How to find out if waste oil and wastes that contain oil are hazardous

A guide to the Hazardous Waste Regulations

Reference number **HWR08 Version 3.1 – June 2007**

We are the Environment Agency. It's our job to look after your environment and make it **a better place** - for you, and for future generations.

Your environment is the air you breathe, the water you drink and the ground you walk on. Working with business, Government and society as a whole, we are making your environment cleaner and healthier.

The Environment Agency - out there, making your environment a better place.

Published by:

Environment Agency
Rio House
Waterside Drive, Aztec West
Almondsbury, Bristol BS32 4UD
Tel: 0870 8506506
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

Contents

1.0 AIMS & SCOPE 4

PART 1 WASTE OILS 5

2 What is a waste oil? 5
3 Classification of waste oil 5
3.1 Determine the hazardous properties of the waste oil 5
3.2 What if data suggests that the oil doesn't possess a hazardous property? 6

PART 2 WASTES CONTAINING OIL 7

4. Flowchart for determining the classification of wastes containing oil 7
4.1 Flowchart steps 8
Step 1 – Knowledge of the contamination 8
Step 2 – Find the waste on the List 8
Step 3 – Determine the oil concentration 8
Step 4 – Determine hazardous properties and compare thresholds with oil concentration 8
Step 5 – Decision 11
Step 6 – Other dangerous substances 11

APPENDIX A – HAZARDS ASSOCIATED WITH THE GENERAL PETROLEUM GROUPS 13

APPENDIX B – ANALYTICAL PRINCIPLES 15

TPH analysis/ extraction techniques 15
1. Extraction method for lubricating/other oils 16
2. Identification and further analysis of the extracted material 16

USE OF CARCINOGENIC PAHS AS MARKER 17

APPENDIX C - WORKED EXAMPLES 18

Virgin oil in drums 18
Kerosene (used for heating) spills 18
Oil spills at a petroleum refinery 18
Garage servicing waste – oily rags and oil filters 19
Worked example showing the PAH marker calculation 20

REFERENCES AND GLOSSARY 21

1.0 Aims & Scope

The purpose of this guide is to provide guidance on how to find out if waste oil and wastes that contain oil are hazardous.
This guide is not sector specific. It is aimed at waste oils or any waste that might contain oil.

Some terms in the document have a numbered reference that is explained in the References section at the end. If looking at an electronic version on screen, you can see the explanation by moving the cursor over the reference number using the mouse.

The document assumes that you know how to classify wastes using the List of Wastes[1] (as implemented by the List of Waste Regulations 2005[2]). The List is commonly referred to as 'the EWC' (European Waste Catalogue).

For a comprehensive guide on how to find out if wastes are hazardous using the List, please look at the joint Agencies technical document WM2: '*Interpretation of the definition and classification of hazardous waste'.* You can find this on our website using the following link: www.environment-agency.gov.uk/hazwaste

This document does not apply to:

- Wastes that are known and/or confirmed by assessment not to include oil or substances contaminated with oil.
- Those wastes that previously contained or were contaminated with oil, but which have been treated by suitable permitted means to remove that oil.
- Coal-derived products.
- Waxes.
- Tars.

There is a scarcity of data on the Internet regarding the hazardous properties of waste oils. The most comprehensive data that can be found on oil products has been prepared by the CONCAWE[3] group. CONCAWE's activities cover areas including waste and occupational health and safety. The main objectives of CONCAWE are:

- To acquire pertinent scientific, economic, technical and legal information on environmental, health and safety issues relating to the refining of crude oil and the distribution and use of petroleum products.
- To communicate the findings in order to improve understanding of these issues by all stakeholders including the industry, authorities and the public at large.

CONCAWE endeavours to conduct its activities with objectivity and scientific integrity.

Given this, we consider that their reports on the classification of oils are appropriate data sources for use in the classification of waste oil and wastes that contain oil.

The information in this guide is based on what we know at the moment. It might change if there is a change in Law, guidance from Government or because of our experience in regulating hazardous waste.

Part 1 Waste oils

2 What is a waste oil?

We consider waste oil to be:

- any waste that is in Chapter 13 *Oil Wastes and Wastes of Liquid Fuels* in the List of Wastes
- the specific oil entries in sub-chapters 0501 *wastes from petroleum refining* and 1201 *wastes from shaping and physical and mechanical surface treatment of metals and plastics*, in the List
- and the specific wastes:
  - 080319* *disperse oil*
  - 080417* *rosin oil*
  - 190207* *oil and concentrates from separation*
  - 190810* *grease and oil mixture from oil/water separation other than those mentioned in 190809*
  - 200126* *oil and fat other than those mentioned in 200125*.

- This includes all fuels. Biodiesel[4] is included if conventional or low-sulphur diesel has been mixed into it.
- This excludes edible[5] oils.

3 Classification of waste oil

The European Commission took the decision that all waste oils except edible oil are hazardous when they prepared the List of Wastes Decision (EWC).

All waste oils (except edible oils) are absolute hazardous entries in the List. Therefore, all waste oils are hazardous waste, regardless of what sort of oil they are, what they are derived from or what they are made of.

