

Chemical works

soap and detergent manufacturing works

Industry Profiles, together with the Contaminated Land Research Report series, are financed under the Department of the Environment's contaminated land research programme.

The purpose of these publications is to provide regulators, developers and other interested parties with authoritative and researched advice on how best to identify, assess and tackle the problems associated with land contamination. The publications cannot address the specific circumstances of each site, since every site is unique. Anyone using the information in a publication must, therefore, make appropriate and specific assessments of any particular site or group of sites. Neither the Department or the contractor it employs can accept liabilities resulting from the use or interpretation of the contents of the publications.

The Department's Contaminated Land Research Report series deals with information needed to assess risks; procedures for categorising and assessing risks; and evaluation and selection of remedial measures.

General guidance on assessing contaminated land and developing remedial solutions which is complementary to the Department's publications is provided by the Construction Industry Research and Information Association (CIRIA).

Acknowledgements

The Department of the Environment is grateful to the members of the Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL), and the following individuals and organisations for assistance in the compilation of this profile:

Arup Environmental (Ove Arup and Partners)

Mr D L Barry (WS Atkins Environment)

Mr B K Chesterton (Director General, The Soap and Detergent Industry Association)

Dr J S Clunie (Procter and Gamble Limited)

National Rivers Authority

Mr I Stringer (Technical Safety and Environment Manager, Lever Brothers Limited)

Mr R Swannell (AEA Technology Harwell)

Dr M R G Taylor (Consultants in Environmental Sciences Limited)

DOE Industry Profile

Chemical works: soap and detergent manufacturing works

	Page
Preface	(iii)
1. Background	1
2. Processes	2
2.1 Raw materials	2
2.2 Delivery, handling and storage of raw materials	3
2.3 Manufacturing processes	3
2.4 Ancillary activities	5
2.5 Wastes	5
3. Contamination	6
3.1 Factors affecting potential contamination	6
3.2 Migration and persistence of contaminants	6
4. Sources of further information	8
Annex Potential contaminants	10
Table 1a Main groups of contaminants and their probable locations — soap manufacturing works	12
Table 1b Main groups of contaminants and their probable locations — detergent manufacturing works	13

This profile is based on work by Dames and Moore International and was prepared for publication by the Building Research Establishment.

Preface

DOE Industry Profiles provide developers, local authorities and anyone else interested in contaminated land, with information on the processes, materials and wastes associated with individual industries. They are not definitive studies but they introduce some of the technical considerations that need to be borne in mind at the start of an investigation for possible contamination.

Every site is unique. Investigation of a site should begin with documentary research to establish past uses. Information on the site's history helps to focus a more detailed investigation. This knowledge needs to be supplemented by information on the type of contamination that may be present and where on site it may be found. Profiles give information on the contamination which might be associated with specific industries, factors that affect the likely presence of contamination, the effect of mobility of contaminants and guidance on potential contaminants.

The date when industrial practices first commenced on a site and its location are important clues in establishing the types of operations that may have taken place, so each profile provides a summary of the history of the industry and its likely geographical spread within the United Kingdom.

Profiles should be read with the following reservations in mind:

- individual sites will not necessarily have all of the characteristics described in the profile of that industry;

- practices can vary between sites and change over time;

- as practices change, problems of possible contamination may also change;

- the profile may refer to practices which are no longer followed, and may omit current practices which avoid contamination.

The risks presented by contaminated sites depend on the nature of the contaminants, the targets to which they are a potential threat (such as humans or groundwater) and the routes or pathways by which they reach these targets. The current or proposed use of a site and its environmental setting are crucial in deciding whether treatment is necessary and if so, the methods to be used. Some sites may not need treatment.

The information in profiles may help in carrying out Control of Substances Hazardous to Health (COSHH) assessments for work on contaminated land - see Health and Safety Guidance Note HS(G) 66 *Protection of workers and the general public during the development of contaminated land*, Health and Safety Executive, 1991, and *A guide to safe working practices for contaminated sites*, Construction Industry Research and Information Association, 1995.

Note: the chemical names given to substances in this profile are often not the modern chemical nomenclature, but the names used historically for those substances.

