

Chemical works

fine chemicals 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).

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DOE Industry Profile

Chemical works: fine chemicals manufacturing works

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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: fine chemical manufacturing works

1. Background

Fine chemicals are those which are manufactured to high and well-defined standards of purity. They include dyestuffs, pigments and their intermediates, intermediates for the pharmaceuticals and pesticides industries, high purity laboratory reagents, vitamins, food additives, high purity solvents and specialist high purity gases for laboratory, industrial and medical uses. Photographic chemicals, pharmaceutical active ingredients, perfumes and pesticides are also classed as fine chemicals but are dealt with in separate profiles (see Section 4).

The historical development of the fine chemical manufacturing industry in the United Kingdom is closely related to the emergence and development of synthetic dyes for the textile industry in the 19th Century. During the 1850s, chemists working with coal tar distillates synthesised the first synthetic dyes.

Research effort resulted in the synthesis of a wide range of complex organic chemicals which formed the building blocks of the emerging fine chemicals industry, particularly the pharmaceutical, pesticide and specialised organics sectors. A notable example is ICI Pharmaceuticals in the United Kingdom which grew out of the Dyestuffs Division of that company.

The presence of the textiles industry in the North-West led to the development of the fine chemicals industry in this area. Good port facilities for transport of bulk materials and the North Sea oil industry encouraged the fine chemicals industry to locate in the North-East. The distribution of this industry generally mirrors that of the chemicals industry as a whole, since fine chemicals manufacture in the past was typically carried out by an operating division of a large bulk chemicals manufacturer. However, the industry is now becoming more fragmented and there are a number of small specialised firms engaged in the manufacture of fine chemicals.

Approximately 80% of fine chemicals manufacture in the UK is currently located along the M62 motorway corridor, from Liverpool and Runcorn in the North-West, across Manchester, Leeds and Halifax, to Hull and Teesside in the North-East. The remainder of this industry is spread throughout the country with some concentrations around Bristol, Glasgow, Birmingham and South Wales.

2. Description of processes

Fine chemicals are not always produced on a small scale. Production may be measured in thousands of tonnes per year for certain food additives and drug intermediates. Although no single production process applies, most fine chemical manufacture is carried out in batch processes with synthesis being followed by separation and purification steps; typically, organic synthesis processes are the most complex. Plant is not dedicated to a single process; it is not unusual for a single plant to be capable of producing 100 separate products.

2.1 Raw materials and their delivery to site

The range and diversity of products categorised as fine chemicals means that an equally diverse range of raw materials is required as precursors. They are usually delivered to site by road, in containers ranging from 25 to 40 kg kegs through 200 litre drums to 1000 litre demountable tanks. Dry raw materials may be supplied in bags or sacks. Other principal deliveries to site will include carrier solvents, acids, bases and industrial gases.

Carrier solvents are used to transfer material mixes through the reaction steps. They may include a wide range of organic solvents including toluene, methanol, dichloromethane and acetone. Acids and bases are used as buffers in various reaction steps as well as in support services such as wet scrubber systems (acidic or alkali scrubber liquors), wastewater treatment (pH adjustment), and deionised water production (regeneration of ion-exchange beds). Carrier solvents, acids and bases are usually supplied in bulk and delivered by road tanker.

The following industrial gases are used: purge gases (such as nitrogen) and, in certain circumstances, the rare gases (argon, xenon, krypton etc). Hot nitrogen may also be used in product drying. Gases such as chlorine, hydrogen chloride, hydrogen etc, may also be used in reaction steps. Gases may be supplied in pressurised cylinders, demountable tanks or may be delivered in bulk by road tanker. The latter is most likely for bulk liquefied gases such as oxygen or nitrogen.

2.2 Raw materials storage and transfer

Drummed raw materials are usually stored inside purpose-built chemical storage warehouses, equipped with fire suppression equipment, secondary containment to receive spills and, in the event of emergency and fire practices, fire-fighting water. Certain storage methods may have been used in the past that are unacceptable today; these include storage in unprotected outdoor compounds with no spill protection or secondary containment.