Although all waste oils are classified as hazardous, it is important to determine what hazardous properties the oil possesses. This will ensure that anyone involved in the transfer of the waste is fully aware of any dangers it might possess.

Determine the 6-digit List of Waste Code

Find the appropriate 6-digit code in the List that applies to the waste oil. Look at WM2 for more advice on using the List (see section 1.0 for a link to WM2).

3.1 Determine the hazardous properties of the waste oil

Do you know what the waste oil is?

If you know what the oil is use the classification data for it to identify its hazardous properties. The best source of information for this is the Safety Data Sheet. Note that the Safety Data Sheet must have been prepared in accordance with European Standards, otherwise the data might not provide information to properly classify it.

If you do not have a Safety Data Sheet, but there is information that tells you which specific petroleum group[6] the oil belongs to, then the classification for that petroleum

group must be used. The classifications for the petroleum groups are reproduced in Appendix A.

Are there other data available to assign hazardous properties?

There are other peer-reviewed data sources available on the internet that could also provide information. More information on use of data sources is provided in Appendix D of WM2.

If there is no data that can determine the appropriate classification of the oil then you should use the general hazardous properties that are described in the table below:

Waste oils are considered to possess the following hazardous properties:

- **H14 Ecotoxic**
- **H5 Harmful**
- **H7 Carcinogenic - with the assumption that where the oil is a Fuel Oil then the classification as a category 3 carcinogen applies, otherwise the classification as a category 2 carcinogen will apply**

The CONCAWE reports provide the supporting data for our decision that waste oils are generally considered to possess these hazards.

3.2 What if data suggests that the oil doesn't possess a hazardous property?

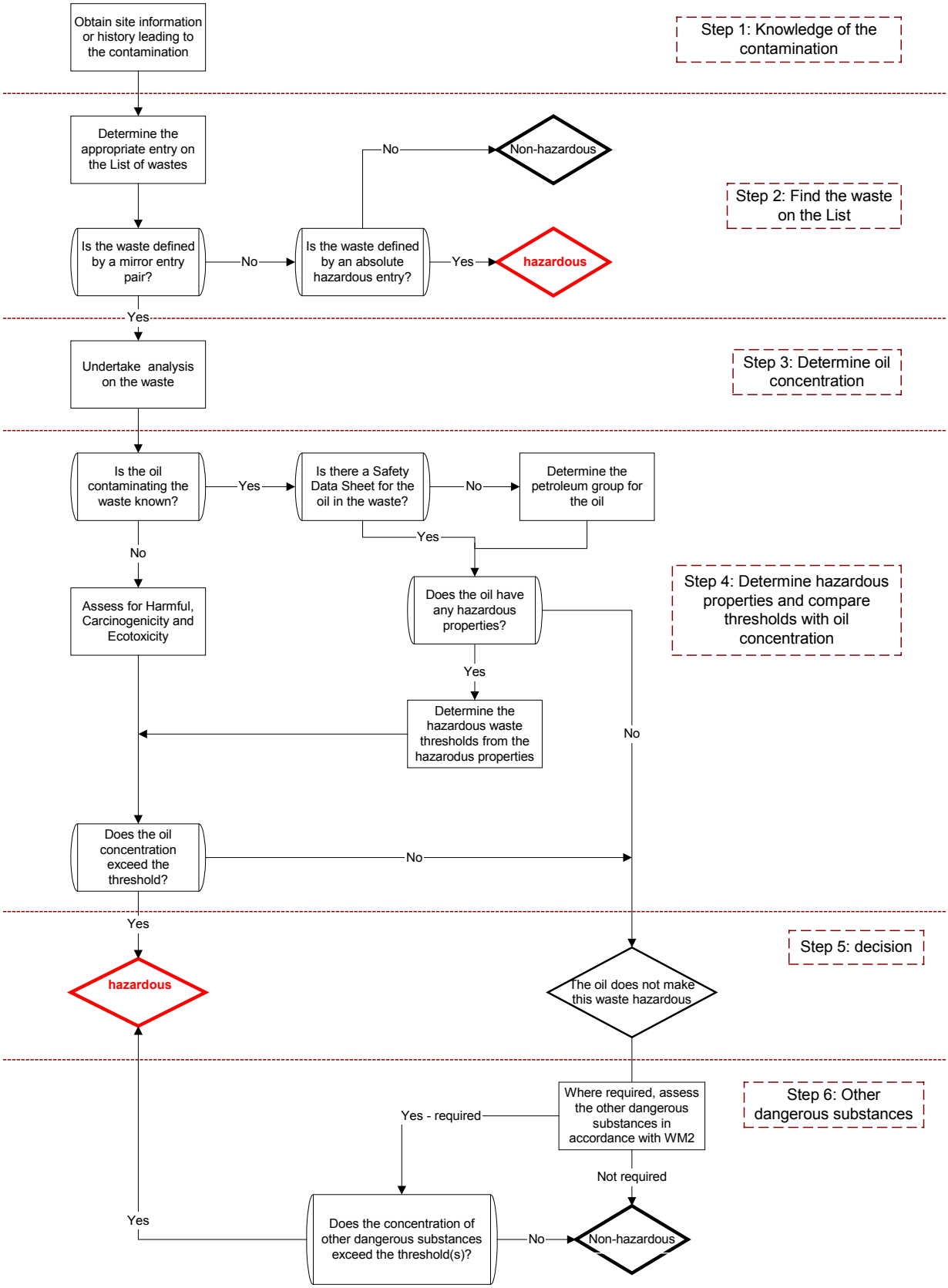
All waste oils (except edible oil) are classified as hazardous according to the List of Wastes. This includes waste oils (except edible oil) that can be demonstrated by Safety Data Sheet information or by peer reviewed data to not possess any hazardous properties. These must be consigned as hazardous waste. All parties involved in the transfer of the oil should retain the Safety Data Sheet or peer-reviewed data as proof to demonstrate that the oil doesn't possess hazardous properties. We advise that such oils should be recorded with the hazard 'Harmful' (H5) for recording on the consignment note and the consignee return as it is mandatory to record a hazardous property for a consignment.

