DEPARTMENT OF THE ENVIRONMENT

Waste Management Paper No 6

Polychlorinated Biphenyl (PCB) Wastes

A Technical Memorandum on Reclamation, Treatment and Disposal including a Code of Practice

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FOREWORD

This is a technical memorandum which deals with the possible sources and the disposal of polychlorinated biphenyl (PCB) wastes arising in, or imported into the UK. It applies, in addition, to analogous substances such as alkylated chlorobiphenyls and polychlorinated ter – and higher phenyls, which have as yet only restricted uses in the UK.

The memorandum has been prepared by the Department's Wastes Division. It is based largely on the informal report of a Sub-Group of the Department of the Environment's Working Group on Waste Disposal Legislation. The membership of the Sub-Group was as follows :

Chairman

Mr I Prestt, Central Unit on Environmental Pollution
Department of the Environment
at present Director, Royal Society for the Protection of Birds

Secretary

Mr J P Gilrow, Central Unit on Environmental Pollution
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Members

Dr H A Vodden Monsanto Chemicals Ltd

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Mr H Pullen also of Redland/Purle (attended on one occasion)

Mr R L Stanley Director, BEAMA Transmission and Distribution Association

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Mr A W Davies Chief Pollution Officer, Glamorgan River Authority

Mr G Davies also of Glamorgan River Authority filled this position on Mr A W Davies's appointment to a regional water authority

Mr M Stansfield Department of Industry

Mr A W Kenny, Mr R G D Osmond and Mr J Bentley of the Department of the Environment also participated.

The final chapter comprises a Code of Practice prepared in a form suitable for those requiring direct answers about disposal of PCB wastes.

1 BACKGROUND

1.1 PCBs are a range of substances consisting of a biphenyl molecule with or without alkyl or aryl substituents in which more than one chlorine atom is substituted in the biphenyl nucleus. As manufactured today they are mixtures of compounds chlorinated to varying degrees according to the intended use and may also contain low levels of such highly toxic impurities as chlorobenzothioxins and polychlorodibenzofurans.

1.2 It is believed that PCBs do not occur naturally. They are very resistant to chemical and biochemical degradation, their stability increasing with the degree of chlorination and therefore they persist in the environment. They are soluble in fats and oils and since they are only metabolized and excreted slowly, they accumulate in the fatty tissues of living organisms.

1.3 The pattern of their environmental behaviour and distribution is revealed by present environmental levels consequent on the previous uncontrolled use and disposal. They are widely distributed with high levels occurring in industrial areas (up to several hundred ppm in sediments near some industrial outfalls in the USA having been recorded) and very low levels elsewhere, typically 0·00001 ppm * in air and sea-water, less than 0·001 ppm in fresh water and less than 0·01 ppm in soil and submarine sediments.

1.4 However, aquatic organisms take up PCBs from water. The mean concentration in North Atlantic plankton is about 0·2 ppm. Levels up to 0·1 ppm in lobsters, 0·5 ppm in mussels and 2 ppm in herring have been reported. Predatory birds, particularly those feeding on aquatic organisms at the end of food chains, show the highest levels : 900 ppm has been reported in the liver of a UK heron.

1.5 Fortunately the end of this food chain is not of importance to man. In the great majority of his foods in the UK, the level is well below 0·05 ppm.

1.6 PCBs are sold under a variety of trade names which are given in Annex 1.

*1 ppm is one part per million.

1.6.1 Prior to 1973 they were used as dielectric fluids, hydraulic fluids, heat transfer fluids, lubricants and vacuum pump fluids and as plasticizers in adhesives, sealants, paints, plastics and carbonless copying paper.

1.6.2 In February 1973 the Council of the OECD agreed to confine their use to dielectric and hydraulic fluids, the latter application being limited to use in mining equipment for special duties. In the UK, the sole manufacturer has operated a more stringent voluntary control since 1971, restricting its sales to dielectric applications although providing samples for research purposes.

