Department of the Environment
Industry Profile

Chemical works

mastics, sealants, adhesives and roofing felt manufacturing works

Industry Profile sponsored by
Contaminated Land and
Liabilities Division

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).

ISBN 1 85112 297 4

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 (W S Atkins Environment)
British Adhesives and Sealants Association
The Association of British Roofing Felt Manufacturers Limited
The British Flat Roofing Council

DOE Industry Profile

Chemical works: mastics, sealants, adhesives and roofing felt manufacturing works

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: mastics, sealants, adhesives and roofing felt manufacturing works

1. Background

This profile covers the manufacture and packaging of materials, such as mastics, sealants, putties, adhesives, waterproofing compounds and roofing felt, used in the construction industry and for 'DIY' applications.

Other construction materials (timber, cement, bricks and asphalt) and animal-based adhesive products are covered in other profiles in this series (see Section 4).

Animal and vegetable-based glues have been manufactured for thousands of years. Adhesives continued to be manufactured solely from natural ingredients until the 20th Century, when synthetic chemicals became available.

Today, the majority of adhesives used in construction are based on synthetic materials. The main classes of synthetic adhesives are water-based adhesives (polymer emulsions), solvent-based adhesives (rubbers in an organic solvent), reactive adhesives (eg epoxies, the general name for products based on epoxy resins) and sealants (some formulations of which have good adhesive properties). Today, animal and vegetable-based adhesives have limited applications in the construction industry, but cellulose-based pastes are widely used to hang wallpaper.

The term 'sealants' includes materials such as joint sealants, gaskets, mastics and beading. Sealant manufacture has followed a similar course of development to adhesives, with natural materials being replaced by synthetic products, which have improved elastic and strength properties and increased functional life. However, there are a number of natural-based products, for example vegetable oil-based putties, still produced in the United Kingdom in significant quantities.

Roofing felt, a fibre mat soaked in a bituminous compound, has been used as a waterproofing layer in building construction for many years. Traditional felts are made from organic (rag), asbestos or glass fibres. Since the mid-1970s the trend has been to use polyester fibre mats. A wide variety of other substances are used for the waterproofing layer, for example mastic asphalt, polyester resins, plastics (typically polyvinyl chloride (PVC)) and rubbers. Remedial waterproofing measures utilise thin liquid-applied coatings which can be based on a number of chemicals, bitumen being the commonest substance.

Companies which became involved in the production of synthetic adhesives and sealants were generally already involved in the chemical industry or associated businesses. Therefore, manufacturers tend to be located in areas dominated by the chemical industry including Hull, the Midlands and Teesside. The production of synthetic waterproofing coatings and compounds also follows this geographical distribution.

Census of Production data indicate that the number of establishments manufacturing both synthetic and natural product-based adhesives increased from about 100 in 1948 to over 230 in 1993, when almost 60% of the works employed

fewer than 10 people. The number of roofing felt manufacturers employing more than 10 people decreased from 25 in 1930 to 15 in 1968. In 1995, the Association of British Roofing Felt Manufacturers Limited reported having 6 members, although it is believed several other companies in the United Kingdom produce roofing felt.

2. Processes

The manufacturing processes for the production of mastics, sealants, liquid waterproofing compounds and adhesives are fairly similar, involving the combination of various substances in a homogeneous mix to form final products which are then packaged in a variety of containers.