The Hazardous Waste Regulations (Regulation 9) provide that the Secretary of State has the power to determine that a specific batch of waste that is on the List marked as hazardous, can be treated as a non-hazardous waste. If you feel that you have waste oil that does not have any hazardous properties as demonstrated by the Safety Data Sheet or peer reviewed data that might benefit from a decision under Regulation 9 of HWR, please contact Defra for further advice, by emailing them at:
waste.management@defra.gsi.gov.uk or in writing to:

Waste Management Division
Defra
Zone 6/E6
Ashdown House
123 Victoria Street
LONDON
SW1E 6DE

Part 2 Wastes containing oil

4. Flowchart for determining the classification of wastes containing oil



4.1 Flowchart steps

Step 1 – Knowledge of the contamination

It is fundamental to obtain as much information as possible about how the waste became contaminated. This knowledge might provide information about the type of oil and/or other dangerous substances in the waste. In some cases it will be straightforward, as you will know exactly how the contamination got there. Other cases, such as contaminated land remediation, it will be more difficult, so the history of the site will require investigation.

Step 2 – Find the waste on the List

You will need to find the appropriate 6-digit code in the List that applies to the waste. This will determine whether the waste is hazardous or not. There are 3 types of entry on the List: absolute hazardous entries, mirror entries and non-hazardous entries. Please refer to WM2 for further advice on these.

Wastes that are contaminated with oil are likely to be covered by mirror entries most of the time. A mirror entry is usually a pair of wastes on the List with different 6-digit codes, one is hazardous – this will be marked with an asterisk, the other is not. The hazardous entry is chosen if the waste contains dangerous substances (such as oil) at or above the relevant threshold levels.

The 6-digit code is required on all transfer documentation associated with the waste.

Step 3 – Determine the oil concentration

You will need to do this by performing analysis on the waste. For details on our recommended principles, please refer to Appendix B.

Step 4 – Determine hazardous properties and compare thresholds with oil concentration

Use Step 1 to identify whether the type of oil in the waste is known or not. This will establish whether a specific source of information can provide the hazardous properties of the oil, or whether to apply the general principles for unknown oil.

A. You know what the oil is:

The primary source of information to determine whether the oil has any hazardous properties is the Safety Data Sheet for it. For this to be appropriate for hazardous waste assessment, it must have been prepared in accordance with European Standards. The Safety Data Sheet should be used unless the process that produced the waste comprised of a thermal, biological, chemical or physical process that completely changed the properties of the oil. In this case, we advise that you follow the general principles for unknown oils described below.

The Safety Data Sheet will identify any hazardous properties the oil possesses. Where it possesses hazardous properties it will also show risk phrases that indicate what the dangerous properties are. The risk phrases can be linked to thresholds for hazardous waste assessment. Advice on the links between risk phrases and hazardous properties is provided in Table 3.1 of WM2.

Some Material Safety Data Sheets (MSDS) are prepared in accordance with American standards. We do not recommend their use for hazardous waste assessment where these don't meet European Standards. If you have a data sheet that doesn't follow the European requirements, we advise that you follow the general principles for unknown oils described below. Please seek advice from the Health and Safety Executive if you are unsure whether a MSDS has not been prepared in accordance with European Standards.

If you know what the oil is, but don't have a Safety Data Sheet, you should be able to identify which petroleum group it belongs to. Appendix A lists the petroleum groups and provides information on which hazardous properties they possess and which risk phrases are appropriate.

B. The oil is unknown

If you don't know what type of oil is in the waste, you must apply the general principles. These are based on 3 hazards: Harmful (H5), Carcinogenic (H7) and Ecotoxic (H14). These principles are based on data from the CONCAWE reports[7, 8] on the classification of oil products.

You will need the results of the analysis to determine whether the unknown oil causes the waste to possess any hazardous properties. Compare the concentration of the unknown oil (both fuel and lubricating/other oil where appropriate) with the hazardous waste thresholds below.

