 1.1964 ¹

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	25 (estimated) ¹

Oil-Water (mN/m or dynes/cm)

(°C)	
20	50 (estimated) ¹

Fire and Reactivity

Flash Point (°C)

148.9
to 287.8 ¹

Sensation

Colour

Dark brown
to black ¹

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	0.689 (estimated) ¹

References¹ CHRIS 85

Sable Island Condensate

Nova Scotia, Canada

Mass and Weight

API Gravity (15/15°C)

39.9 6

Density (g/mL)

For F < 82% & T between 0 and 25°C

$$\text{DEN} = 0.865048 + 0.000383 F - 0.000298 T$$

Where: DEN is density of oil at T and F (g/mL)

F is percent of oil weathered

T is oil temperature (°C)

(°C)	Weathering (Volume %)			
	0	41	71	82
0	0.878 4			
5	0.834 6	0.875 6	0.885 6	0.914 6
	0.876 4			
10	0.875 4			
15	0.823 6	0.869 6	0.870 6	0.899 6
	0.874 4			
20	0.872 4			
25	0.869 4			

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)			
	0	41	71	82
0	12.8 4			
5	2.7 6	88.0 6	2250 6	6600 6
	4.96 4			
10	3.39 4			
15	2.02 6	5.55 6	320 6	2450 6
	2.96 4			
20	2.67 4			
25	2.41 4			

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)			
	0	41	71	82
0	14.6 4			
5	3.2 6	100.6 6	2542 6	7221 6
	5.66 4			
10	3.87 4			
15	2.45 6	6.39 6	368 6	2725 6
	3.39 4			
20	3.06 4			
25	2.77 4			

Pour Point (°C)

	Weathering (Volume %)						
	0	41	71	82			
-22	6	3	6	18	6	27	6
3	4						
-51	2						

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
0	0
0	0 2
15	0 2

Emulsion Stability

(°C)	Weathering (Volume %)
0	0
0	0 2
15	0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	0
0	N/A 2
15	N/A 2

Dispersibility

Natural Dispersibility (% Dispersed)

(°C)	
0	4.8 2
15	27.8 2

Note: Little tendency to disperse at 5°C for fresh and 42% weathered oil (Ross 82a)

Fire and Reactivity

Flash Point (°C)

Weathering (Volume %)			
0	41	71	82
16 (O.C.) ⁶	81 (O.C.) ⁶	135 (O.C.) ⁶	147 (O.C.) ⁶
-11	2		

Sable Island Condensate

Fire Point (°C)

Weathering (Volume %)	
0	41
16 6	84 6
71	141 6
82	161 6

Distillation

Distillation (°C)

(Vol%)	
15	103 6
30	123 6
50	156 6
70	220 6

Solubility

Aqueous Solubility (mg/L)

	Weathering (Volume %)	
	0	42
Salt Water	58.08 6	5.34 6
	11.93 5	
Fresh Water @ 22°C	76.0 7	
	14.4 5	
Distilled Water	74.65 6	8.02 6

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	88.4 4
	81.04 6
Aromatics	10.8 4
Polars	0.23 4
Asphaltenes	0.60 4

Wax Content (Weight %)

2.01 4

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	24h LC ₅₀	48h EC ₅₀	48h LC ₅₀
Daphnia Magna		0.41 #1 5	3.41 #1 5
		2.1 #1 1	18 #1 1
Artemia spp.			5.84 #2 5
		1.94 #1 5	2.58 #1 5
		9.84 #1 1	13.13 #1 1
			4.33 #2 5

Rainbow Trout 6.0 #2 3

#1. Sable Island Condensate

#2. 15°C, Freshwater

Note: Results from (Maclean 88) obtained by fluorescence spectroscopy. Results from (Bobra 88) obtained by purge-and-trap GC analysis.

Non-Metal Content

Hydrogen Sulfide - Existent (mg/m³)

0 6

Sulphur (Weight %)

0.03 2

Sensation

Colour

Clear, pale yellow 3

References

1 Bobra 88

2 EETD 86

3 Hutcheson 83

4 Mackay 82a

5 MacLean 88

6 Ross 82a

7 Suntio 86

Santa Clara Crude Oil

California

Mass and Weight

API Gravity (15/15°C)

22.1 1

Density (g/mL)

(°C)	Weathering (Volume %)		21.6
	0	11.4	
0	0.9327 1	0.9587 1	0.9783 1
15	0.9202 1	0.9479 1	0.9672 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		21.6
	0	11.4	
0	1278 1	45572 #1 1 23705 #2 1	577100 #1 1
15	304 1	1859 1	22755 1

1. shear rate of 1s⁻¹
2. shear rate of 10s⁻¹

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		21.6
	0	11.4	
0	1370 1		
15	331 1	1961 1	23527 1

Pour Point (°C)

	Weathering (Volume %)		21.6
	0	11.4	
-3 1	6 1		27 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		21.6
	0	11.4	
0	30.9 1	N/M 1	N/M 1
15	28.7 1	28.0 1	31.8 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		21.6
	0	11.4	
0	28.6 1	N/M 1	N/M 1
15	23.3 1	21.6 1	31.6 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		21.6
	0	11.4	
0	30.3 1	N/M 1	N/M 1
15	25.7 1	24.9 1	N/M 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		21.6
	0	11.2	
0	0 1	0 1	0 1
15	0 1	0 1	0 1

Emulsion Stability

(°C)	Weathering (Volume %)		21.6
	0	11.2	
0	0 1	0 1	0 1
15	0 1	0 1	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		21.6
	0	11.2	
0	N/A 1	N/A 1	N/A 1
15	N/A 1	N/A 1	N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	0 1
Dasic	0 1
EN 700	5 1
CRX-8	0 1

Fire and Reactivity

Flash Point (°C)

Weathering	(Volume %)	
0	11.4	21.6
-24 1	45.2 2	> 90 2

Distillation

Distillation (°C)

Too much H₂O (ESD 91)

Solubility

Aqueous Solubility (mg/L)

Freshwater 10.40 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 9.7 1

Wax Content (Weight %)

6.1 1

Metal Content

Other Metals (ppm)

	Weathering (Volume %)		
	0	11.4	21.6
Molybdenum	1.5 2	2.0 2	< 0.6 2
Potassium	< 1.5 2	< 1.5 2	< 1.5 2
Zinc	< 0.6 2	< 0.6 2	0.6 2
Lead	< 3 2	< 3 2	< 3 2
Nickel	77 2	97 2	101 2
Iron	115 2	155 2	155 2
Chromium	< 1.5 2	< 1.5 2	< 1.5 2
Magnesium	1.8 2	2.6 2	3.3 2
Vanadium	193 2	250 2	240 2
Copper	< 0.6 2	< 0.6 2	< 0.6 2
Titanium	< 0.6 2	2.0 2	1.9 2
Barium	< 0.3 2	0.6 2	0.65 2
Selenium	< 15 2		
Cobalt	< 1 2		
Manganese	< 0.3 2		
Calcium	42 2		
Aluminum	< 5 2		
Strontium	0.2 2		
Cadmium	< 0.5 2		
Tin	< 15 2		
Mercury	< 15 2		

Other

Reid Vapour Pressure (kPa)

(°C)
37.8
25.1 1

References

1 ESD 91

2 ESD 92

Sockeye Crude Oil

California

Mass and Weight

API Gravity (15/15°C)

26.2 1

Density (g/mL)

(°C)	Weathering (Volume %)		22.1
	0	12.5	
0	0.9081 1	0.9277 1	0.9374 1
15	0.8965 1	0.9166 1	0.9264 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		22.1
	0	12.5	
0	114 1	601 1	3723 1
15	45.1 1	163 1	628 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		22.1
	fresh	12.5	
0	125 1	648 1	3972 1
15	50.3 1	177 1	678 1

Pour Point (°C)

Weathering (Volume %)		22.1
0	12.5	
-12 1	-3 1	3 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		22.1
	0	12.5	
0	28.1 1	29.1 1	N/M 1
15	27.8 1	29.0 1	29.6 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		22.1
	0	12.5	
0	18.3 1	19.8 1	N/M 1
15	16.8 1	17.2 1	19.6 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		22.1
	0	12.5	
0	21.7 1	20.9 1	N/M 1
15	19.1 1	20.8 1	21.0 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	12.5	22.1
0	1 1	1 1	0 1
15	1 1	0 1	1 1

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	12.5	22.1
0	1 1	1 1	0 1
15	1 1	0 1	1 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	12.5	22.1
0	88.3 1	67.0 1	N/A 1
15	89.8 1	N/A 1	69.0 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9522	5 1
Dasic	0 1
EN 700	5 1
CRX-8	10 1

Fire and Reactivity

Flash Point (°C)

Weathering (Volume %)	Flash Point (°C)	
	0	22.1
-17 1	56.9 2	> 90 2

Sockeye Crude Oil

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	134 1	36 1
5	182 1	107 1
10	212 1	130 1
15	245 1	155 1
20	276 1	188 1
25	305 1	212 1
30	332 1	237 1
35	359 1	260 1
40	383 1	267 1
45	402 1	285 1
50	414 1	297 1

Weathering

T_G = 643.2

T_O = 420.6 (ESD 91)

Solubility

Aqueous Solubility (mg/L)

Freshwater 27.64 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 5.1 1

Wax Content (Weight %)

5.3 1

Metal Content

Other Metals (ppm)

	Weathering (Volume %)		
	0	12.5	22.0
Molybdenum	2.0 2	1.1 2	1.5 2
Potassium	< 1.5 2	< 1.5 2	< 1.5 2
Zinc	< 0.6 2	< 0.6 2	< 0.6 2
Lead	< 3 2	< 3 2	< 3 2
Nickel	42.2 2	49.3 2	60.7 2
Iron	3.6 2	7.9 2	11.5 2
Chromium	< 1.5 2	< 1.5 2	< 1.5 2
Magnesium	< 1 2	< 1 2	1.0 2
Vanadium	125 2	139 2	173 2
Copper	< 0.6 2	< 0.6 2	< 0.6 2
Titanium	2.0 2	3.4 2	2.0 2
Barium	< 0.3 2	< 0.3 2	< 0.3 2
Selenium	< 15 2		
Cobalt	< 1 2		
Manganese	< 0.3 2		
Calcium	33.7 2		
Aluminum	< 5 2		
Strontium	0.2 2		
Cadmium	< 0.5 2		
Tin	< 15 2		
Mercury	< 15 2		