Drummed materials are typically moved into and out of storage by fork-lift truck, using dedicated drum clamps. It is not uncommon (and in the past it would have been normal) for drums to be loosely stacked on pallets in transit to and from storage areas — a practice which may have led frequently to accidental spillage. Materials required for one batch process are usually transferred in a single operation. Inside the plant, drums are mostly transported on clamped drum trolleys.

Bulk liquids (solvents, acids and bases) are transferred directly to above- or below-ground bulk storage tanks. According to recommendations for good practice, these should incorporate secondary contained tankage and tanker off-loading stances, the provision of tank overfill protection systems and interlock systems, and adequate standard operating procedures to ensure the safe and secure off-loading of tankers. Less satisfactory procedures may have been common in the past.

Bulk liquids and gases are generally piped into the plant. Pipework is supported on overhead piperacks or is at ground level within lined pipe trenches. Underground pipework may be present in older facilities and could be a cause of leakage.

In the plant itself, raw materials are frequently charged to reactors through ports. Transfer is typically by barrel pump for liquids; dry materials are generally manually charged.

2.3 Outline of production processes

Process operations typically involve a batch reactor into which various raw materials, including catalysts, may be added along with a carrier solvent (eg toluene, methanol, acetone). The reaction may be carried out under pressure, under vacuum or at elevated temperatures. The reaction stage normally finishes with a product separation step involving filtration (eg under vacuum or pressure) and solvent extraction and/or distillation to remove the product from the mother liquors. For inorganic chemicals, one reaction stage is often sufficient, and there may be little or no wastage. Complex high-value organic chemicals, dyes or vitamins may require six or more stages, in which case the loss of yield at each step becomes very important. The raw material consumed can far outweigh the final product. The product is then dried either by vacuum techniques or by flow of heated nitrogen through the slurry. The product is removed and stored or may undergo further purification, depending on the required specification. The final solid or liquid is usually stored and then packaged into containers prior to distribution to customers.

2.3.1 Specialist gases

Specialist gases of high purity include oxygen, nitrogen, argon, neon, krypton and xenon, all of which can be manufactured as by-products from cryogenic air separation plants where the air is liquefied and distilled. Filtered air is compressed in a centrifugal compressor and is cooled to near its dew point, in order to dry it, in a heat exchanger. The resulting dry air is passed through an adsorber to remove traces of hydrocarbons and carbon dioxide, and from there into the bottom of the separation column. The column is operated under constant reflux with nitrogen and oxygen removal at the top and bottom respectively. Other gases are removed at differing column levels. Simpler pressure-absorption plants are used where only oxygen or nitrogen are needed. The gases are stored prior to shipment in bulk or pressurised containers.

2.3.2 Food additives

Food additives are generally those chemicals that are combined with foods to effect certain modifications; they include preservatives, colourants, flavourings and stabilisers. Common additives are propionic and benzoic acids (preservatives), acetic acid and sodium citrate (buffers), saccharin (sweetener), ascorbic acid (Vitamin C) and other vitamins, natural thickeners and spices and essential oils (flavourings). Food additives are typically organic compounds. Monosodium glutamate is a common additive used to enhance natural flavours. Its manufacture involves the fermentation of sugar and ammonia in a reactor, followed by centrifugation, evaporation and hydrolysis, normally in sodium hydroxide solution. The liquor is then neutralised and acidified prior to filtration. The pre-purification process involves crystallisation and colour removal by adding activated carbon. Purification is achieved by centrifugal separation, further crystallisations and product drying.