Chemical works: soap and detergent manufacturing works

1. Background

A soap or detergent is a material which, when dissolved in water, aids the removal of dirt or foreign matter from a surface.

Soap is an alkali metal salt of a long-chain fatty acid and is manufactured using vegetable and animal fats. Soaps are divided into two main types: toilet and industrial.

Detergents are produced synthetically, with the active ingredient being a surface active agent or surfactant. They are anionic, cationic or non-ionic in nature. Detergents may be based on vegetable fats, animal fats, petrochemical sources or be solely derived from petroleum. They have a variety of domestic and commercial applications including washing-up liquids, laundry products and toiletries.

Until the First World War, only soaps were available and these were manufactured from natural fats and oils. 'Synthetic soaps' or detergents were developed as a result of shortages of these fats and oils during the war. They were based on the alkylbenzene sulphonates that were derived from propylene, which was in turn derived from crude oil. Alkylbenzene sulphonates remain the basis for detergent manufacture today.

Detergent manufacture increased greatly during the following decades. Detergents were popular with manufacturers because the price of crude oil was more stable than vegetable oils. Customers liked them because they did not create scum in hard water.

However, by the 1960s, detergents entering rivers from sewage outfalls caused serious problems of foaming. The foam was an environmental as well as an aesthetic problem because it reduced the availability of oxygen at the air-water interface. The problem arose because sewage treatment did not degrade branched hydrocarbon chain surfactants which, on reaching the turbulent and mixing conditions in receiving waters, foamed. This was overcome in the 1960s by using straight-chain (unbranched) molecules which were biodegradable in sewage works.

From the late 1950s until the early 1970s, the number of soap and detergent manufacturing establishments remained relatively constant at around 200 sites. The majority of manufacturing output is now based around a few large facilities located in industrialised areas, with smaller facilities producing for more specialised markets being more evenly spread around the United Kingdom. The industry is based mainly in the South East and the North West, but the soap manufacturing industry has additional centres in Nottingham and Bradford.

2. Processes

2.1 Raw materials

2.1.1 Soap

The manufacture of soap involves utilising various oils and fats to produce soaps with the optimum qualities for their required purposes. A variety of combinations of oils and fats can be used and selection is usually based on quality of oil, desired product properties and current market costs. All naturally occurring oils and fats used in soap making are composed of triglycerides, each molecule of which contains a backbone of glycerol bonded to three fatty acid chains.

The main raw materials are as follows:

Tallow

Obtained by rendering beef or mutton. It is a hard, almost white fat, high in long-chain fatty acids. This produces a soap which dissolves slowly and with a thick lasting lather which is mild and has good cleaning properties.

Palm oil

Produced by the pressing of the palm fruit. Palm oil has slightly different proportions of fatty acids than tallow and produces soaps which are slightly softer and more soluble than tallow soaps.

Coconut oil

Produced by pressing the white flesh of the coconut. Coconut oil is high in shorter-chain fatty acids which give a quick forming lather, consisting of large open bubbles that are not very stable, but with excellent cleaning properties. The soap can, however, be aggressive to the skin in large quantities.

Palm kernel oil

Processed in the same way as palm oil with properties similar to coconut oil due to a similar fatty acid distribution.

Other materials

These include abrasives eg talc, diatomaceous earth, silica, marble, volcanic ash, chalk, feldspar, quartz or sand. A variety of pigments, dyes, perfumes and anti-oxidants can also be added to produce speciality products. The quantities used are small in comparison to the main raw materials.

2.1.2 Detergent

The manufacture of detergents involves the manufacture of the surfactant, followed by the addition of other ingredients in appropriate quantities. The raw materials for surfactant manufacture are petrochemically derived alkylbenzenes, fatty alcohols and sulphuric or pyrosulphuric acid.

Other chemicals required (see Annex) for detergent manufacture include builders (materials which prevent scum formation), corrosion inhibitors, soil suspending agents, oxidising agents, optical brighteners, enzymes, alcohols, oil feedstocks, mild acids, naphtha, neutralisers, anti-oxidants, dyes, perfumes and anti-foaming agents.