Harmful (H5)

The CONCAWE report on the classification of petroleum products identifies that most oils are typically classified as R65 *Harmful. May cause lung damage if swallowed.*
On the basis of the findings of the report, we have adopted the general principle that waste oil is classified as **R65** Harmful.

WM2 identifies that the appropriate threshold for R65 is 25% w/w (250000 mg/kg or ppm).

Where the total quantity of oil in the waste is 25% or more (250000 mg/kg (ppm)) the waste will be hazardous by H5.

Where the analysis shows that the contamination in the waste is from both fuel and unknown lubricating/other oil contamination, their concentrations will need to be added to get the overall oil total.

Carcinogenic (H7)

The CONCAWE report identifies that oils can present a carcinogenic hazard, but this is subject to certain criteria..
The criteria for these classifications are presented in the form of Notes. The oil will be classified as a carcinogen if the condition in its Note is met. **Most virgin oils that are currently available for use in the market today are not carcinogenic.**

On the basis of the CONCAWE findings we have adopted the general principle:

- waste Fuel Oils (including diesel) are classified as category 3 carcinogens; and

- all other waste oils (including petrol and used engine lubricating oil) are category 2 carcinogens

unless there is data to the contrary.

WM2 identifies that the appropriate threshold for a category 3 carcinogen is 1% w/w (10000 mg/kg or ppm). The appropriate threshold for a category 2 carcinogen is 0.1% w/w (1000 mg/kg or ppm).

The analysis will have provided concentrations for fuels and unknown lubricating/other oils in the waste.

For fuels the hazardous waste threshold is:

Where the total petrol range organics [9] (PRO) is 0.1% w/w (1000 mg/kg); or the diesel range organics[10] (DRO) is 1% w/w (10000 mg/kg) or more, the waste will be hazardous by H7.

PRO is considered to be C_6 to C_{10}
DRO is considered to be C_{10} to C_{25}

For unknown lubricating/other oil (shown by analysis not to be fuel)
Lubricating/other oil in the waste will be assumed to be a category 2 carcinogen unless it can be demonstrated that it does not possess carcinogenic properties. This is achieved by analysing for the carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs) and identifying whether these are present at 10 mg/kg per 1000 mg/kg (1%) of the measured unknown lubricating/other oil in the waste. If so, the oil will be assumed to be a category 2 carcinogen. Further details on analysis are provided in Appendix B.

The addition of carcinogenic substances to determine whether the H7 threshold is exceeded is a departure from the principles in The List Decision and the List of Wastes Regulations. In principle, carcinogenic substances should not be additive since the risk of cancer from one agent would not normally be increased by the presence of another cancer agent that acts in a different way. As an example, hexavalent chromium substances cause nasal perforations and benzene causes leukaemia. Adding these two substances isn't appropriate, as the carcinogenic effect is different. More of one can't increase the carcinogenic risk posed by the other. But PAHs all act in the same way - they don't act directly as carcinogens but react in the body together to form PAH epoxides that are the active carcinogenic agent.
This concept has precedent in European legislation. Directive 2005/69/EC recognises the health and environmental effects of PAHs in extender oils and tyres. It states that they may not be placed on the market and used for the production of tyres or parts of tyres if they contain more than 10 mg/kg of the sum of a list of carcinogenic PAHs. We have based the marker threshold on this legislation.

So in conclusion, we justify addition of the carcinogenic PAHs as a marker on the basis that they are a family of compounds that act in the same way to cause the cancer risk.

For lubricating/other oils the threshold is:

Where the lubricating/other oil is 0.1% w/w (1000 mg/kg) or more, the waste will be hazardous by H7, unless the total concentration of carcinogenic PAHs is less than 1% of the lubricating/other oil concentration.

Ecotoxic (H14)

The CONCAWE report on the ecotoxicity of petroleum products shows that oil presents a hazard to the environment.

The report identifies that there is more data for fuels than other oils. The data identifies that the following risk phrase is appropriate for fuels: R51/53 *Toxic to aquatic organisms and may cause long term effects in the aquatic environment.*
For other oils, there is a greater lack of data. The data that is available indicates that the most appropriate risk phrase is R53 *May cause long-term effects in the aquatic environment.*

So, on the basis of the findings of the report, we have adopted the general principle that waste fuels are classified as **R51/53** and lubricating/other oils as **R53**. However, if specific oil possesses a different ecotoxic classification, this must be used and the threshold adjusted accordingly.
This position is subject to review if any new data on the ecotoxic properties of oil provide evidence to the contrary.

WM2 identifies that the appropriate ecotoxic thresholds for these risk phrases are:
For fuels, the hazardous waste threshold is:

Where the total concentration of fuel contamination in the waste is 2.5% w/w (25000 mg/kg) or more, the waste will be hazardous by H14.

For lubricating/other oils the threshold is:

Where the total concentration of lubricating/other oil in the waste is 25% w/w (250000 mg/kg) or more, the waste will be hazardous by H14.

Are any of the thresholds met?

If the oil is present at or above any one of the thresholds the waste will be hazardous.

Note that for ecotoxicity and harmful, the concentration of the oil will need to be added to other ecotoxic or harmful substances to determine if the thresholds are met. Refer to WM2 Appendix C, Chapters C5 and C14 for guidance on this.