2.3.3 Dyestuffs and pigments

Dyestuffs and pigments are synthesised from a relatively small number of primary raw materials, principally cyclic aromatic compounds including benzene, toluene, xylenes, naphthalene and aniline; many aliphatic organics are also used. Inorganic feedstocks include sulphuric acid and oleum for sulphonation, chlorine and bromine for halogenation, nitric acid for nitration, sodium nitrite for diazotisation as well as hydrochloric acid, chlorosulphonic acid and ammonia. Batch processing remains the norm in the dye production industry with reaction steps being carried out in traditional cast iron, mild steel, glass-lined or stainless steel reactors. Typically, dye intermediates go to subsequent process steps in the liquid state, although vacuum dryers, spray dryers and rotary dryers may be used where appropriate.

2.4 Transfer of the finished product

The final product from the fine chemicals manufacturing industry comprises high purity chemical reagents of high value which form the raw material inputs to subsequent process industries. Products are typically packaged in 200 litre drums or smaller containers and stored in warehouses under carefully controlled conditions. Final products are usually despatched by lorry in mixed loads to customers.

2.5 Wastes

Wastes arising from fine chemicals manufacture will be wastewaters, liquid effluents, solid wastes and spent solvents.

Wastewaters are typically discharged via on-site treatment facilities to the sewer as trade effluent. On-site treatment may comprise simple primary settlement and pH adjustment or more sophisticated treatment such as anaerobic digestion or wet air oxidation.

Liquid effluents which cannot be discharged to wastewater treatment systems will typically be tankered to appropriate off-site treatment or disposal facilities, which may include co-disposal landfills, hazardous waste treatment plants (for neutralisation, precipitation etc) or high temperature incineration facilities. In the past, spillages were disposed to soakaways and drains.

Solid wastes will typically comprise purification residues such as spent activated carbon and will probably be disposed of off-site to landfill or high temperature incinerator as appropriate.

Spent solvents may be collected and recovered on site or sent for off-site recovery.

There may be on-site landfill sites or lagoons at older sites.

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

The types of chemical encountered at a particular facility will depend on the nature of the specific final products although a wide range of speciality organic chemicals will usually be involved, particularly in the following sectors:

- Dyestuffs, pigments and intermediates
- Intermediates for pharmaceuticals and pesticides
- Preservatives etc
- Vitamins and food additives.

A wide range of organic solvents is required in the production processes. Bulk quantities of acids and caustic solutions are used in pollution control equipment, such as wet scrubbers and wastewater treatment plants, and in deionised water production.

Fuel oil may be stored on site for heating and steam raising, particularly on older sites. Areas around such storage tanks could be contaminated as a result of spillage and leakage. In older sites, asbestos may have been used in pipe lagging and as asbestos sheet in plant construction. Electrical transformers may be a source of polychlorinated biphenyls (PCBs).

Contamination may occur on any part of a site as a result of spillage, leakage, accident or fire. Because of the high level of security today, material shipment and transfer are the most likely causes of contamination in modern plants. On older sites, soil contamination is typically associated with bulk solvent storage and transfer operations, particularly near underground tanks and tanker off-loading areas. Leakages may have occurred from tanks and pipework carrying solvent and other process chemicals and from product or waste streams. Solvent recovery plants are also potential areas of concern, as are underground effluent drains.

Surface water soakaways on any site with a long history of industrial use will be prime areas for contamination. Contamination is unlikely in interior storage areas for dry material but is possible in areas of exterior drum storage, particularly of waste materials (eg spent activated carbon sludge, distillation residues etc). Hazardous waste storage areas may be prone to soil contamination.

At old sites which manufactured dyestuffs starting with the distillation of coal tar, there may be significant quantities of tar distillation residues such as cresols and polycyclic aromatic hydrocarbons. If organic wastes were incinerated on site in the presence of chlorides, the presence of dioxins may be suspected. In the past, mercury was used in the manufacture of anthraquinone intermediates in dye manufacture.

It should also be noted that many sites have been occupied by the fine chemicals manufacturing industry over a considerable period, during which the nature of the activities and the physical location of plant buildings and storage areas may have changed and environmental security will have improved. Consequently, investigations must take site history into account and any on-site landfills, lagoons or soakaways which can be identified should be given particular attention.