2.2 Delivery, handling and storage of raw materials

Major raw materials are transported to the site by tankers and stored in bulk tanks and tank farms on site in bunded areas. Minor raw materials are transported and stored in a similar manner but in smaller quantities.

The nature of the industry means that handling of raw materials is largely carried out in bulk. The tankers are unloaded in an unloading bay that has facilities for the raw materials to be pumped into bulk tanks or to tank farms. Where the raw materials concerned are stored in drums on site, the drums will normally be unloaded from the vehicle by a fork-lift truck.

2.3 Manufacturing processes

2.3.1 Soap

Before the oils and fats are made into soap, they may first be bleached to remove excess colour and impurities. One method involves passing the oil/fat over activated Fuller's Earth in the presence of an acid at 90°C, on to which the colours and impurities are adsorbed. The oil is then filtered to remove the Earth.

Soap manufacture occurs by saponification which is shown by the following reaction:



Alternatives to sodium hydroxide may be used. The manufacture of some soaps incorporate potassium hydroxide or amine neutralised processes.

There are two main methods of manufacturing soap still in use today:

Batch method

This is the traditional method and is still used for speciality products or at smaller facilities. The soap is produced by saponifying the oils and fats in a soap pan or kettle as follows:

A slow incubation period during which sodium or potassium hydroxide is gradually added to the triglyceride.

A rapid exothermic stage during which the temperature of the soap mass must be carefully controlled and in which the alkali is rapidly used up.

A gradual completion stage.

Continuous process

The continuous saponification process has become increasingly popular over recent years and has a number of variations. The oils/fats are added to sodium hydroxide in the presence of steam and mixed in a hydrolyser. This produces soap and glycerol as outlined above.

Further processes

The next stage in both methods is to separate the soap from the glycerol (called the washing operation) by adding brine to the soap/glycerol mix. The glycerol layer is recovered and refined by distillation. The soap is then mixed with more salt/caustic soda to obtain the correct viscosity/consistency of soap, in an operation called 'fitting'.

After fitting, the liquid soap (known as neat soap), which normally contains 63% total fatty matter (TFM), is then dried, for example in a flash vacuum chamber, to form a semi-plastic soap noodle or chip which is 80% TFM. At the drying stage, chelating agents are added such as EDTA (ethylenediamine tetracetic acid) which remove mainly iron and copper that would otherwise catalyse the decomposition of the soap to a malodorous rancid material and also act as softeners. The soap noodle is then converted into a bar in the 'finishing process'.

For normal toilet soaps, additives such as colorants, perfumes, superfatting agents and titanium dioxide (which reduces the transparent nature of soap) are mixed with the soap noodles. Medicated or shaving soaps require other additives (see the profile on cosmetics and toiletries manufacture, Section 4). This mix is run through a soap mill, with very fine gaps (0.15-0.20 mm), which disperses the additives throughout the soap and also removes any small over-dried soap particles. The soap mix is then 'plodded', which involves compressing the soap under vacuum to remove any trapped air and then extruding the soap into a hard bar. This bar, or billet, can then be stamped into any shape required and cartoned or wrapped ready for sale.

2.3.2 Detergent

Synthetic detergents are based upon the surface active ingredient or surfactant. Surfactant molecules are composed of groups of opposing solubility tendencies, for example a hydrophobic (oil-soluble) hydrocarbon chain and a hydrophilic (water soluble) ionic or non-ionic group. The classification of surfactants is based upon the ionic charge of the water-soluble group as follows:

Anionic surfactants

Those in which the water-soluble group has a negative charge (usually a sulphonate group). These account for approximately 60% of the total surfactants used in the detergent industry. The major types of anionic surfactants (see Annex) are all produced using similar methods, for example by the sulphonation of petroleum feedstocks using sulphuric acid. The products may then be neutralised to form a water-soluble sodium salt.

Non-ionic surfactants

Those in which the water-soluble group has no net charge. They account for approximately 30% of the surfactants used in the detergent industry and are almost exclusively addition products of ethylene oxide or propylene oxide. The hydrophilicity (affinity for water) is provided by hydrogen bonding with the water molecules. Non-ionic surfactants are used in a wide range of applications, for example in washing-up liquids.