Step 5 – Decision

You will now be able to determine whether the oil causes the waste to be hazardous or not.

Step 6 – Other dangerous substances

In most cases, it is not enough to determine whether the waste is hazardous by the presence of oil alone, even if the oil makes the waste hazardous. All of the hazardous properties of the waste must be identified so that those who subsequently handle the waste can do so safely.

The waste might possess other hazardous properties because it contains other dangerous substances. These must be assessed. In some cases the concentration of the oil will need to be added to other dangerous substances that have the same hazardous properties of the oil. These are fully described in WM2.

The description of the waste associated with the 6-digit code obtained in Step 2 will confirm whether you need to assess for other dangerous substances to identify whether the waste is classified as hazardous. If this description only refers to “containing oil”, then the presence of other dangerous substance will not affect whether it is classified as hazardous or not.

Appendix A – Hazards associated with the general petroleum groups

General petroleum type	Hazard			
	Carcinogen	Ecotoxic	Harmful	Others
Crude Oils	Cat 2 R45 (0.1% w/w)	R52/53 (25% w/w)	R65 (25% w/w)	Flammable R10, or R11 or R12
Low Boiling Point Naphthas (Gasolines)	Cat 2 R45 (0.1% w/w)' see note 1	R51/53 (2.5% w/w)	R65 (25% w/w)	Extremely flammable R12 Mutagen category 2 R46 (0.1% w/w) see note 1 Toxic for Reproduction Cat 3 R63 (5%) see note 2
Kerosines	x	R51/53 (2.5% w/w)	R65 (25% w/w)	Flammable R10, or R11 Irritant R38 (20%)
Gas Oils (straight run)	x	R51/53 (2.5% w/w)	R65 (25% w/w) see note 3	x
Cracked Gas Oils (excluding hydrocracked)	Cat 2 R45 (0.1% w/w)	R51/53 (2.5% w/w)	R65 (25% w/w) see note 3	Irritant R38 (20%)
hydrocracked Gas Oils	Cat 3 R40 (1% w/w)	R51/53 (2.5% w/w)	R65 (25% w/w) see note 3	x
Vacuum gas oils	x	R51/53 (2.5% w/w)	R65 (25% w/w) see note 3	x
Other gas oils	Cat 2 R45 (0.1% w/w) See note 4	R51/53 (2.5% w/w)	R65 (25% w/w) see note 3	x
Distillate Fuel Oils – Diesel fuel, Fuel Oils nos. 2 & 4 and diesel fuel no. 2	Cat 3 R40 (1% w/w)	R51/53 (2.5% w/w)	R65 (25% w/w) see note 3	x
Heavy Fuel Oil Components	Cat 2 R45 (0.1% w/w)	R52/53 (25% w/w) Data currently under review	x (for clarified slurry oil R48/21 (25% w/w))	x
Lubricating Greases	Cat 2 R45 (0.1% w/w) See note 4	Limited data R53 at least (25% w/w)	x	Depends on other constituents e.g. organo-metallic thickners
Unrefined/Acid Treated Oils	Cat 1 R45 (0.1% w/w)	No aquatic tox data R53 at least (25% w/w)	R65 (25% w/w) see note 3	x
Highly Refined Base Oils	x	x	R65 (25% w/w) see note 3	x
Other Lubricant Base Oils	Cat 2 R45 (0.1% w/w) See note 5	x	R65 (25% w/w) see note 3	x
Residual Aromatic Extracts	Not enough data	R53	x	x
Untreated Distillate Aromatic Extracts	Cat 2 R45 (0.1% w/w)	R53	x	Limited data – possibly Irritant R38 (20% w/w)
Treated Distillate Aromatic Extracts	Cat 2 R45 (0.1% w/w) See note 5	R53	x	x

Paraffin And Hydrocarbon Waxes	x	x	x	x
Foots Oils	Cat 2 R45 (0.1% w/w) See note 5	x	x	x
Slack Waxes	Cat 2 R45 (0.1% w/w) See note 4	x	x	x
Petrolatums	Cat 2 R45 (0.1% w/w) See note 4	x	x	x
Bitumens	x	x	x	x
Petroleum Cokes	x	x	x	x

Note 1: Unless benzene < 0.1% in the oil
Note 2: Unless toluene <5% in the oil
Note 3: Unless data suggests that it doesn't meet the criteria of an aspiration hazard
Note 4: Unless refining history indicates original feedstock is not carcinogenic
Note 5: Unless it can be shown that the oil has a DMSO extract <3% using IP346

Not included are those Petroleum types where there is insufficient data to make classifications

Aspiration hazard - petroleum substances and their preparations are classified as Xn, R65 (Harmful: may cause lung damage if swallowed) if they meet the following criteria:
• they must contain more than 10% hydrocarbons, and
• the viscosity must be below 7 mm2/s (i.e. 7 centistokes) at 40°C;
optionally, the surface tension must not be greater than 33 mN/m at 25°C.
CONCAWE reports advise classification as an aspiration hazard where human experience shows that a substance or preparation presents an aspiration hazard, regardless of whether or not the criteria are met.