Other

Reid Vapour Pressure (kPa)

(°C)
37.8
21.1 1

References

1 ESD 91

2 ESD 92

Sour Blend Crude Oil

Mass and Weight

API Gravity (15/15°C)

34.8 1

Density (g/mL)

For T between 0 and 25°C

$$\text{DEN} = 0.856 - 0.00077 T$$

Where: DEN is density of fresh oil at T (g/mL)

T is oil temperature (°C)

(°C)	Weathering (Weight %)		
	0	10	20
0	0.861 1		
	0.852 3		
5	0.850 3		
10	0.847 3		
15	0.850 1		
	0.842 3		
20	0.840 3	0.861 3	0.875 3
25	0.836 3		

Viscosity

Dynamic Viscosity (mPa.s or cP)

$$\text{VISC} = \exp(3.189 - 4691.9 T / (273(T + 273)))$$

VISC is dynamic viscosity of fresh oil at T (mpa.s)

exp is exponential base e

T is oil temperature (°C)

Where:

(°C)	Weathering (Volume %)	
	0	
0	24.2 3	
	26.7 4	
5	16.9 3	
10	10.9 3	
	19.4 4	
15	8.20 3	
20	6.59 3	
	9.5 4	
25	5.95 3	

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering	(Volume %)
	0	
0	28.4	3
5	19.9	3
10	12.9	3
15	9.74	3
20	7.85	3
25	7.12	3

Pour Point (°C)

Weathering	(Weight %)
0	10 20
6 3	6 3 9 3
-50 4	

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering	(Volume %)
	0	
15	25.8	1
	25.6	2
Room	24.1	4

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering	(Volume %)
	0	
15	0.75	1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering	(Volume %)
	0	
15	13.0	2
Room	27.5	4

Emulsion

Emulsion Formation Tendency

(°C)	Weathering	(Volume %)
	0	
0	0.58	1
15	0	1

Emulsion Stability

(°C)	Weathering (Volume %)
0	0
0	0.9 1
15	0.1 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
0	0
0	92.3 1
15	N/A 1

Fire and Reactivity

Flash Point (°C)

6.6 1

Fire Point (°C)

< 10.5 4

Combustion Results

Easily ignited, 5.0 Wt% residue 4

Distillation

Distillation (°C)

(Vol%)	Vapour Temp	Liquid Temp
IBP	45 4	114 1
5		140 1
10	95 4	164 1
15		188 1
20	130 4	213 1
25		239 1
30	180 4	264 1
40	235 4	
50	300 4	
60	345 4	
70	380 4	
80	385 4	
85	390 4	

Weathering

T_O = 386.0

T_G = 506.5 (EETD 84)

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

	Weathering (Weight %)		
	0	10	20
Saturates	82.3 3	76.9 3	72.5 3
Aromatics	13.2 3	14.7 3	16.4 3
Polars	2.33 3	3.86 3	4.34 3
Asphaltenes	2.21 3	4.58 3	6.73 3

Wax Content (Weight %)

	Weathering (Weight %)		
	0	10	20
	5.62 3	8.49 3	9.95 3

References

1 EETD 84

2 EETD 85

3 Mackay 82a

4 Twardus 80

South Cormorant Crude Oil

U.K., North Sea

Contributor to Brent system at Sullom Voe, Shetland Islands.

Mass and Weight

API Gravity (15/15°C)

35.7 1

Density (g/mL)

(°C)	
15	0.846 1

Viscosity

Pour Point (°C)

-6.0 1

Distillation

Yield on Crude

	Range, °C	Volume %
C ₁ -C ₄		2.8 1
Gasoline	C ₅	7.5 1
	to 85	
Naphtha	85	15.4 1
	to 165	
Kerosene	165	12.9 1
	to 235	
Gas Oil	235	13.4 1
	to 300	
Gas Oil	300	7.9 1
	to 350	
Residuum	> 350	40.5 1

Non-Metal Content

Sulphur (Weight %)

0.56 1

References

¹ Aalund 83c

South Louisiana Crude Oil

South Louisiana, U.S.A.

Mass and Weight

API Gravity (15/15°C)

37.0 2

34.5 8

Density (g/mL)

(°C)	<hr/>	
15.6	0.839	2

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	<hr/>	
38	4.3	7

Pour Point (°C)

-9 7

Dispersibility

Chemical Dispersibility (% Dispersed)

C9527	55	4
Dasic	30	4
EN 700	30	4

Distillation

Distillation (°C)

(Vol%)		
5	76	2
10	105	2
15	132	2
20	156	2
25	178	2
30	203	2
35	221	2
40	239	2
45	254	2
50	271	2
55	284	2
60	302	2
65	321	2
70	341	2
75	362	2
80	384	2
85	411	2
90	440	2
95	468	2
FBP	530	2

Solubility

Aqueous Solubility (mg/L)

in seawater	23.37	1
in distilled water	37.9	5

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	65.1	3
Aromatics	26.3	3
Polars	8.4	3
Asphaltenes	0.2	3

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	24h LC ₅₀	48h LC ₅₀	96h LC ₅₀
POLYCHAETA:			
Platynereis Dumerilii		12.3 6	9.5 6
Neanthes Arenaceodentata	18.0 9	13.9 9	12.5 9
Capitella Capitata	> 19.8 9	16.2 9	12.0 9
CRUSTACEA:			
Mysidopsis Almyra	11.7 1	8.7 1	
Leander tenuicornis		10.2 6	6.0 6
Palaemonetes Pugio	> 16.8 1	> 16.8 6	> 16.8 6
Penaeus Aztecus	> 19.8 1	> 19.8 6	> 19.8 6
FISH:			
Menidia Beryllina	9.7 1	8.7 6	5.5 6
Fundulus Similis	16.8 1	16.8 6	16.8 6
Cyprinodon Variegatus	> 19.8 1	> 19.8 6	> 19.8 6

Acute Toxicity, Oil in Water Emulsion (mg/L)

	24h LC ₅₀	48h LC ₅₀	96h LC ₅₀
CRUSTACEA:			
Mysidopsis Almyra	165 1	37.5 1	
Palaemonetes Pugio	1700 1	1650 1	200 1
Penaeus Aztecus	> 1000 1	> 1000 1	> 1000 1
FISH:			
Menidia Beryllina	7600 1	5000 1	3700 1
Fundulus Similis	6610 1	6000 1	6000 1
Cyprinodon Variegatus	80000 1	33000 1	29000 1

Metal Content

Other Metals (ppm)

Nickel	1.1 2	2.2 8
Vanadium	0.9 2	1.9 8

Non-Metal Content

Nitrogen (Weight %)

0.031 2
0.69 8
0.13 7

Sulphur (Weight %)

0.21 2
0.25 8

References

1 Anderson 74
5 Murray 84
9 Rossi 76

2 API 81
6 Neff 76

3 Clark 77
7 NSD 88

4 EETD 89
8 pancirov 74

South West Texas Light Crude Oil

Texas, U.S.A.

Mass and Weight

API Gravity (15/15°C)

41.0 ¹

Density (g/mL)

(°C)

Unknown

0.8210 ¹

Viscosity

Kinematic Viscosity (mm²/sec or cst)

(°C)

38

1.40 ¹

Non-Metal Content

Sulphur (Weight %)

0.08 ¹

References

¹ NSD 88

Spindle Oil

Spindle Oil

Bearing Oil
High Speed Bearing Oil

Mass and Weight

API Gravity (15/15°C)

29.1 ¹

Density (g/mL)

$\frac{(\text{°C})}{15} \quad 0.8802 \text{ }^1$

Fire and Reactivity

Flash Point (°C)

76 (C.C.) ¹

Toxicity

Toxicity (mg/L)

Bluegill $\frac{24\text{h TL}_m}{2990 \text{ \#1 }^1}$
1. freshwater

Biological Oxygen Demand (days)

$\frac{(\%)}{53} \quad 5 \text{ }^1$

Sensation

Colour

Light brown ¹

Other

Reid Vapour Pressure (kPa)

$\frac{(\text{°C})}{37.8} \quad 0.689 \text{ (estimated) }^1$

References

¹ CHRIS 85

Spray Oil

Dormant Oil
 Foliage Oil
 Kerosene Heavy
 Plant Spray Oil

Mass and Weight

API Gravity (15/15°C)

41.1 1

Density (g/mL)

(°C)	
15	0.8193 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
1.7	3.229 1
15	2.282 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
15	2.786

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	25 (estimated) 1

Oil-Water (mN/m or dynes/cm)

(°C)	
20	50 (estimated) 1

Fire and Reactivity

Flash Point (°C)

min 60 (C.C.) 1

Flammability Limits (Volume %)

in air	0.6 to 4.6 1
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Spray Oil

Distillation

Boiling Range (°C)

310
to 371 ¹

Toxicity

Toxicity (mg/L)

Salmon fingerlings $\frac{\text{Lethal}_{500}}{500 \text{ \#1 }^1}$ 10 20
1. freshwater

Biological Oxygen Demand (days)

(%)
 $\frac{53}{5}^1$

Sensation

Colour

Colourless
to light brown ¹

Odour Threshold (ppm)

1 ¹

Other

Reid Vapour Pressure (kPa)

(°C)
 $\frac{37.8}{0.689 \text{ (estimated)}}^1$

References

¹ CHRIS 85

Statfjord Crude Oil

Norway and U.K., North Sea

Mass and Weight**API Gravity (15/15°C)**

38.4 1
38.2 5
37.8 3

Density (g/mL)

(°C)	Weathering	(Volume %)		
	0	20.1	32.3	42.1
15.5	0.834 4	0.867 4	0.882 4	0.895 4

Viscosity**Dynamic Viscosity (mPa.s or cP)**

(°C)	Weathering	(Volume %)		
	0	20.1	32.3	42.1
6	12 4	50 4	113 4	483 4
13	7 4	20 4	57 4	221 4

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
15	7.33 1
20	6.09 3
38	4.40 5

Pour Point (°C)

	Weathering	(Volume %)		
	0	20.1	32.3	42.1
	-15 4	7 4	11 4	16 4
	4 1			
	-3 3			

Interfacial Tensions**Oil-Seawater (mN/M of dynes/cm)**

(°C)	Weathering	(Volume %)		
	0	20.1	32.3	42.1
13	23 4	16 4	15 4	16 4

Emulsion

Emulsion Formation Tendency

Forms emulsions with relatively high stability. (Daling 91)

Water Content of Emulsion (Volume %)