Cationic surfactants

Those in which the water-soluble group has a positive charge (eg ammonium group). They account for less than 10% of the surfactants used in the detergent industry, are seldom found in washing powders but are widely used in fabric conditioning liquids.

The production of anionic surfactants, the commonest type used, involves an initial reaction comprising the addition of alkylbenzene and oleum in the sulphonator; the fatty alcohol is added to this mixture after the reaction has begun. The mixture is then neutralised by the addition of sodium hydroxide to produce a surfactant slurry. The slurry passes into a reaction vessel, known as a 'crutcher', along with sodium

tripolyphosphate (the builder) and other additives. During this phase, water is removed and the tripolyphosphate salt helps to thicken the mixture. The final stage is drying. This is carried out by pumping the mixture to a high level and spraying it against a counter current of hot air to produce small particles of the finished detergent. This is only required for conventional phosphate-built detergents, not the newer compact (ultra/micro) detergents or heavy duty liquid detergents.

The caking of powder on storage is avoided by use of various additives. Liquid synthetic detergents may be mixed with other liquid or solid raw materials to produce liquid fabric washing products, with various compounds used as solubilisers (see Annex).

2.4 Ancillary activities

A number of supporting activities are necessary for the running of the plant and production processes. These include, for example, oil-fired boilers, with the necessary oil storage tanks. Similarly, coal fired boiler systems may have existed. Buildings on site may have contained asbestos insulation or cladding, and the electrical equipment may contain polychlorinated biphenyls (PCBs). Some plants may have had effluent treatment facilities.

2.5 Wastes

A soap or detergent manufacturing facility commonly generates aqueous process wastes, which are often recycled after the removal of solids and other constituents, as well as cooling water which is generally recycled.

Wastes may also originate from research and development activities, as returned products, reject batches or as sludge from biological treatment or neutralisation of liquid effluents.

The storage of waste depends on its physical state. Liquid waste can be stored in sumps, drums or tanks depending on the volume and ultimate destination of the waste.

The soap or detergent manufacturing processes also produce glycerol as a by-product which is generally stored until it can be sold.

3. Contamination

The contaminants on a site will largely depend on the history of the site and on the range of materials produced there. Potential contaminants are listed in the Annex and the probable locations on site of the main groups of contaminants are shown in Tables 1a and 1b. It is most unlikely that any one site will contain all of the contaminants listed. It is recommended that an appropriate site investigation be carried out to determine the exact nature of the contamination associated with individual sites.

The soap and detergent manufacturing industry uses a wide range of chemicals that could cause ground contamination, including acids, alkalis and organic solvents.

3.1 Factors affecting potential contamination

Detergents may have more potential for ground contamination than other substances because of their hydrophobic and hydrophilic nature. Tables 1a and 1b indicate the likely general locations on site where particular groups of potential contaminants might originate. However, due to, amongst other things, their different mobility potentials, the locations indicated may not fully reflect where those contaminants may be encountered.

The distribution of any contaminants across the site due to leakages or spillages, for example, will tend to be concentrated around the storage areas (including storage tanks), unloading and loading facilities or bays and around the routes of any on-site pipelines that are used to carry materials.

Therefore, the potential for ground contamination will be related to the engineering standards of the area, such as concrete bases and plant housekeeping. Tanks and drums in specially engineered and bunded areas will be of less concern than those stored otherwise.

There is also potential for contamination of soil and groundwater if any of the structures holding waste fail. The extent of this depends on the age and engineering design of the plant. Surface water soakaways on any site with a long history of industrial use will also be possible areas for contamination.

Asbestos contamination may be present in any area where pipes, conveyor belts or chimneys were located, particularly where steam raising took place. In addition, the building fabric may have had asbestos fire insulation or cladding to roofs. There may be contamination from PCBs in electrical substations. Plant rationalising or demolition works in the past could have caused contamination, or moved it elsewhere on site.