Appendix B – Analytical principles

Analysis must be able to both identify and quantify the petroleum product present. There is no simple test that can do this. A step-wise procedure, utilising various analytical techniques, needs to be adopted.

TPH analysis/ extraction techniques

Total Petroleum Hydrocarbon analysis is widely carried out on soils/contaminated land where it is appropriate to determine the presence and extent of contamination from petroleum fuel products and crude oils. However, it is a less satisfactory technique where lubricating/other high carbon range oils are concerned especially when it comes to quantifying small amounts of such products.

Extraction techniques use a solvent to extract organic matter from the material. When non-hydrocarbon solvents are used the extract could be analysed by infra-red for the hydrocarbon content. When hydrocarbon solvents are used for the extraction, quantification is by gravimetric determination after removal of the solvent. In this case the determination is not TPH but oil/grease since the more volatile petroleum substances will be lost during recovery of the solvent.

Some of the more common methods for the analysis of TPH include[11]:
(1) USEPA Method 418.1 or Modified 418.1,
(2) USEPA Method 9071b,
(3) USEPA Modified 8015M for Diesel-Range Organics (DRO) and
(4) USEPA Modified 8015M for Gasoline (Petrol)-Range Organics (GRO/PRO) [TPHCWG, 1998a].

Method 418.1 consists of solvent extraction followed by treatment in a silica gel column and infrared spectroscopy;

Method 8015 is suitable for wastes where the suspected contamination is within the DRO and PRO range. The method involves solvent extractions followed by gas chromatography. If it is suspected that the sample is predominately a gasoline (i.e., volatile) fraction, purge and trap sample introduction to the gas chromatograph is often used in the determination of PRO.

Method 9071b is a gravimetric method that consists of solvent extraction, evaporation of the solvent, and a weight measurement.

Note that there will be some overlap between the corresponding TPH analytical methods. For example, a TPH method designed for petrol range organics (i.e., C6 to C10) may report some of the hydrocarbons present in diesel fuel (i.e., C10 to C25) and vice-versa. TPH Method 418.1 will extract the complete range from gasoline through lube oil, motor oil, and grease (i.e., C8 to C40). But this method is not specific to hydrocarbons. In fact, it can give false positive results when organic matter is extracted from the environmental media for analysis. In other words, TPH measurements do not always indicate petroleum contamination

TPH analysis is sufficient for the identification and quantification of fuels but not lubricating/other oils and an extraction procedure will determine oils but not the volatile fraction of fuels.

A 2-step process quantifies lubricating/other oils:
1) Extraction
2) Identification and further analysis of the extracted material.

1. Extraction method for lubricating/other oils[12]

The extraction method used is USEPA METHOD 9071b with some minor amendments as identified below:
Note that it is vital that the amount of sample taken should be sufficient to achieve the threshold limit. We recommend that no less than 100g be used.
Extraction:
i) Replacement of n-hexane by 40-60'C petroleum ether.
The use of n-hexane cannot be recommended on Health and Safety grounds. The Workplace Exposure Limit for n-hexane is markedly different from other aliphatic hydrocarbons it being set at 72 mg/m3 compared to 1800 mg/m3 for pentane or iso-hexane. 40-60'C petroleum ether is a suitable alternative, it being the recommended solvent for extraction of oil in various British Standard methods.

ii) Treatment of all waste samples according to the sediment/soil procedure.
Preservation with hydrochloric acid and addition of hydrochloric acid to the sample prior to extraction is not necessary when the matter of interest is mineral oil. The addition of hydrochloric acid will preserve and facilitate the extraction of fatty acids which are not of interest when assessing a waste for mineral oil content.

iii) Minor equipment change.
A 250ml round, flat-bottomed, flask can be used throughout the procedure. This avoids transferring the extract from a 125ml flask to a 250ml flask with consequent potential loss of extract. The volume of solvent used may need to be increased.
A solvent collector can be substituted for the Soxhlet apparatus after the extraction period to obviate the need for a separate distillation stage.

iv) Dry in an oven.
Where solely oil is of interest, traces of solvents remaining after recovery can be removed by placing the flask in an oven at 105'C prior to cooling and weighing.

2. Identification and further analysis of the extracted material[13]

Infra-red spectroscopy of the extracted matter will show whether it is solely mineral oil/grease or that it contains more than just hydrocarbons.
If other substances are present the extract can be saponified and the unsaponifiable matter (mineral oil) portion quantified.

The procedure is set out by MAFF: Food Analysis Collaboratively Tested Non-Statutory Methods, Method No. V7 Unsaponifiable matter
The mineral oil portion is quantified by the constant weight remaining.

The resulting unsaponifiable matter can then be examined by infra-red to confirm that only hydrocarbons now remain.