2.1 Raw materials and delivery

2.1.1 Sealants and solvent-based adhesives

The following raw materials are common to the manufacture of both sealants and solvent-based adhesives:

Organic solvents	This is a group of organic liquids used in various ways during the manufacturing processes. Examples include aromatic solvents (eg toluene), chlorinated solvents (eg methyl chloride), ethylene glycol, esters, ketones and alcohols.
Polymers and resins	The polymers are usually solid, although their precursors can be solid or liquid. Examples of this group are cellulose, epoxy resins, bisphenol-A and epichlorohydrin. The substances in this group may be pre-mixed with additives. Examples also include adhesives, such as polyvinyl acetate, and various polyurethane and latex-based compounds. Other groups include rosin-derived tackifiers and acrylic emulsions.
Plasticisers	These modify the plastic polymers to a softer, less brittle state and are mainly phthalate esters which are non-volatile, usually oily, liquids.
Driers	These additives are used in the manufacture of resins and include cobalt and manganese compounds.
Silanes	These mainly liquid products are used as adhesion promoters.
Biocides	Examples of the biocidal agents used in building products include arsine, phthalimide, nitrogen/sulphur heterocyclic compounds (eg pyrithione, pyrazophos and thioquinox) and elemental sulphur.
Fillers	This is a group of solid, usually inert, compounds which are used to 'bulk' certain products. Examples include barytes, limestone, whiting, carbon black and, in the past, asbestos.

2.1.2 Sealants

The following raw materials are used in the manufacture of sealants only:

Vegetable and mineral oils	These include soya bean oil, rape seed oil, linseed oil and petroleum oils.
Pigments	This is a large group of compounds, both organic and inorganic, including cadmium, lead and zinc salts, organic and inorganic peroxides and sulphates, such as sodium sulphate.
Anti-oxidants	These are added to polymer mixes to protect them from oxidation and include phenol and amine derivatives, for example phenyl-2-naphthylamine and p,p-diaminodiphenylmethane.
Ultraviolet absorbers	Benzotriazole is used to inhibit the ultraviolet degradation of products.
Flame retardants	These compounds are added to resins and polymers to give fire-proof qualities to the final product and include dicyandiamide and antimony compounds.

2.1.3 Adhesives

The following raw materials are used in the manufacture of adhesives only (see Section 2.1.1). The raw materials used are dependent on the type of adhesive for example water-based, hot melt or solvent-based.

Water-based adhesives

Water-based adhesives are comprised of polymer emulsions from a wide variety of chemicals for example polyvinyl acetate (PVA) and acrylics. Other constituents include:

Polymers	For example, ethylene vinyl acetate (EVA), polyurethane, styrene-butadiene rubbers (SBR), natural rubber latex and styrene acrylates.
Plasticisers	For example, phthalate esters eg dibutyl phthalate (DBP) and dimethyl phthalate (DMP); high boiling glycol esters eg butyl diglycol acetate.
Preservatives	For example, phenolics, formalin and thioazolones.
Fillers	For example, chalk and clays.
Others	Some two-pack adhesive systems include chromium compounds, aluminium salts and other metal salts, for example zirconium and organic cross-linking systems.

Hot melt adhesives
Hot melt adhesives comprise solid material requiring high temperature manufacture and application. The raw materials used include:

Polymers	Blends of EVA, synthetic waxes and synthetic resins, for example rosin esters and SBR.
Fillers	Thermally stable clays and oxides, for example titanium dioxide and silica.
Anti-oxidants	Butylated hydroxytoluene and derivatives.

2.1.4 Roofing felt
The raw materials for the manufacture of roofing felt are bitumen and fibrous mat. Bitumen contains a mixture of organic compounds including long-chain aliphatics, aldehydes, ketones, phenols, polycyclic aromatic hydrocarbons (PAHs) and amines. Polymer-modified bitumen can also contain styrene-butadiene, styrene or atactic polypropylene. Organic fibres include rag or paper, glass fibre, polyester and asbestos (no longer used). For further information regarding asbestos see the relevant profile listed in Section 4.

A wide variety of raw materials is needed to produce the paints, sealants and coatings used as waterproofing agents.

Raw materials are generally delivered by road, in tankers, drums or in bags.

2.2 Transfer and storage of materials on site

The transport of bulk solids on site is by pneumatic or mechanical conveyors. The transport of drums and bags is usually by pallet on fork-lift trucks. Liquids are transported in drums or transferred to bulk storage and then distributed by pump or gravity flow in pipelines.