	Weathering (Volume %)		
(°C)	20.1	32.3	42.1
13	36 3	77 3	73 3

Note: Oil weathered 20.1 Vol% did not form stable emulsion (Daling 88)
88)

Dispersibility

Chemical Dispersibility (% Dispersed)

Relatively low dispersibility with Finasol OSR-5. (Daling 91)

Fire and Reactivity

Flash Point (°C)

	Weathering (Volume %)		
	20.1	32.3	42.1
	38 2	64 2	111 2

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
20.1	185 2	150 2
32.3	251 2	200 2
42.1	300 2	250 2

Yield on Crude

	Range, °C	Volume %	Weight %
Gasoline	C5	4.44 3	3.47 3
	to 65		3.47 3
Light Naphtha	65	4.08 3	3.51 3
	to 90		
Naphtha	90	12.89 3	11.71 3
	to 150		
Heavy Naphtha	150	6.06 3	5.69 3
	to 180		
Light Gas Oil	180	10.70 3	10.38 3
	to 240		
Gas Oil	240	16.01 3	16.20 3
	to 320		
Gas Oil	320	9.34 3	9.72 3
	to 375		
Heavy Gas Oil	375	5.24 3	5.56 3
	to 420		
Heavy Gas Oil	420	15.79 3	17.07 3
	to 525		
Heavy Gas Oil	525	3.72 3	4.14 3
	to 565		
Residuum	> 565	8.48 3	9.92 3

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

	Weathering (Volume %)			
	0	20.1	32.3	42.1
Saturates				56.2 4
Aromatics				34.8 4
Polars				7.8 4
Asphaltenes "hard"	0.01 4	0.01 4	0.02 4	0.02 4
Asphaltenes "soft"	0.39 4	0.47 4	0.54 4	0.63 4

Wax Content (Weight %)

	Weathering (Volume %)			
	0	20.1	32.3	42.1
	4.14 4	4.78 4	5.77 4	6.68 4
	5.7 5			

Metal Content

Other Metals (ppm)

Nickel	1.03	1
Vanadium	0.53	1
Sodium	13	3
Nitrogen (total)	1.03	1

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

1.32 1

Nitrogen (Weight %)

1.03 1

Sulphur (Weight %)

0.27 1
0.28 3

Other

Acid Number (mg KOH/g)

total: 0.06 3

Reid Vapour Pressure (kPa)

(°C)	
37.8	37.9 1
	37.4 5

References

1 Aalund 83c
5 NSD 88

2 Brandvik 91

3 Corbett 90

4 Daling 88

Sumatran Heavy (Duri) Crude Oil

Indonesia

Mass and Weight

API Gravity (15/15°C)

20.3 1
20.6 2

Density (g/mL)

(°C)	Weathering (Volume %)	
	0	5.3
Unknown	0.9300 2	
0	0.9428 1	0.9451 1
15	0.9312 1	0.9374 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)	
	0	5.3
0	N/M 1	N/M 1
15	13302 #1 1	12904 #1 1
	40178 #2 1	27946 #2 1

#1. Shear rate 10/s

#2. Shear rate 1/s

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
38	400 2

Pour Point (°C)

	Weathering (Volume %)	
	0	5.3
	18 1	22 1
	14 2	

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	5.3
0	N/M 1	N/M 1
15	N/M 1	N/M

Sumatran Heavy (Duri) Crude Oil

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering	(Volume %)
	0	5.3
0	N/M 1	N/M 1
15	N/M 1	N/M 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering	(Volume %)
	0	5.3
0	N/M 1	N/M 1
15	N/M 1	N/M 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering	(Volume %)
	0	5.3
0	0 1	
15	0 1	0 1

Emulsion Stability

(°C)	Weathering	(Volume %)
	0	5.3
0	0 1	
15	0 1	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering	(Volume %)
	0	5.3
0	N/A 1	
15	N/A 1	N/A 1

Fire and Reactivity

Flash Point (°C)

Weathering	(Volume %)
0	5.3
53.6 1	> 90 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 7.0 1

Wax Content (Weight %)

15.8 1

Metal Content

Other Metals (ppm)

Molybdenum	<	0.6	1
Potassium	<	1.5	1
Zinc		0.6	1
Lead	<	3	1
Nickel		30.9	1
Iron		12.9	1
Chromium	<	1.5	1
Magnesium		3.0	1
Vanadium		1.2	1
Copper	<	0.6	1
Titanium	<	0.6	1
Barium	<	0.3	1

Non-Metal Content

Sulphur (Weight %)

0.21 2

References

1 ESD 92

2 NSD 88

Sumatran Light (Minas) Crude Oil

Indonesia

Mass and Weight

API Gravity (15/15°C)

32.9 1
35.2 2

Density (g/mL)

(°C)	
Unknown	0.8490 2
0	0.877 1
15	0.860 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
0	N/M 1
15	41475 #1 1
	322800 #2 1

#1. Shear rate 10/s

#2. Shear rate 1/s

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
50	11.4 2

Pour Point (°C)

38 1
32 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
0	N/M 1
15	N/M 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	
0	N/M 1
15	N/M 1

Oil-Water (mN/m or dynes/cm)

(°C)	
0	N/M 1
15	N/M 1

Emulsion

Emulsion Formation Tendency

(°C)	
0	0 1
15	0 1

Emulsion Stability

(°C)	
0	0 1
15	0 1

Water Content of Emulsion (Volume %)

(°C)	
0	N/A 1
15	N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	0 1
Dasic	0 1
EN 700	0 1
CRX-8	0 1

Fire and Reactivity

Flash Point (°C)

16.9 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes	5.9 1
	0.12 2

Wax Content (Weight %)

28.3 1

Metal Content

Other Metals (ppm)

Molybdenum	< 0.6	1
Potassium	< 1.5	1
Zinc	< 0.6	1
Lead	< 3	1
Nickel	8.5	1
Iron	8.0	1
Chromium	< 1.5	1
Magnesium	2.0	1
Vanadium	0.7	1
Copper	2.0	1
Titanium	< 0.6	1
Barium	< 0.3	1

Non-Metal Content

Sulphur (weight %)

0.09 2

References

¹ ESD 92

² NSD 88

Swanson River Crude Oil

Cook Inlet, Alaska

Mass and Weight

API Gravity (15/15°C)

29.7 2

29.7 1

Density (g/mL)

(°C)	
15.6	0.878 2

ViscosityKinematic Viscosity (mm²/sec or cSt)

(°C)	
25	10.5 2
37.8	6.1 1
	6.1 2

Pour Point (°C)

< -15 2

Distillation

Distillation (°C)

(Vol%)	
IBP	26 2
1.9	50 2
4.8	75 2
7.7	100 2
12.9	125 2
18.9	150 2
23.4	175 2
27.4	200 2
31.7	225 2
36.5	250 2
43.2	275 2

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

8.1 2

Swanson River Crude Oil

Nitrogen (Weight %)

0.203 ²

Sulphur (Weight %)

0.16 ¹

0.16 ²

Sensation

Colour

Brownish black ²

References

¹ Bland 67

² Coleman 78

Sweet Blend Crude Oil

Mass and Weight

API Gravity (15/15°C)

38.6 1

Density (g/mL)

$$\text{DEN} = 0.8406 - 0.0006 T$$

Where:

DEN is density of fresh oil at T (g/mL)

T is oil temperature (°C)

(°C)	Weathering (Weight %)		
	0	10	20
0	0.840 1		
5	0.838 1		
10	0.835 1		
15	0.831 1		
20	0.829 1	0.847 1	0.859 1
25	0.825 1		

Viscosity

Dynamic Viscosity (mPa.s or cP)

$$\text{VISC} = \exp(2.89 - 4886.5 T / (273(T + 273)))$$

Where:

VISC is dynamic viscosity of fresh oil at T

exp is exponential base e

T is oil temperature (°C)

(°C)	Weathering (Volume %)	
	0	
0	21.0 1	
	20.1 3	
5	11.5 1	
10	7.99 1	
	14.2 3	
15	5.31 1	
20	4.77 1	
	8.1 3	
25	4.13 1	

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)	
	0	
0	25 1	
5	13.7 1	
10	9.6 1	
15	6.39 1	
20	5.75 1	
25	5.01 1	

Sweet Blend Crude Oil

Pour Point (°C)

		Weathering (Weight %)			
		0	10	20	
-33	1	-27	1	6	1
-35	3				

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
Room Temp.	24 3

Oil-Seawater (mN/M or dynes/cm)

		Weathering (Weight %)				
(°C)		0	10	20		
Room	19.5	1	16.9	1	20.2	1

Oil-Water (mN/m or dynes/cm)

(°C)	
Room Temp.	27.3 3

Fire and Reactivity

Flash Point (°C)

< 9 (o.c.) 3

Fire Point (°C)

10 (o.c.) 3

Combustion Results

Easily ignited, 6.1 Wt% residue 3

Distillation**Distillation (°C)**

(Vol%)	
0	50 3
10	95 3
20	130 3
30	185 3
40	230 3
50	280 3
60	335 3
70	370 3
80	380 3
90	385 3

Solubility**Aqueous Solubility (mg/L)**

Distilled Water 63.5 2

Hydrocarbon Group**Hydrocarbon Group Analysis (Weight %)**

	Weathering (Weight %)		
	0	10	20
Paraffins	70.6 1	82.5 1	80.8 1
Aromatics	21.0 1	11.9 1	12.8 1
Polars	4.58 1	2.37 1	2.75 1
Asphaltenes	3.78 1	3.20 1	3.62 1

Wax Content (Weight %)

	Weathering (Weight %)		
	0	10	20
	2.18 1	3.02 1	3.41 1

References

1 Mackay 82a

2 Murray 84

3 Twardus 80

Synthetic Crude Oil

Synthetic Crude Oil

From Syncrude, August 1986

Mass and Weight

API Gravity (15/15°C)

32.6 2

Density (g/mL)

(°C)	Weathering (Volume %)		
	0	11.0	22.4
0	0.8721 2	0.8969 2	0.9160 2
15	0.8614 2	0.8868 2	0.9058 2

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		
	0	11.0	22.4
0	8.8 2	15.7 2	41.7 2
15	4.6 2	8.9 2	18.8 2

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	11.0	22.4
0	8.0 2	19.7 2	42.0 2
15	5.3 2	11.1 2	20.3 2

Pour Point (°C)