Use of carcinogenic PAHs as marker

The PAHs that are carcinogens beyond reasonable doubt (and have been classified by IARC) are:

1. benz[a]anthracene
2. benzo[b]fluoranthene
3. benzo[j]fluoranthene
4. benzo[k]fluoranthene
5. benzo[a]pyrene
6. chrysene
7. dibenz[a,h]anthracene
8. indeno[1,2,3-cd]pyrene

So, rather than total of 16 EPA priority PAHs we need to just look at 8 above that are classified as carcinogens. Of the 16 priority PAHs, 7 are classified as carcinogens beyond doubt by IARC. Benzo[j]fluoranthene is the additional one, not on the 16 EPA priority PAHs.

Acenaphtene, acenaphtylene, fluoranthene, phenanthrene, and pyrene have been considered suspected carcinogens. Only naphthalene, anthracene, benzo[ghi]perylene, and fluorene have been considered non-carcinogenic. Note that in certain documents benzo(e)pyrene is also listed as a proven carcinogen.

Appendix C - Worked examples

Virgin oil in drums

Any container drum or other packaging that contains oil that can be removed by the methods normally used (pouring, scraping, etc) should be classified as the contents of the drum, rather than packaging.

A 205l drum of diesel, where 100ml of diesel could be poured from the drum, should be classified as 130701* *fuel oil and diesel*. Note there is no *de-minimus* and the amount 100 ml is only used for illustrative purposes, but would be more than sufficient to determine that the contents were diesel.

A 2.5l plastic keg (tare weight 300g) contaminated with unleaded petrol (R12, R45, R38, R65, R67, R51/53) & R45 (0.1% w/w) would be classified as 150110* *packaging containing residues of or contaminated by dangerous substances* even if the petrol was poured out, but the keg wasn't subsequently rinsed out to remove the residual unleaded petrol. This is because of the flammability of the petrol.

Kerosene (used for heating) spills

Kerosene used for heating oil has spilled onto the ground from a ruptured tank. The contaminated ground has been removed and requires disposal. What concentration of kerosene would make the contaminated ground hazardous?

Kerosene (or regular burning oil and other synonyms) manufactured to BS 2869:1998 has the following classification:

R10	Flammable - **Where the waste (the contaminated ground) has a flashpoint that is 55 °C or less, the waste will be hazardous by H3. This will need to be determined by testing.**
R38	Irritating to the skin. Threshold = 20%
R51/53	Toxic to aquatic organisms and may cause long term effects in the aquatic environment. Threshold = 2.5%
R65	Harmful: may cause lung damage if swallowed. Threshold = 25%

So, the limiting threshold for kerosene in the contaminated ground is 2.5% w/w.

Oil spills at a petroleum refinery

Where oil is spilt at a petroleum refinery, there is an absolute entry code for such wastes.
This is 050105* *oil spills*.
This waste is an absolute entry, so any oil spills at a petroleum refiners are hazardous waste regardless of the composition of dangerous substances in the waste.

Garage servicing waste – oily rags and oil filters

Oily rags are covered by the following entries on the List:
150202 absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances*
150203 absorbents, filter materials, wiping cloths and protective clothing other than those mentioned in 150202
The appropriate choice is determined by whether the concentrations of dangerous substances exceed the thresholds.

If the rags are used to absorb virgin oil then the SDS should be used to identify whether it has any hazardous properties. If it has, the risk phrases associated with it can be used to determine what the thresholds are. If the SDS shows that the virgin oil doesn't possess any hazardous properties, then any rags used to wipe up that virgin oil will not be hazardous unless it also comes into contact with another dangerous substance (e.g. used engine oil).
Used engine oil is considered to be a category 2 carcinogen. So, if the rags are used to wipe up used engine oil, the rag will be hazardous where the oil is present at 0.1% or more. It is likely that in most circumstances, this will be the case, so we advise that oily rags used to absorb used engine oil should be classed as hazardous waste, unless there is evidence to prove otherwise.

Hazardous oily rags must not be disposed of in the same bin as non-hazardous rags and wiping cloths or any other non-hazardous waste. Mixing hazardous waste with non-hazardous waste is banned under the Hazardous Waste Regulations unless you have a waste permit that allows it.

Waste oil filters from vehicles are covered in List sub-chapter *1601*:
160107 oil filters*
They are an absolute entry, so are hazardous.
Oil filters that have been drained or crushed at the garage or vehicle repair facility are still considered hazardous because these will still be classed as an oil filter according to the List of Waste. There is no alternative code that can be used for an oil filter removed from a vehicle and crushed at a garage or vehicle repair facility..

Where an oil filter is consigned to a waste management facility and crushed in accordance with the waste permit, there is an alternative code for the crushed filters. This is found in List sub chapter 1912 '*19 12 wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified':*

191211 other wastes (including mixtures of materials) from mechanical treatment of waste containing dangerous substances*
191212 other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 191211

The appropriate code will depend on how much oil remains in the crushed filters. The oil in the filters will be assumed to be a category 2 carcinogen unless there is evidence to prove otherwise. So, if there is 0.1% or more oil remaining in a filter, the load will be hazardous waste.
Modern crushers are available on the market for waste management companies that can compact the filters so that there is less than 0.1% oil remaining.

Worked example showing the PAH marker calculation

Preliminary screening of land requiring remediation indicates that there is significant hydrocarbon contamination. The site history shows heavy HGV use and vehicle servicing and refuelling. It also shows that the soil in the area has typically low organic content. No other significant contamination was observed other than hydrocarbons.