Storage areas may be found within the manufacturing unit and also in adjacent designated storage areas. Today, bulk storage vessels are generally sited on impervious floors with bund walls. However, in the past, storage areas may not have been bunded and secured against leakage to the underlying ground. Underground storage tanks are common on older sites.

2.3 Manufacturing processes

Vegetable-based adhesives (principally methyl cellulose)
Cellulose is reacted with methyl chloride at high temperatures and pressures. The resultant product is normally a flaky solid. Biocidal agents are added to the product before packing.

Water-based adhesives
A fine polymer dispersion is formed by high intensity mixing of the polymer in water. The polymer emulsions are blended with other components in stirred mixers. Some operations will involve chemical reactions.

Solvent-based adhesives
A natural or synthetic rubber or polymer is mixed with organic solvent and additives in a closed mixing vessel to form an homogeneous product.

Reactive adhesives
These are normally manufactured as two-part systems, resin and hardener, which are packed separately and mixed before use. Epoxy resins are manufactured by the reaction of bisphenol-A and epichlorohydrin in a stirred reaction vessel. The vessel is heated and sodium hydroxide (caustic soda) is added. The epoxy resin formed by the reaction is filtered off, may be further purified by solvent distillation, and is then mixed with the required additives and packaged.

Sealants
The required raw materials are weighed and then added to a mixing vessel where the ingredients are batch mixed. The product is then discharged for packaging, which may be automatic or semi-automatic.

Roofing felt
Roofing felt is manufactured by first impregnating a carrier with bitumen and then coating it with a thicker layer, also of bitumen, on both sides. Both impregnation and coating are achieved by dipping the carrier in to baths containing hot molten bitumen. The finished surface is coated with sand or talc to avoid sticking in the roll. It is common for mineral flakes to be incorporated on one side during manufacture which obviates the need to apply a surface dressing later, after the felt has been laid on the roof.

Waterproofing compounds
These are produced as paints, sealants, tars etc. For details of paint manufacture, reference should be made to the relevant Industry Profile (see Section 4).

2.4 Waste management

In general, waste management policies have advanced significantly over the last 20 years, and waste minimisation, recycling, recovery and safe disposal to licensed landfills or incinerators are normal current practices. However, in the past, wastes could have been disposed of on site or to local landfills, into local watercourses or burned as fuel. The amounts of aqueous wastes generated by this industry are relatively small but may still contain significant quantities of solvents and oils. Oil traps or separators may be used to prevent spills reaching the sewer system. In the past, a significant quantity of solvent waste was generated at many sites manufacturing adhesives. Larger sites may have had their own wastewater treatment plants.

2.5 Ancillary activities

On-site generation of power and steam may be carried out using gas, coal or oil. Electrical substations may have contained transformers filled with polychlorinated biphenyls (PCBs) oils.

Solvent vapours and/or waste solvents may also be incinerated to provide heat for production processes. Alternatively, solvent recovery systems may be used to recover and clean the waste solvent.

Depending on the size and complexity of the site, laboratory facilities may have stored small quantities of chemicals.

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 Table 1. 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.

3.1 Factors affecting contamination

Contamination could result from leaks, spillages or on-site disposal of waste materials. Contamination of a site is most likely to have occurred in storage and handling areas where the potential for spillage and leakage was greatest. Each production unit will normally have had its own storage facilities for raw materials, products and wastes, near to the production area. Some substances (for example bulk liquids, liquid wastes and fuels) may have been stored in underground tanks. Leaks from tanks, pipework and other sub-surface infrastructure may have occurred for long periods of time before detection. Similarly, soakaways, drainage and sewer systems are potential areas of contamination.