Weathering (Volume %)		
0	11	22.4
-72 2	-45 2	-36 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		
	0	11.0	22.4
0	28.1 2	31.0 2	31.6 2
15	25.7 2	28.4 2	30.1 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		
	0	11.0	22.4
0	29.3 2	18.6 2	17.8 2
15	29.0 2	29.6 2	15.5 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		
	0	11.0	22.4
0	31.3 2	20.1 2	19.2 2
15	30.8 2	30.5 2	18.2 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	11.0	22.4
0	0 2	0 2	0 2
15	0 2	0 2	0 2

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	11.0	22.4
0	0 2	0 2	0 2
15	0 2	0 2	0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	11.0	22.4
0	N/A 2	N/A 2	N/A 2
15	N/A 2	N/A 2	N/A 2

Dispersibility

Chemical Dispersibility (% Dispersed)

EN 700	65 3
Dasic	25 3

Natural Dispersibility (% Dispersed)

(°C)	
15	10 6

Fire and Reactivity

Flash Point (°C)

< -21 2

Synthetic Crude Oil

Distillation

Distillation (°C)

(Vol%)	Liquid Temp		Vapour Temp	
IBP	93.5	2	24.4	2
5	180	2	75.0	2
10	215	2	113	2
15	249	2	142	2
20	273	2	168	2
25	293	2	192	2
30	312	2	210	2
35	326	2	223	2
40	344	2	234	2
45	355	2	243	2
50	361	2	250	2
55	375	2	262	2
60	392	2	277	2
65	407	2	293	2
70	422	2	313	2

Weathering

T_O = 418.6

T_G = 631.8 (EETD 86)

Solubility

Aqueous Solubility (mg/L)

		22 °C
Fresh Water	2.3 7	29.9 9
Distilled Water	43.7 8	
Seawater	5.0 7	

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	81.8 2
Aromatics	17.0 2
Polars	0.9 2
Asphaltenes	0.3 2
	0.1 4

Wax Content (Weight %)

0.2 4

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	48h EC ₅₀	48h LC ₅₀
Daphnia Magna	0.23 7 3.0 1	0.84 7 11.0 1
Artemia spp.	1.4 7 6.7 1	1.88 7 9.0 1

Note: Results from (Maclean 88) obtained by fluorescence spectroscopy.
Results from (Bobra 88) obtained by purge-and-trap GC analysis.

Metal Content

Other Metals (ppm)

Molybdenum	< 0.6	5
Potassium	< 1.5	5
Zinc	< 0.6	5
Lead	< 3	5
Nickel	< 1	5
Iron	< 3	5
Chromium	< 1.5	5
Magnesium	1.1	5
Vanadium	< 0.6	5
Copper	< 0.6	5
Titanium	< 0.6	5
Barium	< 0.3	5

Non-Metal Content

Sulphur (Weight %)

	Weathering	(Volume %)	
	0	11.0	22.4
	0.23 2	0.15 2	0.20 2

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	41.64 4

References

- | | | | |
|-------------|--------------|--------------|-------------|
| 1 Bobra 88 | 2 EETD 86 | 3 EETD 89 | 4 ESD 91 |
| 5 ESD 92 | 6 Fingas 90a | 7 MacLean 88 | 8 Murray 84 |
| 9 Suntio 86 | | | |

Taching Crude Oil

Taching Crude Oil

China, offshore

Mass and Weight

API Gravity (15/15°C)

31.0 1
33.0 2

Density (g/mL)

(°C)	
Unknown	0.8600 2
0	0.888 1
15	0.870 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
0	N/M 1
15	5138000 #1 1

#1. Shear rate 0.1/s

Kinematic Viscosity (mm²/sec or cst)

(°C)	
38	29.0 2

Pour Point (°C)

38 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
0	N/M 1
15	N/M 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	
0	N/M 1
15	N/M 1

Oil-Water (mN/m or dynes/cm)

(°C)	
0	N/M 1
15	N/M 1

Emulsion

Emulsion Formation Tendency

(°C)	
0	0 1
15	0 1

Emulsion Stability

(°C)	
0	0 1
15	0 1

Water Content of Emulsion (Volume %)

(°C)	
0	N/A 1
15	N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	0 1
Dasic	0 1
EN 700	0 1
CRX-8	0 1

Fire and Reactivity

Flash Point (°C)

22.7 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 5.6 1

Wax Content (Weight %)

32.2 1

Metal Content

Other Metals (ppm)

Molybdenum	<	0.6	1
Potassium	<	1.5	1
Zinc	<	0.6	1
Lead	<	3	1
Nickel		2.8	1
Iron		11	1
Chromium	<	1.5	1
Magnesium		1.6	1
Vanadium	<	0.6	1
Copper	<	0.6	1
Titanium	<	0.6	1
Barium	<	0.3	1
Selenium	<	15	1
Cobalt	<	1	1
Manganese	<	0.3	1
Calcium		54.5	1
Aluminum	<	5	1
Strontium	<	0.2	1
Cadmium	<	0.5	1
Tin	<	15	1
Mercury	<	15	1

Non-Metal Content

Sulphur (weight %)

0.04 2

References

1 ESD 92

2 NSD 88

Takula

Angola, offshore

Mass and Weight**API Gravity (15/15°C)**

32.2 1

Density (g/mL)

(°C)	Weathering (Volume %)		
	0	10.6	18.4
0	0.8782 1	0.8996 1	0.9142 1
15	0.8637 1	0.8860 1	0.8961 1

Viscosity**Dynamic Viscosity (mPa.s or cP)**

(°C)	Weathering (Volume %)		
	0	10.6	18.4
0	12631 #1 1	7070.0 #1 1	N/M 1
	44372 #2 1	47270 #2 1	
15	110.0 1	844.0 #1 1	3148 #1 1
		3683.0 #2 1	17150 #2 1

#1. Shear rate 10/s

#2. Shear rate 1/s

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
15	127.4 1

Pour Point (°C)

	Weathering (Volume %)		
	0	10.6	18.4
15 1	19 1	26 1	

Interfacial Tensions**Air-Oil (mN/M or dynes/cm)**

(°C)	Weathering (Volume %)		
	0	10.6	18.4
0	N/M 1	N/M 1	N/M 1
15	30.6 1	N/M 1	N/M 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		
	0	10.6	18.4
0	N/M 1	N/M 1	N/M 1
15	28.1 1	N/M 1	N/M 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		
	0	10.6	18.4
0	N/M 1	N/M 1	N/M 1
15	31.5 1	N/M 1	N/M 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	10.6	18.4
0	0 1		
15	1.0 1	1.0 1	0 1

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	10.6	18.4
0	0 1		
15	1.0 1	1.0 1	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	10.6	18.4
0	N/A 1		
15	84.0 1	70.5 1	N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	5 1
Dasic	0 1
EN 700	5 1
CRX-8	5 1

Fire and Reactivity

Flash Point (°C)

Weathering	(Volume %)	
0	10.6	18.4
-7.0 1	40.9 1	> 90 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 2.8 1

Wax Content (Weight %)

Asphaltenes 15.9 1

References

1 ESD 92

Tarsiut A-25 Crude Oil

Beaufort Sea, Canada

Mass and Weight

API Gravity (15/15°C)

30.8 1

Density (g/mL)

(°C)	
21	0.8711 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
20	5.432 1
30	4.117 1
40	3.155 1

Pour Point (°C)

-31.9 1

References

1 Dome 84

Tarsiut Crude Oil

Beaufort Sea, Canada

Mass and Weight**API Gravity (15/15°C)**

23.3
to 30.2 7
28.0 2

Density (g/mL)

For Fv < 16.4% & T between 0 and 15°C

$$\text{DEN} = 0.888923 + 0.00066 \text{ Fv} - 0.000324 \text{ T}$$

Where: DEN is density of oil at T and Fv (g/mL)

Fv is volume percent of oil weathered

T is oil temperature (°C)

(°C)	Weathering (Volume %)		
	0	12.4	16.4
0	0.884 3	0.8998 4	0.9021 4
15	0.875 3	0.8900 4	0.8922 4
	0.895 7		
15.6	0.8868 2		

Viscosity**Dynamic Viscosity (mPa.s or cP)**

(°C)	Weathering (Volume %)		
	0	12.4	16.4
0	12.3 3	27.0 4	28.8 4
15	7.4 3	13.4 4	13.9 4
20	7.148 2		
30	5.386 2		
40	4.141 2		

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0		
0	13.9 3		
15	8.5 3		

Pour Point (°C)

< -61 7
< -60 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		16.4
	0	12.4	
0	28.0 ³	30.7 ⁴	30.8 ⁴
15	26.5 ³	29.1 ⁴	27.7 ⁴

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		16.4
	0	12.4	
0	16.6 ⁴	18.0 ⁴	16.3 ⁴
15	14.1 ⁴	13.9 ⁴	14.3 ⁴

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		16.4
	0	12.4	
0	20.0 ³	19.1 ⁴	18.5 ⁴
15	18.4 ⁴	17.9 ⁴	17.8 ⁴

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		16.4
	0	12.4	
0	0 ³		
15	0 ³	0 ⁴	0 ⁴

Emulsion Stability

(°C)	Weathering (Volume %)		16.4
	0	12.4	
0	0 ³		
15	0 ³	0 ⁴	0 ⁴

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		16.4
	0	12.4	
0	N/A ³		
15	N/A ³	N/A ³	N/A ³

Dispersibility**Natural Dispersibility (% Dispersed)**

(°C)	Weathering (Volume %)		
	0	12.4	16.4
0	38 4	16 4	17 4
15	30 4	22 4	39 4

Fire and Reactivity**Flash Point (°C)**

65 3

Distillation**Distillation (°C)**

(Vol%)	Vapour Temp	Liquid Temp
0	82	214 4
	to 138 7	
5		227 4
10	168	237 4
	to 198 7	
15		248 4
20		261 4
25		274 4
30	227	287 4
	to 253 7	
35		298 4
40		305 4
50	274	
	to 306 7	
70	334	
	to 371 7	
90	431	
	to 457 7	
Final	567	
	to 610 7	

WeatheringT_O = 487.0T_G = 234.8 (EETD 85)

Solubility

Aqueous Solubility (mg/L)

		22 °C
Fresh Water	8.20 8	2.0 9
Seawater	7.2 8	

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	91.9 5
Aromatics	7.4 5
Polars	0.4 5
Asphaltenes	.03 5

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	24h EC50	48h EC50	24h LC50	48h LC50
Daphnia Magna		3.47 8		6.37 8
		0.85 1		1.55 1
Artemia spp.	> 7.2 8		> 7.2 8	
	> 1.6 1		> 1.6 1	

Note: Results from (Maclean 88) obtained by fluorescence spectroscopy.
Results from (Bobra 88) obtained by purge-and-trap GC analysis.