3.2 Migration and persistence of contaminants

3.2.1 Organic compounds

The organic solvents liable to be encountered are volatile and have moderate to high vapour pressures. They readily partition from the liquid phase to the vapour phase resulting in high concentrations in the soil pore space above the saturated zone. Close to the soil surface some will be lost directly to the atmosphere by evaporation. Free phase product consisting of some of the less soluble

components or solvents, eg toluene, also tend to migrate to the water-table. In most cases such compounds are less dense than water and therefore float on the surface of the water-table. The more soluble organic solvents, including the alcohols and methylated spirits, readily migrate through the soil system and eventually to groundwater. Although the solubilities of organic compounds, such as toluene or some of the oils used in the manufacturing processes are relatively low, their dissolved concentrations may be several orders of magnitude greater than water quality standards permit and may be increased through co-solvency effects, particularly if spilt with surfactants.

Overall, the transport and fate of the organic compounds within the sub-surface environment are dependent upon a number of physical, chemical and biological factors. The higher the organic matter and clay content within the soil, the greater the degree of adsorption of the organics and the greater the reduction in the degree of contaminant migration. Therefore, the greatest degree of migration will occur in coarse-grained sands and gravels with little organic matter. Less soluble aromatic compounds can become absorbed on to clay or organic matter and so can provide on-going sources of water pollution long after the source has been removed, by continuing to desorb into soil-water. The risk from buried organics to current and potential water supplies may therefore be considerable.

Natural biodegradation may result in a significant removal of some organic compounds, particularly some of the alkylbenzenes and the natural oils. However, some potentially biodegradable compounds may persist due to environmental conditions unfavourable for microbial activity, for example acidic or alkaline conditions caused by spills. It is possible that partial degradation may result in the production of more polar intermediates from the parent compounds, some of which may be more mobile. Although some of the potentially biodegradable oils and fatty alcohols are not particularly mobile and largely insoluble, leachate passing through such contaminated soil may become highly charged with breakdown products of these compounds resulting in a leachate with a high Biochemical Oxygen Demand (BOD).

3.2.2 Metals

The movement of metals through the soil is significantly retarded by the presence of clay minerals and organic matter. The solubility of some metals may increase under acidic conditions. In other cases the relationship is more complex.

3.2.3 Other factors

Asbestos is neither soluble or biodegradable and persists in the soil.

Wind dispersion of contaminated soil may be a further transport mechanism, if there is gross surface contamination by some of the less mobile contaminants, for example metals and asbestos.

PCBs are fat-soluble, and have a propensity to accumulate in food chains.

4. Sources of further information

4.1 Organisations

For further information concerning the soap and detergent manufacturing industry in the United Kingdom, the following organisations should be consulted:

Society of Chemical Industry
14/15 Belgrave Square
London
SW1X 8PS

The Soap and Detergent Industry Association
PO Box No. 9
Hayes Gate House
Hayes
Middlesex
UB4 0JD

The United Kingdom Chemical Industries Association Limited
Kings Buildings
Smith Square
London
SW1P 3JJ

4.2 Sources of information concerning the activities described in this profile

Austin G T. *Shreve's chemical process industries*. 5th Edition. McGraw-Hill, London, 1984.

Dragun J. *The soil chemistry of hazardous materials*. Hazardous Materials Control Research Institute, Silver Spring, MD, USA, 1988.

Eckroth D, Graber E, Klingsberg A and Siegel P M. *Kirk-Othmer concise encyclopaedia of chemical technology*. John Wiley and Sons, Chichester, 1985.

Information on researching the industry of sites may be found in:

Department of the Environment. *Documentary research on industrial sites*. DOE, 1994.

4.3 Related DOE Industry Profiles

Chemical works: cosmetics and toiletries manufacturing works
Chemical works: organic chemicals manufacturing works

4.4 Health, safety and environmental risks

The Notes issued by the Chief Inspector of Her Majesty's Inspectorate of Pollution (HMIP) provide guidance for the processes prescribed for integrated pollution control in Regulations made under the Environmental Protection Act 1990.

The Control of Substances Hazardous to Health (COSHH) Regulations 1994 and the Management of Health and Safety at Work Regulations 1992 are available from HMSO. Information on relevant health and safety legislation and approved codes of practice published by HSE publications are available from Health and Safety Executive Books, PO Box 1999, Sudbury, Suffolk, CO10 6FS (telephone 01787 881165), as well as HMSO and other retailers.