3.2 Migration and persistence of contaminants

Where surface water is present there is a risk of contamination by all the contaminants listed in the Annex, especially by the more soluble organics such as the alcohols (eg methanol), acetone, ethyl acetate and phenols. The phenols are very mobile, particularly phenol itself, which is very soluble and can migrate considerable distances from its source. Phenols can also permeate water supply pipes of polymeric materials such as PVC and can attack the joints of metal pipes which are usually made of PVC or plastic sealing compounds.

Risks to groundwater may be similar to those stated above, the magnitude of the risk depending on the depth of the water-table and the strength and properties of the soil structure. Generally, the higher the organic matter and clay content within the soil, the greater the adsorption of organics and the lower their mobility. Conversely, the greatest migration of contaminants will occur in coarse-grained sands and gravels with little organic content. The most soluble compounds are the most mobile. The less soluble aromatic compounds which become adsorbed onto clay or organic matter may cause water pollution long after the original source has been removed, as a result of the chemical continuing to desorb and dissolve into soil-water. The risk from organic compounds in the soil to future water supplies may therefore be considerable.

Other less soluble solvents such as toluene, and spillages of oil hydrocarbons, will also tend to migrate to the water-table. These compounds are usually less dense than water and will float on the water-table surface. Chlorinated solvents (also of low aqueous solubility) are denser than water and will tend to migrate to the bottom of aquifers. They are persistent chemicals and can render groundwater unsuitable for public supply at low concentrations. Chlorinated solvents are one of the most common groups of pollutants of groundwater found beneath old industrial sites.

Most of the organic solvents liable to be encountered may be found in liquid or vapour form; close to the soil surface some of the organic solvents will be lost directly to the atmosphere by evaporation.

Some organic contaminants will naturally biodegrade (eg benzoic acid, acetic acid) but some (eg benzene, toluene, pyridine, petroleum hydrocarbons) may persist owing to unfavourable environmental conditions for degradation. Halogenated organic compounds may require highly specific conditions for biodegradation to take place, and may degrade very slowly. Dye-related compounds (eg anthraquinone) are only slightly or hardly water-soluble. They are likely to persist, or only be partially degraded, under normal soil conditions. Organosulphur compounds are mostly insoluble while organonitrogen compounds usually have low but significant solubility. They are likely to be persistent, their biodegradability decreasing with greater sulphur/nitrogen substitution. Tars may persist because of their insolubility and because of unfavourable environmental conditions for degradation. Asbestos, polychlorinated biphenyls (PCBs), metal

contaminants, mineral acids (eg sulphuric acid) and sodium hydroxide, are not biodegradable.

If contamination by organic solvents is widespread it may provide the opportunity for groundwater contamination by other organic materials which have low solubilities in water but are readily soluble in such solvents.

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 (eg. copper, zinc and lead). In other cases the relationship is more complex. For example, trivalent chromium is more soluble under acidic conditions, whereas the solubility of hexavalent chromium is increased under both acidic and alkaline conditions and arsenic may become more soluble at higher pH levels.

Wind dispersion of contaminated soil may be a further transport mechanism, but it is unlikely to be a major factor unless there is gross surface contamination by some of the less mobile contaminants such as asbestos. It is possible that plant buildings and infrastructure were insulated with asbestos lagging, or asbestos cement sheeting was used in roofing or cladding. This waste asbestos material may be found in discrete dumps on the site where plant has been dismantled or is still associated with existing buildings and plant.

PCBs and some of the halogenated organics are fat-soluble and have a propensity to accumulate in food chains.

Acid spillage near buildings may affect the integrity of concrete/cements used in foundations.