Metal Content

Other Metals (ppm)

Nickel	0.5 7
Vanadium	0.34 7
Copper	1.57 7
Iron	9.57 7

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

36 7

Sulphur (Weight %)

0.09
to 0.15 7

Other

Reid Vapour Pressure (kPa)

(°C)
37.8 0.8 3

References

1 Bobra 88
5 EETD 86
9 Suntio 86

2 Dome 84
6 EETD 89

3 EETD 84
7 Gulf 83

4 EETD 85
8 MacLean 88

Tartan Crude Oil

Tartan Crude Oil

U.K., North Sea

Contributor to the Flotta system.

Mass and Weight

API Gravity (15/15°C)

41.7 ²

Density (g/mL)

(°C)
Unknown 0.8180 ²

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
4.4 11.6 ¹

Pour Point (°C)

-8.9 ²

Distillation

Yield on Crude

	Range, °C	Volume %
C ₁ -C ₄		3.5 ¹
Naphtha	C ₅	5.7 ¹
	to 65	
Naphtha	65	20.0 ¹
	to 150	
Naphtha	150	7.1 ¹
	to 180	
Kerosene	180	10.8 ¹
	to 235	
Gas Oil	235	12.3 ¹
	to 300	
Gas Oil	300	8.3 ¹
	to 343	
Residuum	> 343	32.2 ¹

Non-Metal Content

Sulphur (Weight %)

0.56 2

Other

Reid Vapour Pressure (kPa)

(°C)

38	70.3	1
	69.4	2

References

1 Aalund 83c

2 NSD 88

Terra Nova Crude Oil

Newfoundland, Canada

Mass and Weight

Density (g/mL)

(°C)	Weathering	(Volume %)
	0	
0	0.8713	1
10	0.8500	5
15	0.8560	1
20	0.842	5
30	0.834	5

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering	(Volume %)
	0	
0	69	1
15	22	1

Pour Point (°C)

27 5

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering	(Volume %)
	0	
0	27.9	1
15	27.2	1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering	(Volume %)
	0	
0	29.4	1
15	28.8	1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering	(Volume %)
	0	
0	29.2	1
15	28.7	1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
15	0 0.43 1

Emulsion Stability

(°C)	Weathering (Volume %)
15	0 0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
15	0 N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	30 1
Dasic	20 1
EN 700	20 1
CRX-8	20 1

Natural Dispersibility (% Dispersed)

(°C)	
15	5 4

Solubility

Aqueous Solubility (mg/L)

Freshwater	31.81 2
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Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes	0.7 2
	7.7 5

Wax Content (Weight %)

12.3 2
11.8 5

Metal Content

Other Metals (ppm)

Molybdenum	< 0.6	3
Potassium	< 1.5	3
Zinc	< 0.6	3
Lead	< 3	3
Nickel	1.3	3
Iron	4.5	3
Chromium	< 1.5	3
Magnesium	< 1	3
Vanadium	< 0.6	3
Copper	< 0.6	3
Titanium	0.65	3
Barium	< 0.3	3
Selenium	< 15	3
Cobalt	< 1	3
Manganese	< 0.3	3
Calcium	46	3
Aluminum	< 5	3
Strontium	< 0.2	3
Cadmium	< 0.5	3
Tin	< 15	3
Mercury	< 15	3

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	37.4 1

References

1 EETD 89
5 Ross 89

2 ESD 91

3 ESD 92

4 Fingas 90a

Terra Nova K-08 DST #1 Crude Oil

Newfoundland, Canada

Mass and Weight

API Gravity (15/15°C)

31.0 1

Density (g/mL)

(°C)	Weathering (Weight %)		
	0	5.0	14.9
15	0.8704 1	0.8786 1	0.8809 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Weight %)		
	0	5.0	14.9
25	N/M 1	N/M 1	N/M 1
50	8.7 1	11.7 1	17.8 1

Pour Point (°C)

	Weathering (Weight %)		
	0	5	14.9
	27 1	30 1	33 1

Interfacial Tensions

Spreading Coefficient on Seawater (mN/m or dynes/cm)

	Weathering (Weight %)		
	0	5.0	14.9
1	DNS 2	DNS 2	DNS 2
15	DNS 2	DNS 2	DNS 2

Note: DNS = did not spread

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Weight %)		
	0	5.0	14.9
1	0.15 2	0 2	0 2
15	1.0 2	1.0 2	0 2

Emulsion Stability

(°C)	Weathering (Weight %)		
	0	5.0	14.9
1	1.0 2	0 2	0 2
15	1.0 2	1.0 2	0.93 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Weight %)		
	0	5.0	14.9
1	49.3 2	0 2	0 2
15	88.9 2	84.6 2	57.6 2

Fire and Reactivity

Flash Point (°C)

	Weathering (Weight %)	
	0	5
	< 21 1	32 1
		61 1

Distillation

Distillation (°C)

(Vol%)	Weathering (Weight %)		
	0	5.0	14.9
IBP	25 1	85 1	111 1
5	98 1	136 1	183 1
10	136 1	173 1	217 1
20	207 1	240 1	276 1
30	270 1	300 1	329 1
40	330 1	356 1	381 1
50	390 1	412 1	431 1
60	448 1	465 1	481 1
70	519 1	531 1	546 1
% Recovered	70.5 1	69.1 1	66.9 1

ASTM D 2887-Modified

Solubility

Aqueous Solubility (mg/L)

	Weathering (Weight %)	
	0	5
seawater at 22°C	19.0 2	13.5 2
		1.3 2

Non-Metal Content

Sulphur (Weight %)

Weathering		(Weight %)	
0		5.0	14.9
0.70	1	0.74	1
			0.80 1

References

1 PetroCan 85

2 Ross 85

Terra Nova K-08 DST #2 Crude Oil

Newfoundland, Canada

Mass and Weight

API Gravity (15/15°C)

32.9 1

Density (g/mL)

(°C)	Weathering (Weight %)	
	0	5.0
15	0.8604 1	0.8742 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Weight %)	
	0	5.0
25	16.7 1	26.5 1
50	5.7 1	7.8 1

Pour Point (°C)

	Weathering (Weight %)	
	0	5.0
	12 1	15 1

Interfacial Tensions

Spreading Coefficient on Seawater (mN/m or dynes/cm)

	Weathering (Weight %)		
	0	5.0	19.5
1	DNS 2	DNS 2	DNS 2
15	9.0 2	5.2 2	DNS 2

Note: DNS = did not spread

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Weight %)		
	0	5.0	19.5
1	1.0 2	1.0 2	1.0 2
15	1.0 2	1.0 2	1.0 2

Emulsion Stability

(°C)	Weathering (Weight %)		
	0	5.0	19.5
1	1.0 2	1.0 2	1.0 2
15	1.0 2	1.0 2	1.0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Weight %)		
	0	5.0	19.5
1	90.1 2	87.6 2	51.1 2
15	90.0 2	89.4 2	88.8 2

Fire and Reactivity

Flash Point (°C)

	Weathering (Weight %)	
	0	5.0
	< 21 1	< 21 1

Distillation

Distillation (°C)

(Vol%)	Weathering (Weight %)			
	0		5.0	
IBP	2	1	44	1
5	87	1	107	1
10	117	1	140	1
20	173	1	198	1
30	233	1	253	1
40	288	1	310	1
50	346	1	366	1
60	408	1	425	1
70	472	1	486	1
% Recovered	76.0	1	75.1	1

ASTM D 2887-Modified

Solubility

Aqueous Solubility (mg/L)

	Weathering (Weight %)		
	0	5.0	19.5
seawater at 22°C	27.0 2	19.1 2	0.9 2

Non-Metal Content

Sulphur (Weight %)

Weathering (Weight %)	
0	5.0
0.69 1	0.71 1

References

1 PetroCan 85

2 Ross 85

Terra Nova K-08 DST #3 Crude Oil

Newfoundland, Canada

Mass and Weight

API Gravity (15/15°C)

	Weathering (Weight %)		
	0	5.0	14.8
	32.6 ¹	30.5 ¹	27.6 ¹

Density (g/mL)

	Weathering (Weight %)		
(°C)	0	5.0	14.8
15	0.8620 ¹	0.8729 ¹	0.8891 ¹

Viscosity

Kinematic Viscosity (mm²/sec or cst)

	Weathering (Weight %)		
(°C)	0	5.0	14.8
25	18.7 ¹	22.8 ¹	201 ¹
50	5.9 ¹	8.2 ¹	14.1 ¹

Pour Point (°C)

	Weathering (Weight %)		
	0	5.0	14.8
	12 ¹	18 ¹	24 ¹

Interfacial Tensions

Spreading Coefficient on Seawater (mN/m or dynes/cm)

	Weathering (Weight %)		
	0	5.0	14.8
1	DNS ²	DNS ²	DNS ²
15	9.8 ²	8.0 ²	DNS ²

Note: DNS = did not spread

Emulsion

Emulsion Formation Tendency

	Weathering (Weight %)		
(°C)	0	5.0	14.8
1	1.0 ²	1.0 ²	0.1 ²
15	1.0 ²	1.0 ²	1.0 ²

Emulsion Stability

(°C)	Weathering (Weight %)		
	0	5.0	14.8
1	1.0 2	1.0 2	1.0 2
15	1.0 2	1.0 2	1.0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Weight %)		
	0	5.0	14.8
1	88.3 2	87.1 2	76.1 2
15	90.1 2	90.1 2	90.0 2

Fire and Reactivity

Flash Point (°C)

	Weathering (Weight %)		
	0	5.0	14.8
	< 21 1	< 21 1	52 1

Distillation

Distillation (°C)

(Vol%)	Weathering (Weight %)		
	0	5.0	14.8
IBP	1 1	69 1	115 1
5	86 1	116 1	168 1
10	117 1	147 1	202 1
20	176 1	208 1	259 1
30	238 1	266 1	312 1
40	297 1	321 1	366 1
50	356 1	379 1	421 1
60	420 1	438 1	477 1
70	487 1	502 1	547 1
% Recovered	74.0 1	72.9 1	67.0 1
			67.0

ASTM D 2887-Modified

Solubility

Aqueous Solubility (mg/L)