Information on the health, safety and environmental hazards associated with individual contaminants mentioned in this profile may be obtained from the following sources:

Howard P H. *Handbook of environmental fate and exposure data for organic chemicals*. Vols I and II. USA, Lewis Publishers, 1990.

Sax N and Lewis R. *Hazardous chemicals desk reference*. New York, Van Nostrand Reinhold Company, 1987.

Verschueren K. *Handbook of environmental data on organic chemicals*. 2nd Edition. New York, Van Nostrand Reinhold Company, 1983.

4.5 Waste disposal and remediation options

Useful information may be obtained from the Department of the Environment series of Waste Management Papers, which contain details of the nature of industrial waste arisings, their treatment and disposal. A current list of titles in this series is available from HMSO Publications Centre, PO Box 276, London, SW8 5DT.

Publications containing information on the treatment options available for the remediation of contaminated land sites, prepared with the support of the Department of the Environment's Research Programme, can be obtained from National Environmental Technology Centre Library, F6, Culham, Abingdon, Oxfordshire, OX14 3DB.

A full list of current titles of Government publications on all aspects of contaminated land can be obtained from CLL Division, Room A323, Department of the Environment, Romney House, 43 Marsham Street, London, SW1P 3PY.

Advice on the assessment and remediation of contaminated land is contained in guidance published by the Construction Industry Research and Information Association (CIRIA), 6 Storey's Gate, Westminster, London, SW1P 3AU.

Annex Potential contaminants

The chemical compounds and other materials listed below generally reflect those associated with the industry and which have the potential to contaminate the ground. The list is not exhaustive; neither does it imply that all these chemicals might be present nor that they have caused contamination.

Soap works

Organic	oils eg tallow oil, tall oil, palm oil, coconut oil, castor oil, olive oil lanolin acids eg naphthenic acid phenol (carbolic acid) triglyceride ($(*RCOO)_3C_3H_5$) soap ($*RCOO Na$) glycerol ($C_3H_5(OH)_3$) alkylbenzene sulphonates ethylenediamine tetracetic acid (chelating agent) polycyclic aromatic hydrocarbons <small>*R = a hydrocarbon chain</small>
Inorganic	sodium hydroxide (caustic soda) sodium tripolyphosphate (STPP) potassium hydroxide sodium chloride solution (brine) titanium dioxide (pigment)
Others	dyes anti-oxidants

Detergent manufacture

Acids	sulphuric pyrosulphuric (oleum ($H_2S_2O_7$)) is a mixture of sulphuric acid and sulphur trioxide) sulphonic hydrochloric chlorosulphonic
Inorganic	sulphate sodium or magnesium silicate aluminium borate magnesium phosphate sodium carbonate (soda ash) zinc oxide

Organic	alkylbenzenes fatty alcohols (lauryl alcohol) isopropyl alcohol toluene industrial methylated spirits (a mixture of ethanol and methanol) carboxymethyl cellulose (soil suspending agent)
Anionic surfactants	sulphonated aromatic/aliphatic hydrocarbons eg linear alkylbenzene sulphonates sulphonated α -olefins sulphated fatty alcohols/acids sulphonated maleic esters carboxymethylated fatty acids phosphated alcohol ethoxylates
Non-ionic surfactants	ethylene oxide/propylene oxide products eg fatty alcohol ethoxylate (fatty acid alkanolamide)
Cationic surfactants	quaternary ammonium salts alkylpyridinium salts alkylimidazolium salts
Additives	eg sodium or magnesium sulphates magnesium phosphate sodium benzoate
Solubilisers (for liquid detergents)	urea alcohols triethanolamine

General potential contaminants

Polychlorinated biphenyls (PCBs)

Asbestos

Fuel oils

Coal and ash

Effluent treatment chemicals

Table 1a Main groups of contaminants and their probable locations**Chemical works: soap manufacturing works**

Contaminants		Location								
		Raw materials deliver/ storage/ transfer	Process areas	Waste storage	Waste disposal	Process pipework/ pumps	Drainage system/ soakaways	Fuel storage/ pipework	Electrical transformer areas	Effluent tanks, pipework and pumps
Main groups	Sub-groups									
Inorganic compounds										
Alkalis										
Asbestos			1			2				
Organic compounds	vegetable oils									
	phenols									
	alcohols, glycols and derivatives									
	polycyclic aromatic hydrocarbons (PAHs)									
Polychlorinated biphenyls (PCBs)										
Fuels (eg oil, coal)										

¹building fabric²steam mains

Shaded boxes indicate areas where contamination is most likely to occur.