It is likely that the most extensive contamination will occur through the release of organic solvents. Lubricating oils may have been used in machinery and vehicle maintenance. Contamination by mineral fillers and non-mineral oils, where present, is unlikely to present a significant environmental hazard unless the fillers included asbestos. Metal contamination arising from its presence in driers, stabilisers, pigments and biocides may be of significance (particularly lead compounds and to a lesser extent cadmium and chromium compounds) but will tend to be confined to the surface layers of the soil. Such contamination may be less of an overall hazard owing to environmental factors limiting metal mobility (see Section 3.2).

Asbestos contamination may have arisen through its use as a fibre in roofing felt manufacture, or generally around the site following its removal from buildings or pipework, where it may have been used as cladding, roofing or insulation material. Electrical transformers or capacitors may have contained polychlorinated biphenyls (PCBs) as dielectric fluids; contamination may have occurred where these were dismantled or refilled.

3.2 Migration and persistence of contaminants

The organic solvents which may be encountered are mostly volatile and have moderate to high vapour pressures. They will occur in the vapour phase resulting in high concentrations in the soil pore space above the saturated zone. Close to the soil surface some solvent will be lost directly to the atmosphere by evaporation. Free phase product, consisting of the less soluble organic solvents or any oil hydrocarbons present, will tend to migrate to the water table. In most cases, such compounds are less dense than water and will therefore float on the surface of the water table. The more water-soluble organic compounds, such as acetic acid,

ethylene glycol and methanol, will readily migrate through the soil system and eventually to groundwater. Although the solubility of some of the other organic compounds is relatively low, their dissolved concentrations may be several orders of magnitude greater than water quality standards permit. Consequently they may pose a significant risk to current and potential water supplies.

Significant spillages of solvents into the soil may accelerate the migration of some of the organic compounds which have low solubility in water but are readily soluble in organic solvents. Such solvents could, therefore, increase the potential for groundwater contamination by these organic compounds, for example some of the organic pigments, chlorinated hydrocarbons, asphalt components (eg polycyclic aromatic hydrocarbons), plasticisers and possibly even some of the resin-associated materials. Lateral movement through the soil either in the dissolved or free phase may also impact on surface waters.

The transport and fate of both organic and inorganic compounds within the sub-surface environment will be dependent upon physical, chemical and biological factors. The higher the natural organic matter and clay content of the soil, the greater the degree of adsorption of organic compounds and the slower they migrate. The greatest degree of migration will occur in coarse-grained sands and gravels with little organic matter. The less soluble organic compounds which become adsorbed on to clay or organic matter will provide ongoing sources of water pollution long after the source has been removed by continuing to desorb into the soil-water.

Biodegradation processes in soils can be influenced by a number of factors, namely moisture content, oxygen concentration and pH, acting separately or in combination. For example, low moisture content reduces microbiological activity, while high moisture content can reduce oxygen penetration and possibly lead to anaerobic soil conditions. Such conditions enhance the biodegradation of some materials, for example chlorinated compounds, while aerobic conditions are needed to biodegrade many oils. Low pHs tend to reduce the bacterial population and encourage fungal activity; at pHs lower than 5, microbiological activity is much reduced. The presence of heavy metals also inhibits micro-organisms. As a result of these factors, at high concentrations in soil, even relatively non-persistent compounds may not biodegrade readily.

Water-based adhesives will eventually biodegrade. Although not considered generally hazardous, their potential for pollution when entering water courses is high.

The movement of metals through the soil is significantly retarded by the presence of clay minerals and organic matter. The solubility of some metals (for example zinc and lead) may increase under acidic conditions. In other cases the relationship is more complex. For example, arsenic may become more soluble at higher pHs and lead is generally precipitated as hydroxide, phosphate or carbonate under alkaline conditions.

PCBs are insoluble in water but are fat-soluble and have a propensity to accumulate in food chains.

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. Asbestos is neither soluble or biodegradable.