1.7 The general conclusion is that the use of PCBs should be restricted to applications where the employment of substitute products would present greater overall hazards and that their disposal should accord with the Code of Practice herein (section H).

1.8 The EEC will shortly be publishing two directives relating to PCBs; one dealing with the restrictions on marketing, and use which is closely aligned to OECD and UK production controls; and the other is concerned with the treatment and disposal of PCB waste.

2 NATURE OF WASTES AND ARISINGS

2.1 The wastes requiring disposal are:

2.1.1 those arising in the manufacture of PCBs, both solid and liquid

2.1.2 dielectric fluid removed from transformers because of degradation or contamination

2.1.3 dielectric fluid in scrapped transformers

2.1.4 dielectric of scrapped capacitors ex manufacture, and in redundant equipment

2.1.5 fluids replaced in "historical" non-dielectric uses or in scrapped equipment ie pre 1971 for applications employing PCBs of UK origin and pre 1973 for those employing PCBs from OECD.

2.1.6 PCB contaminated material eg scrap capacitor windings, absorbent material used in cleaning equipment or spills

2.1.7 imported wastes.

2.2 In the manufacturing process, the commercial material is distilled from a mixed chlorination product leaving the higher boiling fractions and substances formed by polymerization. These still bottoms range from tars to glasses; they are highly chlorinated, stable and therefore very persistent in the environment but are relatively immobile. In addition there are unwanted liquid fractions and contaminated cloths, paper, sawdust, Fuller's Earth, etc used to mop up spills and leaks arising in transfer and use and to clean out equipment. There is only one manufacturer in the UK. Current manufacturing waste arisings are about 400 tonnes of PCB pa of which [illegible] third is liquid the demand for PCB is static and [illegible] increase

2.3 Because of their high boiling point, [illegible] non flammability and dielectric characteristics, PCBs have been used in transformers since the 1940s. Prior to 1971 only some units carried labels warning users of the need for adequate disposal. Since 1971 new transformers have been so labelled and some manufacturers have contacted all their customers, even those who purchased units in the 1940s, advising them of the need for adequate disposal. Some retrospective labelling identifying this need has been carried out on the older equipment still in use

2.4 There are ten major UK manufacturers of transformers whose combined use of the more highly chlorinated transformer PCB fluids is about 300 tonnes pa of which about two-thirds is for the home market; the demand is static since the growing demand for transformers in this area is being met by the development of large dry-dielectric types and of alternative dielectric fluids such as those based on silicones, though the changeover is slow due to their higher cost. PCB-filled transformers are principally used where the consequences of fire from ignition of the dielectric, due to arcing or from an external source, would be serious eg in ships, basements of buildings and (but not in the UK) mines. However the dense fumes which are evolved when PCBs are subjected to high temperatures makes them unacceptable in some situations eg underground public transport systems.

2.5 Transformer dielectric fluids may be adversely affected by entry of water and the equipment operators are therefore advised to sample and analyse the fluid periodically. (The manufacturer of PCB provides an analytical service.) It may be necessary to replace the fluid because of contamination or breakdown. Since the life of large transformers is about thirty years, the UK is just coming to the period of substantial replacement of PCB-filled units. At present a few are scrapped annually with an average dielectric charge per unit of 1 tonne. It is expected that about 130 tonnes of PCBs will arise for disposal in 1985 (from both sources: rejected dielectric and scrapped transformers) and about 250 tonnes in 2000.

2.6 Large capacitors are used to smooth out large (shock) load fluctuations on industrial power supply systems. Many large factories are equipped with banks of them. The four major manufacturers use about 600 tonnes pa of the lower chlorinated PCBs for this purpose. The average content per unit is about 3kg with a range over all units of 0·75 to 30kg.