The soil was analysed according to USEPA methods 8015 and 9071b to determine the fuel range concentration and lubricating/other oil concentration respectively. The sample was also analysed for USEPA priority PAHs plus other potentially carcinogenic PAHs. It is assumed that all PAHs present are due to the hydrocarbon contamination and don't arise from natural sources.

The results were as follows:

Fuel range: PRO concentration = 286 mg/kg; DRO concentration = 5635 mg/kg
Total lubricating/other oil = 6950 mg/kg

Oil guide 8	US EPA list of priority PAHs	Representative concentration mg/kg
	1. Napthalene	3.0
	2. Acenapthene	<1
	3. Acenapthylene	<1
	4. Fluorene	4.1
	5. Anthracene	12.5
	6. Phenanthrene	5.2
	7. Fluoranthene	4.6
	8. Pyrene	45.6
✔	9. Benz[*a*]anthracene (IARC group 2a)	12.3
✔	10. Chrysene	13.0
✔	11. Benzo[*b*]fluoranthene	17.7
✔	12. Benzo[*k*]fluoranthene	27.9
✔	13. Benzo[*a*]pyrene (IARC group 2a)	12.4
✔	14. Dibenzo[*a,h*]anthracene (IARC group 2a)	11.3
✔	15. Indeno[*1,2,3-c,d*]pyrene	23.3
	16. Benzo[*g,h,I*]perylene	33.0
	Other PAHs that are suspected carcinogens in IARC Group 2b	
✔	benzo[j]fluoranthene	14.2

Threshold comparison:

H5: The total hydrocarbon concentration is less than the Harmful (H5) threshold of 250000 mg/kg.

H14: The total fuel concentration is less than 25000 mg/kg; and the total lubricating/other oil concentration is less than the 250000 mg/kg concentration.

H7: The total PRO is less than1000 mg/kg threshold; the total DRO is less than 10000 mg/kg threshold.
The total lubricating/other oil is 6950 mg/kg, so exceeds the 1000 mg/kg threshold.
The total of 8 carcinogenic PAHs (identified by the tick in the above table) is 132.1 mg/kg. The ratio of 8 carcinogenic PAHs to total lubricating/other oil is 1.9%. This exceeds the marker threshold, so the lubricating/other oil is considered to be a category 2 carcinogen. As the 1000 mg/kg threshold is exceeded by the concentration of the lubricating/other oil, the waste will be hazardous.

The soil is hazardous and is classified 170503* *soil and stones containing dangerous substances*

References and glossary

[1] List of Wastes: This is the EU List of Wastes Decision 2000/532 (as amended).

[2] List of Wastes Regulations: This is SI 2005:895 The List of Waste (England & Wales) Regulations 2005 which implemented the EU List of Wastes Decision 2000/532 (as amended).

[3] CONCAWE is an abbreviation for CONservation of Clean Air and Water in Europe. It serves to carry out research on environmental issues relevant to the oil industry. Its membership has broadened to include most oil companies operating in Europe.

[4] Biodiesel is a renewable transport fuel made mainly from vegetable oils. It is produced from plant material by a simple chemical process. The resulting *Biodiesel* (or Methyl Ester) can be used in all diesel engines with little or no modification either on its own or as a mixture with conventional or low sulphur diesel.

[5] Edible oils： An edible oil is fat extracted from animal or plant sources. They are non-hazardous unless otherwise identified in the List of Wastes (e.g. 080417* *Rosin Oil*).

[6]Petroleum Group – groups of petroleum substances with similar chemical structures and/or chemical properties. The groupings were defined by CONCAWE.

[7] Report 01/54 'Environmental classification of petroleum substances - summary data and rationale'. Prepared by CONCAWE Petroleum Products Ecology Group, 2001

[8] Report 6/05 'Classification and labelling of petroleum substances according to the EU dangerous substances directive'. (CONCAWE recommendations – July 2005)

[9] Petrol range organics (PRO): This is sometimes referred to as Gasoline Range Organics (GRO). It is a term used to cover petroleum substances with a particular range of carbon atoms. PRO is considered to be C_6 to C_{10}

[10] Diesel range organics (DRO): is a term used to cover petroleum substances with a particular range of carbon atoms. DRO is considered to be C_{10} to C_{25}

[11] American Petroleum Institute: Risk-Based Methodologies for Evaluating Petroleum Hydrocarbon Impacts at Oil and Natural Gas E&P Sites. Publication 4709

[12] USEPA METHOD 9071B: with some minor amendments.

[13] MAFF: Food Analysis Collaboratively Tested Non-Statutory Methods, Method No. V7 Unsaponifiable matter

Would you like to find out more about us, or about your environment?

Then call us on
08708 506 506 (Mon-Fri 8-6)

email
enquiries@environment-agency.gov.uk

or visit our website
www.environment-agency.gov.uk

incident hotline 0800 80 70 60 (24hrs)
floodline 0845 988 1188

Product Code: **GEHO0607BMTW-E-E**