	Weathering (Weight %)		
	0	5	14.8
seawater at 22°C	23.1 2	20.7 2	3.4 2

Non-Metal Content

Sulphur (Weight %)

Weathering		(Weight %)
0	5.0	14.8
0.68	1	0.71 1
		0.76 1

References

1 PetroCan 85

2 Ross 85

Terra Nova K-08 DST #4 Crude Oil

Newfoundland, Canada

Mass and Weight

API Gravity (15/15°C)

32.5 1

Density (g/mL)

(°C)	Weathering (Weight %)		
	0	5.1	14.2
15	0.8621 1	0.8735 1	0.8895 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Weight %)		
	0	5.1	14.2
25	18.2 1	27.3 1	105 1
50	5.9 1	8.1 1	13.8 1

Pour Point (°C)

	Weathering (Weight %)		
	0	5.1	14.2
	12 1	15 1	21 1

Interfacial Tensions

Spreading Coefficient on Seawater (mN/m or dynes/cm)

	Weathering (Weight %)		
	0	5.1	14.2
0	DNS 2	DNS 2	DNS 2
15	8.6 2	6.6 2	DNS 2

Note: DNS = did not spread

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Weight %)		
	0	5.1	14.2
1	1.0 2	1.0 2	1.0 2
15	1.0 2	1.0 2	1.0 2

Emulsion Stability

(°C)	Weathering (Weight %)		
	0	5.1	14.2
1	1.0 2	1.0 2	1.0 2
15	1.0 2	1.0 2	1.0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Weight %)		
	0	5.1	14.2
1	89.8 2	86.7 2	67.5 2
15	87.4 2	93.9 2	89.3 2

Fire and Reactivity

Flash Point (°C)

	Weathering (Weight %)		
	0	5.1	14.2
	< 21 1	< 21 1	60 1

Distillation

Distillation (°C)

(Vol%)	Weathering (Weight %)		
	0	5.1	14.2
IBP	3 1	76 1	130 1
5	90 1	120 1	175 1
10	119 1	151 1	210 1
20	177 1	210 1	267 1
30	234 1	264 1	320 1
40	290 1	316 1	377 1
50	345 1	370 1	434 1
60	405 1	427 1	494 1
70	467 1	484 1	
% Recovered	77.0	75.6 1	64.2 1

ASTM D 2887-Modified

Solubility

Aqueous Solubility (mg/L)

	Weathering (Weight %)		
	0	5.1	14.2
seawater at 22°C	18.7 2	14.6 2	2.2 2

Non-Metal Content

Sulphur (Weight %)

Weathering		(Weight %)
0		5.1
		14.2
<hr/>		
0.67	1	0.69 1
		0.74 1

References

¹ PetroCan 85

² Ross 85

Texas Gulf Coast Heavy Crude Oil

Texas, U.S.A.

Mass and Weight

API Gravity (15/15°C)

27.0 ¹

Density (g/mL)

(°C)	
Unknown	0.8900 ¹

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
38	11.0 ¹

Non-Metal Content

Sulphur (Weight %)

0.25 ¹

References

¹ NSD 88

Texas Gulf Coast Light Crude Oil

Texas, U.S.A.

Mass and Weight

API Gravity (15/15°C)

35.0 ¹

Density (g/mL)

(°C)
Unknown 0.8500 ¹

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
38 4.5 ¹

Non-Metal Content

Sulphur (Weight %)

0.03 ¹

References

¹ NSD 88

Thistle Crude Oil

U.K., North Sea

Contributor to Brent system at Sullom Voe, Shetland Islands.

Mass and Weight

API Gravity (15/15°C)

37.0 2

Density (g/mL)

(°C)

Unknown	0.8400 2
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Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)

20	5.87 1
38	4.3 2

Pour Point (°C)

12 2

Distillation

Yield on Crude

	Range, °C	Weight %	Volume %
C1-C4		0.69 1	
Gasoline	C5	5.6 1	7.0 1
	to 85		
Naphtha	85	15.0 1	16.6 1
	to 165		
Kerosene	165	11.9 1	12.6 1
	to 235		
Light Gas Oil	235	12.9 1	12.9 1
	to 300		
Heavy Gas Oil	300	9.8 1	9.6 1
	to 350		
Residuum	> 350	43.8 1	39.8 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 0.19 2

Thistle Crude Oil

Wax Content (Weight %)

9.0 2
7.7 1

Metal Content

Other Metals (ppm)

Nickel/Vanadium 2.67 2

Non-Metal Content

Hydrogen Sulfide - Existent (mg/m³)

< 0.01 1

Sulphur (Weight %)

0.31 2

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	51.7 1

References

1 Aalund 83c

2 NSD 88

Tia Juana Crude Oil

Venezuela

Mass and Weight

API Gravity (15/15°C)

26.7 2

Density (g/mL)

(°C)	
Unknown	0.8940 2
	0.9000 1

ViscosityKinematic Viscosity (mm²/sec or cSt)

(°C)	
38	26.0 2
	16.8 1

Pour Point (°C)

-30.0 2
< -30 1**Non-Metal Content**

Sulphur (Weight %)

1.63 2

References

1 Fina 82

2 NSD 88

Tia Juana Heavy Crude Oil

Venezuela

Mass and Weight

API Gravity (15/15°C)

12.1 2

Density (g/mL)

(°C)	
Unknown	0.9850 2
	0.9800 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
50	3.0 2

Pour Point (°C)

-1.0 2
-3 1

Hydrocarbon Group

Wax Content (Weight %)

0.30 2

Non-Metal Content

Sulphur (Weight %)

2.70 2

References

1 Fina 82

2 MSD 88

Tia Juana Light Crude Oil

Venezuela

Mass and Weight

API Gravity (15/15°C)

32.1 2

27.0 1

Density (g/mL)

(°C)

Unknown 0.8650 2

ViscosityKinematic Viscosity (mm²/sec or cSt)

(°C)

37.8 14.8 1

38.0 10.4 2

Pour Point (°C)

-43 2

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

8.7 1

Sulphur (Weight %)

1.10 2

1.49 1

References

1 Bland 67

2 NSD 88

Trading Bay Crude Oil

Cook Inlet, Alaska

Mass and Weight

API Gravity (15/15°C)

28.7 1

Density (g/mL)

(°C)	
15.6	0.883 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
25	12.9 1
37.8	8.3 1

Pour Point (°C)

-1 1

Distillation

Distillation (°C)

(Vol%)	
IBP	24 1
4.1	75 1
8.0	100 1
12.0	125 1
16.0	150 1
20.0	175 1
24.0	200 1
28.3	225 1
34.3	250 1
39.1	275 1

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

2.8 1

Nitrogen (Weight %)

0.192 1

Sulphur (Weight %)

0.15 1

Sensation

Colour

Brownish black 1

References

1 Coleman 78

Trading Bay Crude Oil (Offshore Cook Inlet)

Cook Inlet, Alaska

Mass and Weight

API Gravity (15/15°C)

31.0 1

Density (g/mL)

(°C)	
15.6	0.871 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
25	6.6 1
37.8	5.3 1

Pour Point (°C)

< -15 1

Distillation

Distillation (°C)

(Vol%)	
IBP	28 1
1.6	50 1
4.0	75 1
9.7	100 1
15.5	125 1
19.9	150 1
24.3	175 1
28.5	200 1
32.7	225 1
37.6	250 1
45.4	275 1

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

4.3 1

Nitrogen (Weight %)

0.149 1

Sulphur (Weight %)

0.05 ¹

Sensation

Colour

Brownish black ¹

References

¹ Coleman 78

Transmountain Blend Crude Oil

Mass and Weight

API Gravity (15/15°C)

33.8 ²

Density (g/mL)

For Fv < 28.5% & T between 0 and 15°C

$$\text{DEN} = 0.866996 + 0.002108 \text{ Fv} - 0.000758 \text{ T}$$

Where: DEN is density of oil at T and Fv (g/mL)

Fv is volume percent of oil weathered

T is oil temperature (°C)

(°C)	Weathering (Volume %)		
	0	18.8	28.5
0	0.865 ²	0.9107 ³	0.9250 ³
15	0.855 ²	0.8989 ³	0.9127 ³

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		
	0	18.8	28.5
0	650 ³	> 10000 ³	> 10000 ³
15	10.5 ³	142 ³	577 ³

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	18.8	28.5
0	750 ³		
15	12.3 ²	158 ³	632 ³

Pour Point (°C)

	Weathering (Volume %)		
	0	18.8	28.5
	2 ³	8 ³	18 ³

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		
	0	18.8	28.5
0	28.8 ³	N/M ³	N/M ³
15	25.0 ²	29.1 ³	N/M ³

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		28.5
	0	18.8	
0	19.9 3	N/M 3	N/M 3
15	19.3 2	25.1 3	N/M 3

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		28.5
	0	18.8	
0	20.5 3	N/M 3	N/M 3
15	19.3 2	26.5 3	N/M 3

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		28.5
	0	18.8	
0	1.0 3	1.0 3	0 3
15	0.2 2	1.0 3	1.0 3

Emulsion Stability

(°C)	Weathering (Volume %)		28.5
	0	18.8	
0	1.0 3	1.0 3	0 3
15	0.1 2	1.0 3	1.0 3

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		28.5
	0	18.8	
0	90.1 3	75.4 3	N/A 3
15	N/A 2	89.0 3	87.0 3

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	15 5
Dasic	10 5
EN 700	15 5
CRX-8	15 5

Natural Dispersibility (% Dispersed)

(°C)	
15	3 8

Fire and Reactivity

Flash Point (°C)

-2.0 3

Distillation

Distillation (°C)

(Vol%)	Liquid Temp
IBP	113 3
5	144 3
10	174 3
15	203 3
20	234 3
25	265 3
30	295 3

Weathering

T_O = 381.0

T_G = 629.9 (EETD 84)

Solubility

Aqueous Solubility (mg/L)

		22 °C
Fresh Water	7.9 9	15.5 10
Seawater	5.56 9	

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Saturates	81.0 4
Aromatics	13.6 4
Polars	1.9 4
Asphaltenes	3.5 4
	3.5 6

Wax Content (Weight %)

6.7 6

Toxicity

Acute Toxicity of Water Soluble Fraction (mg/L)

	24h EC ₅₀	48h EC ₅₀	24h LC ₅₀	48h LC ₅₀
Daphnia Magna		1.1 ⁹ 2.2 ¹		4.27 ⁹ 8.4 ¹
Artemia spp.	3.61 ⁹ 8.0 ¹		> 5.56 ⁹ > 12.4 ¹	

Note: Results from (Maclean 88) obtained by fluorescence spectroscopy.
Results from (Bobra 88) obtained by purge-and-trap GC analysis.