Table 1b Main groups of contaminants and their probable locations

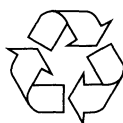
Chemical works: detergent manufacturing works

Contaminants		Location								
		Raw materials deliver/storage/transfer	Process areas	Waste storage	Waste disposal	Process pipework/pumps	Drainage system/soakaways	Fuel storage/pipework	Electrical transformer areas	Effluent tanks, pipework and pumps
Main groups	Sub-groups									
Metalloids and metal compounds (principally zinc oxide)										
Inorganic compounds										
Mineral acids										
Alkalis										
Asbestos			1			2				
Organic compounds	alcohols, glycols and derivatives									
	alkylbenzenes									
Polychlorinated biphenyls (PCBs)										
Fuels (eg oil, coal)										

¹building fabric

²steam mains

Shaded boxes indicate areas where contamination is most likely to occur.



Recycled paper

DOE Industry Profiles

Airports
Animal and animal products processing works
Asbestos manufacturing works
Ceramics, cement and asphalt manufacturing works
Chemical works: coatings (paints and printing inks) manufacturing works
Chemical works: cosmetics and toiletries manufacturing works
Chemical works: disinfectants manufacturing works
Chemical works: explosives, propellants and pyrotechnics manufacturing works
Chemical works: fertiliser manufacturing works
Chemical works: fine chemicals manufacturing works
Chemical works: inorganic chemicals manufacturing works
Chemical works: linoleum, vinyl and bitumen-based floor covering manufacturing works
Chemical works: mastics, sealants, adhesives and roofing felt manufacturing works
Chemical works: organic chemicals manufacturing works
Chemical works: pesticides manufacturing works
Chemical works: pharmaceuticals manufacturing works
Chemical works: rubber processing works (including works manufacturing tyres or other rubber products)
Chemical works: soap and detergent manufacturing works
Dockyards and dockland
Engineering works: aircraft manufacturing works
Engineering works: electrical and electronic equipment manufacturing works (including works manufacturing equipment containing PCBs)
Engineering works: mechanical engineering and ordnance works
Engineering works: railway engineering works
Engineering works: shipbuilding, repair and shipbreaking (including naval shipyards)
Engineering works: vehicle manufacturing works
Gas works, coke works and other coal carbonisation plants
Metal manufacturing, refining and finishing works: electroplating and other metal finishing works
Metal manufacturing, refining and finishing works: iron and steelworks
Metal manufacturing, refining and finishing works: lead works
Metal manufacturing, refining and finishing works: non-ferrous metal works (excluding lead works)
Metal manufacturing, refining and finishing works: precious metal recovery works
Oil refineries and bulk storage of crude oil and petroleum products
Power stations (excluding nuclear power stations)
Pulp and paper manufacturing works
Railway land
Road vehicle fuelling, service and repair: garages and filling stations
Road vehicle fuelling, service and repair: transport and haulage centres
Sewage works and sewage farms
Textile works and dye works
Timber products manufacturing works
Timber treatment works
Waste recycling, treatment and disposal sites: drum and tank cleaning and recycling plants
Waste recycling, treatment and disposal sites: hazardous waste treatment plants
Waste recycling, treatment and disposal sites: landfills and other waste treatment or waste disposal sites
Waste recycling, treatment and disposal sites: metal recycling sites
Waste recycling, treatment and disposal sites: solvent recovery works
Profile of miscellaneous industries incorporating:
Charcoal works
Dry-cleaners
Fibreglass and fibreglass resins manufacturing works
Glass manufacturing works
Photographic processing industry
Printing and bookbinding works

Copies may be purchased from:

Publications Sales Unit
Block 3, Spur 7,
Government Buildings,
Lime Grove,
Ruislip, HA4 8SF

Price £10

Cheques payable to DOE.