4. Sources of further information

4.1 Organisations

For information concerning the mastics, sealants and adhesives manufacturing industry in the United Kingdom, the following organisations should be consulted:

The Association of British Roofing Felt Manufacturers Limited
38 Bridlesmith Gate
Nottingham
NG1 2GQ

The British Adhesive and Sealants Association Limited
35 Fellowes Way
Stevenage
Hertfordshire
SG2 8BW

The British Flat Roofing Council
38 Bridlesmith Gate
Nottingham
NG1 2GQ

The National Council of Building Material Producers
The Building Centre
26 Store Street
London
WC1E 7BT

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.

British Adhesives and Sealants Association. *Adhesives and sealants year book and directory.* Published annually.

De Bussy. *Materials and technology.* Longmans, London. 1968.

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

Encyclopaedia of Polymer Science and Engineering. Wiley, USA. 1985.

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

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

4.3 Related DOE Industry Profiles

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: linoleum, vinyl and bitumen-based floor covering manufacturing works
Chemical works: rubber processing works (including works manufacturing tyres or other rubber products)
Gas works, coke works and other coal carbonisation plants
Timber products manufacturing works
Waste recycling, treatment and disposal sites: solvent recovery sites

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. Series 4 of the Process Guidance Notes covers many aspects of the Chemical Industry Sector.

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. Of particular relevance is:

> **Department of the Environment.** *Special Wastes: a technical memorandum providing guidance on their definition.* Waste Management Paper No. 23. London, HMSO, 1981. New edition in preparation.

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.

Contaminants relevant to both sealant and adhesive manufacture

Metals and metalloids	arsenic barium cadmium chromium cobalt lead manganese
Inorganic elements and compounds	mineral acids alkalis eg sodium hydroxide (caustic soda) silanes (adhesion promoters) sulphur
Organic compounds	solvents eg aliphatic hydrocarbons aromatic hydrocarbons aldehydes alcohols ketones carboxylic acids esters glycols chlorinated aliphatic compounds, particularly chloromethane and dichloromethane plasticisers eg phthalate esters amines polymers and resins eg 2,2-bis(p-hydroxyphenyl) propane (bisphenol A) epichlorohydrin anti-oxidants eg phenyl-2-naphthylamine p,p'-diaminodiphenylmethane
Pesticides/biocides	phthalimide heterocyclic nitrogen/sulphur compounds eg pyrithione pyrazophos thioquinox formaldehyde

Contaminants relevant to sealant manufacture only

Organic compounds	mineral oil petroleum hydrocarbons methanol (formed from the breakdown of silicone sealants) benzotriazole (ultraviolet absorber) dicyanodiamide (flame retardant)
Metals and metalloids	antimony zinc
Inorganic ions	sulphates

Contaminants relevant to roofing felt manufacture

Polyester	
Asbestos	not now used
Constituents of bitumen	long chain aliphatics aldehydes ketones phenols polycyclic aromatic hydrocarbons (PAHs) amines polymer-modified bitumen including styrene-butadiene styrene atactic polypropylene

General contaminants

Fuel oils

Coal

Polychlorinated biphenyls (PCBs)

Asbestos

Lubricating oils

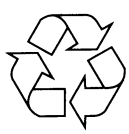
Table 1 Main groups of contaminants and their probable locations

Chemical works: mastics, sealants, adhesives and roofing felt manufacturing works

Main groups of contaminants	Location													
	Raw materials delivery/storage				Transport/ handling	Manufacturing process				Waste management	Solvent recovery	Heating systems and fuel storage	Electrical substations	Building fabric/ pipework/ pumps
	A	B	C	D		A	B	C	D					
Metal, metalloids and their compounds	■	■		■	■	■	■		■	■				
Inorganic compounds	■	■		■	■	■	■		■	■				
Organic compounds	■	■	■	■	■	■	■	■	■	■	■			
Pesticides and biocides	■	■		■	■	■	■		■	■				
Fuels												■		■
Asbestos	■	■	■		■	■	■	■		■				■
Polychlorinated biphenyls (PCBs)													■	

A Adhesives
B Sealants
C Roofing felt
D Waterproofing materials

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

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