Metal Content

Other Metals (ppm)

Molybdenum	< 0.6	7
Potassium	< 1.5	7
Zinc	< 0.6	7
Lead	< 3	7
Nickel	8.3	7
Iron	5.2	7
Chromium	< 1.5	7
Magnesium	2.9	7
Vanadium	6.2	7
Copper	< 0.6	7
Titanium	< 0.6	7
Barium	0.4	7
Cadmium	< 0.5	7
Selenium	< 15	7
Cobalt	< 1	
Manganese	< 0.3	7
Calcium	58.7	7
Aluminum	< 5	7
Strontium	0.38	7
Tin	< 15	7
Mercury	< 15	7

Non-Metal Content

Sulphur (Weight %)

0.79⁵

Other

Reid Vapour Pressure (kPa)

(°C)	
37.8	45.7 ²

References

1 Bobra 88
5 EETD 89
9 MacLean 88

2 EETD 84
6 ESD 91
10 Suntio 86

3 EETD 85
7 ESD 92

4 EETD 86
8 Fingas 90a

Transoil #10

Alberta, Canada

An oil in water dispersion (65% oil - 35% water) transported by AEC Pipelines, Edmonton, Alberta, Canada.

Mass and Weight**Density (g/mL)**

(°C)	Weathering 0	(Volume %)
0	1.0019	1
15	0.9955	1

Toxicity**Toxicity (mg/L)**

Fingerling Rainbow Trout	$\frac{LC_{50}}{2000}$	3
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Metal Content**Other Metals (ppm)**

Molybdenum	3.6	2
Potassium	< 1.5	2
Zinc	0.6	2
Lead	< 3	2
Nickel	48.3	2
Iron	13.1	2
Chromium	< 1.5	2
Magnesium	14.0	2
Vanadium	127	2
Copper	< 0.6	2
Titanium	1.7	2
Barium	< 0.3	2

References

1 EETD 89

2 ESD 92

3 Harris 90

Turbine Oil

Turbine Oil

Steam Turbine Oil
Steam Turbine Tube Oil

Mass and Weight

Density (g/mL)

(°C)	
20	0.8684 ¹

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
20	25 (estimated) ¹

Oil-Water (mN/m or dynes/cm)

(°C)	
20	50 (estimated) ¹

Fire and Reactivity

Flash Point (°C)

198.9
to 251.7 (O.C.) ¹

Sensation

Colour

Colourless
to pale brown ¹

References

¹ CHRIS 85

Udang Crude Oil

Indonesia

Mass and Weight

API Gravity (15/15°C)

14.3 1

Density (g/mL)

(°C)	
0	0.9800
15	0.9701 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	
0	81890 1
15	10700 1

Kinematic Viscosity (mm²/sec or cSt)

(°C)	
0	83561 1
15	11030 1

Pour Point (°C)

3 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
0	N/M 1
15	32.2 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	
0	N/M 1
15	25.4 1

Oil-Water (mN/m or dynes/cm)

(°C)	
0	N/M 1
15	32.5 1

Emulsion

Emulsion Formation Tendency

(°C)	
0	0 1
15	0 1

Emulsion Stability

(°C)	
0	0 1
15	0 1

Water Content of Emulsion (Volume %)

(°C)	
0	N/A 1
15	N/A 1

Dispersibility

Chemical Dispersibility (% Dispersed)

CRX-8	0 1
Dasic	0 1
EN 700	0 1

Fire and Reactivity

Flash Point (°C)

> 90 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 3.8 1

Wax Content (Weight %)

1.0 1

Metal Content

Other Metals (ppm)

Molybdenum	<	0.6	1
Potassium	<	1.5	1
Zinc		2.1	1
Lead	<	3	1
Nickel		71	1
Iron	<	3	1
Chromium	<	1.5	1
Magnesium		28.0	1
Vanadium		26.8	1
Copper	<	0.6	1
Titanium		0.9	1
Barium		1.3	1

References

¹ ESD 92

Ukalerk 2C-50 Crude Oil

Northwest Territories, Canada

Mass and Weight

API Gravity (15/15°C)

45.7 ¹

Density (g/mL)

(°C)	
21	0.7978 ¹

Viscosity

Pour Point (°C)

1.7 ¹

References

¹ Dome 84

ULA Crude Oil

Paraffinic North Sea Crude

Mass and Weight

API Gravity (15/15°C)

38.6 1

Density (g/mL)

(°C)	Weathering	(Volume %)		
	0	21.1	32.4	41.7
15.5	0.8312 1	0.8602 1	0.8731 1	0.8811 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering	(Volume %)		
	0	21.1	32.4	41.7
13	9 1	24 1	60 1	154 1

Pour Point (°C)

Weathering	(Volume %)		
0	21.1	32.4	41.7
6 1	21 1	25 1	30 1

Interfacial Tensions

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering	(Volume %)		
	0	21.1	32.4	41.7
13	28 1	27 1	26 1	26 1

Emulsion

Emulsion Formation Tendency

Forms emulsion with relatively high stability. (Daling 91)

Dispersibility

Chemical Dispersibility (% Dispersed)

Medium chemical dispersability with Finasol OSR-5 (Daling 91b)

Fire and Reactivity

Flash Point (°C)

Weathering (Volume %)		
21.1	32.4	41.7
45 1	84 1	118 1

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
21.1	196 1	150 1
32.4	260 1	200 1
41.7	303 1	250 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

	Weathering (Volume %)			
	0	21.1	32.4	41.7
Saturates				61.7 Vol% 1
Aromatics				31.7 Vol% 1
Polars				5.1 Vol% 1
Asphaltenes				1.5 Vol% 1
Asphaltenes "Hard"	0.42 Vol% 1	0.52 Vol% 1	0.59 Vol% 1	0.67 Vol% 1
Asphaltenes "Soft"	1.24 Vol% 1	1.51 Vol% 1	1.74 Vol% 1	1.97 Vol% 1

Wax Content (Weight %)

Weathering (Volume %)			
0	21.1	32.4	41.7
5.77 1	7.06 1	8.11 1	9.19 1

References

¹ Daling 91

Uviluk Crude Oil

Mass and Weight

API Gravity (15/15°C)

29.4 1

Density (g/mL)

(°C)	Weathering (Volume %)		20
	0	9.7	
0	0.8899 1	0.9090 1	0.9244 1
15	0.8787 1	0.8978 1	0.9152 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		20
	0	9.7	
0	32.2 1	88.6 1	266.3 1
15	13.8 1	27.5 1	67.1 1

Kinematic Viscosity (mm²/sec or cst)

(°C)	Weathering (Volume %)		20
	0	9.7	
0	28.6 1	428.7 1	
15	15.7 1	70.9 1	

Pour Point (°C)

	Weathering (Volume %)		20
	0	9.7	
	-12 1	-3 1	3 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)		20
	0	9.7	
0	28.7 1	32.7 1	N/M 1
15	26.7 1	28.0 1	29.8 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)		20
	0	9.7	
0	23.5 1	18.7 1	N/M 1
15	12.2 1	13.8 1	13.9 1

Uviluk Crude Oil

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)		
	0	9.7	20
0	25.2 1	24.8 1	N/M 1
15	24.3 1	23.2 1	22.8 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	9.7	20
0	1.0 1	1.0 1	1.0 1
15	0.08 1	1.0 1	1.0 1

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	9.7	20
0	0.31 1	1.0 1	1.0 1
15	0 1	0 1	0.31 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	9.7	20
0	95.8 1	90.0 1	69.7 1
15	N/A 1	N/A 1	N/A 1

Dispersibility

Natural Dispersibility (% Dispersed)

(°C)	Weathering (Volume %)		
	0	9.7	20
0	0 1	0 1	0 1
15	7.6 1	2.8 1	0 1

Fire and Reactivity

Flash Point (°C)

-9 1

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	123 1	50 1
5	163 1	102 1
10	184 1	118 1
15	206 1	134 1
20	233 1	157 1
25	261 1	184 1
30	287 1	212 1
35	312 1	237 1
40	336 1	259 1
45	362 1	277 1
50	392 1	299 1
55	414 1	323 1

Weathering

T_O = 407.2

T_G = 505.7 (EETD 86)

Non-Metal Content

Sulphur (Weight %)

Weathering (Volume %)		
0	9.7	20.0
0.24 1	0.17 1	0.24 1

References

¹ EETD 86

Uviluk P-66 Crude Oil

Northwest Territories, Canada

Texaco 1983

Mass and Weight

API Gravity (15/15°C)

24.9 1

Density (g/mL)

For fresh oil and T between 0 and 25°C

$$\text{DEN} = 0.91542 - 0.000727 T$$

Where: DEN is density of oil at T

T is oil temperature (°C)

(°C)	Weathering (Volume %)
0	0
0	0.9155 1
15	0.9040 1
20	0.9012 1
25	0.8972 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
15	28.6 1

Oil-Seawater (mN/M or dynes/cm)

(°C)	Weathering (Volume %)
0	0
15	8.8 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)
0	0
15	21.4 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)
0	0
15	0 1

Emulsion Stability

(°C)	Weathering (Volume %)
15	0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)
15	N/A 1

Distillation

Distillation (°C)

(Vol%)	Liquid Temp	Vapour Temp
IBP	185 1	69 1
5	209 1	108 1
10	233 1	114 1
15	257 1	148 1
20	281 1	162 1
25	305 1	171 1

Weathering

T_O = 458.4
 T_G = 476.3 (EETD 85)

References

¹ EETD 85

Wabasca Bitumen

Alberta, Canada

Method of production is cold bailing and centrifugation.