4. Sources of further information

4.1 Organisations

For further information concerning the fine chemicals manufacturing industry in the United Kingdom, the following organisations and trade associations should be consulted:

The British Association for Chemical Specialities Limited
The Gatehouse
White Cross
Lancaster
LA1 4XQ

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

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

The Specialised Organic Chemicals Sector Association
Kings Building
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. London, McGraw-Hill, 1984.

Department of the Environment. *Special waste*. Waste Management Paper No. 23. London, HMSO, 1982.

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

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

Kent, J A (editor). *Riegel's handbook of industrial chemistry*. Ninth edition. New York, Van Nostrand Reinhold, 1992.

Case study including information on fine chemicals

Paul V. *Bibliography of case studies on contaminated land: investigation, remediation and redevelopment*. Garston, Building Research Establishment, 1995.

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

Chemical works: cosmetics and toiletries manufacturing works
Chemical works: inorganic chemicals manufacturing works
Chemical works: organic chemicals manufacturing works
Chemical works: pesticides manufacturing works
Chemical works: pharmaceuticals manufacturing 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
Textile works and dye 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. Of particular relevance is:

Her Majesty's Inspectorate of Pollution. *Batch manufacture of organic chemicals in multipurpose plant.* Chief Inspector's Guidance to Inspectors, Process Guidance Note IPR 4/5. London, HMSO, 1993.

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:

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.

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

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.

Solvents (general use including food chemicals)	toluene methanol dichloromethane acetone
Inorganic compounds (food chemicals)	sodium hydroxide ammonium salts sodium nitrate sodium nitrite sodium metabisulphite titanium dioxide
Organic compounds (food chemicals)	propionic acid benzoic acid acetic acid ethyl acetate monosodium glutamate sodium citrate saccharin ammonium compounds phenols in flavourings such as thymol, eugenol terpenes such as menthol, Vitamin A
Inorganic compounds (excluding food chemicals)	sulphuric acid nitric acid chlorosulphonic acid hydrochloric acid sodium hydroxide sodium nitrite sodium sulphate chlorine compounds bromine compounds
Metals and metalloid compounds (excluding food chemicals)	vanadium trioxide arsenic pentoxide(fungicide) arsenic trioxide (dyeing mordant) arsenic trisulphide (pigment) lead cadmium mercury chromium in hexavalent form

Organic compounds
(excluding food chemicals)

benzene
toluene
xylenes
phenols
aminophenols
cresols
cresotic acid
aniline
acetic acid
ethyl acetate
benzoic acid
anthraquinone
halogenated organics
eg 2,4,6-trichloroanisole (dyeing),
chlorophenols, bromofluorobenzenes
aromatic amines
eg 2-naphthylamine, benzidine,
4-aminodiphenyl (used especially in dyes)
organo-sulphur compounds
eg dimethyl sulphate, thiophene, thiazole,
thiazol yellow, thiamorpholine
organo-nitrogen compounds
eg amines as above, nitriles, isocyanates,
carbarnates, 1H-pyrrole,
pyridine, diazines, triazines, quaternary
ammonium salts, nitrobenzenes
polycyclic aromatic hydrocarbons from coal tar;
eg naphthalene, benzo(a)pyrene

Fuel

coal
fuel oils

Asbestos

Polychlorinated
biphenyls

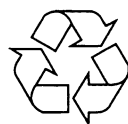
Dioxins

Table 1 Main groups of contaminants and their probable locations

Chemical works: fine chemicals manufacturing works

Contaminant		Location								
Main group	Sub-group	Building fabric	Raw material delivery and storage	Process areas	Tanks pipework and pumps	Product storage and blending	Waste storage/ on-site disposal	Wastewater treatment facilities	Fuel storage	Electricity substations and transformers
Metals and metalloid compounds	excluding food chemicals: metals and their salts									
Inorganic compounds										
Acids.	excluding food chemicals									
Alkalis										
Asbestos										
Organic compounds	solvents									
	food chemicals									
	excluding food chemicals									
	fuel oils									
	polychlorinated biphenyls									
	dioxins									

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
Gasworks, 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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