Mass and Weight

API Gravity (15/15°C)

11.0
to 18.1 1

Density (g/mL)

(°C)	
Unknown	0.946
	to 0.993 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
0	
25	420
	to 27100 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 10.3
to 15.2 1

Metal Content

Other Metals (ppm)

Vanadium	128.8 1
	to 183.6 1
Nickel	46.8 1
	to 87.2 1

Non-Metal Content

Oxygen

0.74
to 1.25 1

Carbon Residue - Ramsbottom (Weight %)

7.2
to 9.2 1

Carbon Content (Weight %)

81.22
to 83.89 1

Nitrogen (Weight %)

0.30
to 1.23 1

Sulphur (Weight %)

3.93
to 5.62 1

Hydrogen (Weight %)

10.84
to 11.30 1

Other

Acid Number (mg KOH/g)

0.49
to 1.87 1

Ash (Weight %)

0.09
to 0.50 1

References

¹ ARC 87

Wainwright-Kinsella Crude Oil

Alberta, Canada

Mass and Weight

API Gravity (15/15°C)

23.1 1

Density (g/mL)

(°C)
21 0.9145 1

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
40 32.50 1

Pour Point (°C)

-39.0 1

Distillation

Yield on Crude

	Range, °C	Volume %
Naphtha	C5 to 190	19.0 1
Kerosene	190 to 277	12.0 1
Distillate	277 to 343	11.0 1
Gas Oil	343 to 565	26.0 1
Residuum	> 565	32.0 1

Metal Content

Other Metals (ppm)

Nickel 40.30 1
Vanadium 79.90 1

Non-Metal Content

Carbon Content (Weight %)

6.70 ¹

Sulphur (Weight %)

15800 ppm ¹

Other

Reid Vapour Pressure (kPa)

(°C)

37.8

30.3 ¹

References

¹ Aalund 83c

West General Texas Crude Oil

Texas, U.S.A.

Mass and Weight

API Gravity (15/15°C)

40.0 ¹

Density (g/mL)

(°C)
Unknown 0.8250 ¹

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
38 1.40 ¹

Non-Metal Content

Sulphur (Weight %)

0.20 ¹

References

¹ NSD 88

West Sak Crude Oil

Alaska, U.S.A.

Mass and Weight

API Gravity (15/15°C)

22.4 1

22.4 2

Density (g/mL)

(°C)

Unknown 0.9190 2

ViscosityKinematic Viscosity (mm²/sec or cSt)

(°C)

15 95.5 2

15.6 95.9 1

Pour Point (°C)

-50 1

-46 2

Distillation

Yield on Crude

	Range	Volume %
unknown	C4	0.63 1
Light Gasoline	C5	1.90 1
	to 65.6	
Naphtha	65.6	14.40 1
	to 193	
Distillate	193	27.50 1
	to 343	
Gas Oil	343	16.60 1
	to 449	
Residuum	> 343	55.60 1

Metal Content

Other Metals (ppm)

Nickel 22 1

Vanadium 61 1

Non-Metal Content

Carbon Residue - Ramsbottom (Weight %)

7.62 1

Sulphur (Weight %)

1.82 1

1.82 2

Other

Reid Vapour Pressure (kPa)

(°C)

37.8

18.6 1

18.4 2

References

1 Aalund 83

2 NSD 88

West Texas Ellenburger Crude Oil

Texas, U.S.A.

Mass and Weight

API Gravity (15/15°C)

47.6 ¹

Density (g/mL)

(°C)
Unknown 0.7900 ¹

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
38 1.80 ¹

Pour Point (°C)

-32 ¹

Non-Metal Content

Sulphur (Weight %)

0.10 ¹

References

¹ NSD 88

West Texas Intermediate Crude Oil

Texas, U.S.A

Mass and Weight

API Gravity (15/15°C)

36.4 2

Density (g/mL)

(°C)	Weathering (Volume %)		
	0	14.1	28.5
0	0.8538 2	0.8786 2	0.8994 2
15	0.8420 2	0.8674 2	0.8875 2

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)		
	0	14.1	28.5
0	14.89 2	41.48 2	139.7 2
15	7.02 2	15.81 2	49.32 2

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	14.1	28.5
0	17.44 2	47.21 2	155.3 2
15	8.34 2	18.23 2	55.65 2

Pour Point (°C)

Weathering (Volume %)	Pour Point (°C)	
	0	14.1
28.5	-23 2	-15 2

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	28.5
0	27.2 2	26.9 2
15	26.6 2	29.5 2

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)	
	0	28.5
0	17.9 2	23.0 2
15	18.9 2	18.1 2

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)	
	0	28.5
0	20.1 2	25.4 2
15	19.1 2	20.6 2

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	14.1	28.5
0	0 2		1.0 2
15	0 2	0 2	0.90 2

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	14.1	28.5
0	0 2		1.0 2
15	0 2	0 2	1.0 2

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	14.1	28.5
0	N/A 2		70.4 2
15	N/A 2	N/A 2	40.4 2

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	30 1
Dasic	10 1
EN 700	40 1
CRX-8	90 1

Fire and Reactivity

Flash Point (°C)

Weathering	(Volume %)	
	0	28.5
-17.0 2	31.5 2	87.2 2

Solubility

Aqueous Solubility (mg/L)

Freshwater 27.8 ²

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 0.7 ²

Wax Content (Weight %)

3.5 ²

Metal Content

Other Metals (ppm)

Molybdenum	<	0.6	²
Potassium	<	1.5	²
Zinc		1.1	²
Lead	<	3	²
Nickel		18.8	²
Iron		22.6	²
Chromium	<	1.5	²
Magnesium		24.7	²
Vanadium		3.2	²
Copper	<	0.6	²
Titanium		0.76	²
Barium		3.2	²
Selenium	<	15	²
Cobalt	<	1	²
Manganese		0.4	²
Calcium		100	²
Aluminum	<	5	²
Strontium	<	0.38	²
Cadmium	<	0.5	²
Tin	<	15	²
Mercury	<	15	²

References

¹ ESD 91

² ESD 92

West Texas Light Crude Oil

Texas, U.S.A.

Mass and Weight

API Gravity (15/15°C)

42.0 ¹

Density (g/mL)

(°C)
Unknown 0.8200 ¹

Viscosity

Kinematic Viscosity (mm²/sec or cSt)

(°C)
38 3.30 ¹

Non-Metal Content

Sulphur (Weight %)

0.25 ¹

References

¹ NSD 88

West Texas Sour Crude Oil

Texas, U.S.A.

Mass and Weight

API Gravity (15/15°C)

34.0 2
30.2 1

Density (g/mL)

(°C)	Weathering (Volume %)		
	0	14.7	29.9
Unknown	0.8550 2		
0	0.8862 1	0.9144 1	0.9400 1
15	0.8743 1	0.9019 1	0.9280 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)					
	0		14.7		29.9	
0	113.2	#1 1	877.8	#1 1	7271	#1 1
	616.0	#2 1	5004	#2 1	26814	#2 1
15	12.99	1	38.50	1	262.0	1

#1. Shear rate 10/s

#2. Shear rate 1/s

Kinematic Viscosity (mm²/sec or cSt)

(°C)	Weathering (Volume %)		
	0	14.7	29.9
15	14.86 1	42.69 2	282.2 1
38	5.80 2		

Pour Point (°C)

Weathering (Volume %)		
0	14.7	29.9
-27 1	-1 1	12 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	Weathering (Volume %)	
	0	29.9
0	31.9 1	N/M 1
15	27.0 1	31.8 1

Oil-Seawater (mN/M of dynes/cm)

(°C)	Weathering (Volume %)	
	0	29.9
0	17.3 1	N/M 1
15	17.8 1	28.3 1

Oil-Water (mN/m or dynes/cm)

(°C)	Weathering (Volume %)	
	0	29.9
0	27.0 1	N/M 1
15	22.0 1	31.8 1

Emulsion

Emulsion Formation Tendency

(°C)	Weathering (Volume %)		
	0	14.7	29.9
0	1.0 1		0 1
15	0.10 1	0.5 1	1.0 1

Emulsion Stability

(°C)	Weathering (Volume %)		
	0	14.7	29.9
0	1.0 1		0 1
15	0.50 1	0.1 1	1.0 1

Water Content of Emulsion (Volume %)

(°C)	Weathering (Volume %)		
	0	14.7	29.9
0	90.9 1		N/A 1
15	97.8 1	N/A 1	73.8 1

Dispersibility

Chemical Dispersibility (% Dispersed)

C 9527	35 1
Dasic	10 1
EN 700	25 1
CRX-8	25 1

Fire and Reactivity

Flash Point (°C)

Weathering		(Volume %)
0		29.9
-13.9	1	35.6
		1
		> 90
		1

Solubility

Aqueous Solubility (mg/L)

Freshwater 52.1 1

Hydrocarbon Group

Hydrocarbon Group Analysis (Weight %)

Asphaltenes 2.5 1

Wax Content (Weight %)

5.1 1

Metal Content

Other Metals (ppm)

	Weathering		(Volume %)
	0		29.9
Molybdenum	1.2	1	1.3
Potassium	< 1.5	1	< 1.5
Zinc	0.5	1	0.7
Lead	< 3	1	< 3
Nickel	4.4	1	5.9
Iron	17.8	1	28.4
Chromium	< 1.5	1	< 1.5
Magnesium	1.1	1	2.1
Vanadium	17.8	1	23.8
Copper	< 0.6	1	< 0.6
Titanium	< 0.6	1	< 0.6
Barium	< 0.3	1	< 0.3
Cadmium	< 0.5	1	
Selenium	< 15	1	
Cobalt	< 1	1	
Manganese	< 0.3	1	
Calcium	39.8	1	
Aluminum	< 5	1	
Strontium	< 0.2	1	
Tin	< 15	1	
Mercury	< 15	1	

Non-Metal Content

Sulphur (Weight %)

1.90 ²

References

¹ ESD 92

² NSD 88

Weyburn-Midale Crude Oil

Saskatchewan, Canada

Mass and Weight

Density (g/mL)

(°C)	
Room Temp.	0.89 1

Viscosity

Dynamic Viscosity (mPa.s or cP)

(°C)	Weathering (Volume %)
	0
0	88 1
10	29 1
20	18 1

Pour Point (°C)

-28 1

Interfacial Tensions

Air-Oil (mN/M or dynes/cm)

(°C)	
Room Temp.	24.1 1

Oil-Water (mN/m or dynes/cm)

(°C)	
Room Temp.	29.7 1

Emulsion

Emulsion Formation Tendency

Fractions weathered (18.0, 27.7 vol%)
formed fairly stable emulsions. (Daling 88)

Fire and Reactivity

Fire Point (°C)

< 14 1

Combustion Results

Easily ignited, 7.4 Vol% residue 1

Distillation

Distillation (°C)

(Vol%)		
0	45	1
10	90	1
20	130	1
30	190	1
40	230	1
50	265	1
60	275	1
70	335	1
80	385	1

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¹ Twardus 80



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