2.7 These capacitors first went into service in the late 1950s and since their life is about twenty-five years, waste from them is not yet significant. However, it is estimated that by the 1980s 130 tonnes PCB pa and by 2000 400 tonnes pa will arise for disposal.

2.8 There is no parallel to the transformer case of occasional replacement of the fluid in large capacitors due to deterioration.

2.9 Small PCB-filled capacitors are fitted to the starter units of fluorescent lights and fractional horse-power motors of the type used in domestic and light-industrial electrical equipment. Typically they contain about 50 g of the lower chlorinated PCBs, mostly absorbed in the windings. They carry no label identifying the PCB content. There are upwards of 100 million fluorescent

lights in use. The waste in these applications arises when the equipment is scrapped or (as rejects) during manufacture of the capacitors. Owing to the development of alternative capacitors and motor systems it is understood that the use is likely to decrease. At present the estimated use is 600 tonnes pa PCB in some 16 million units with a waste production of 250 tonnes pa which, it is estimated, will peak at 600 tonnes in 1980, or possibly sooner, and then decrease to 100 tonnes by 1990.

2.10 The use of PCBs for purposes other than those detailed above was about 100 tonnes in 1972/73. It has not been possible to estimate the current waste production for the historical uses but a study of Deposit of Poisonous Waste Act notifications suggests that there is now little waste from this source.

2.11 In recent years up to 250 tonnes PCB pa wastes, both from manufacture and use, have been imported from mainland Europe because of insufficient adequate disposal capacity in this area.

2.12 The annual waste arisings, present and predicted are summarized in Annex 2.

3 TOXICITY ASPECTS

3.1 As deduced from animal experiments, the acute oral toxicity of PCBs to man is low, being similar to DDT. The chronic toxicity is moderate. In an incident in Japan in which PCB contaminated rice oil was estimated to have been consumed by more than 15,000 people, of the 1,000 confirmed cases the average dose associated with significant clinical symptoms was 30 mg/day but effects were noticed in those who had taken in 3 mg/day over several months.

3.2 It is also known however that some aquatic organisms may be killed at very low levels, for example certain freshwater shrimps at 0·001 ppm or less in water, a consequence of the factors noted in 1.4 and it has been reported that no threshold level was found below which shrimps did not accumulate PCBs. The accumulation of PCBs in the livers of predatory birds feeding on aquatic organisms may interfere with the shell-forming process leading to thin-shelled eggs and a consequential high mortality amongst chicks.

3.3 There is some uncertainty in interpreting data on toxicity due to the presence in early commercial preparations of significant levels of impurities, notably chlorobenzodioxins and polychlorodibenzofurans. It is therefore difficult to set permissible levels for PCBs. The US Food and Drug Administration have set interim levels in food ranging from 0.2 ppm for special infant and junior foods to 5 ppm for poultry and the edible part of fish and shellfish. The US Environmental Protection Agency has recommended that discharge to surface waters should be controlled so that levels do not exceed 0.00001 ppm in the recipient waters.

3.4 Whilst the moderate toxicity of PCBs argues that the precautions need not be extreme but the concentration up the aquatic food chain and scarse knowledge of the chronic effects in man (as is not unusual with substances which do not occur naturally) argue for practical controls.

4 GENERAL DISCUSSION OF METHODS OF TREATMENT AND CURRENT DISPOSAL METHODS

4.1 Incineration

4.1.1 Most of the currently generated PCB wastes are destroyed by incineration, this being done in units registered in the UK under the Alkali Acts as Chemical Incinerators. These units are fitted with wet gas scrubbing systems and are capable of achieving sustained temperatures of 1100°C. There are at present four or possibly five such units in the UK.

The wastes disposed of in this way include:

a Liquid waste from the manufacturing process and from transformers and large capacitors.

b Solid wastes from the manufacturing process, usually cast in drums.

c Miscellaneous solid wastes including waste from the manufacture of small capacitors and contaminated rags, sawdust, Fuller's Earth etc arising at manufacturing and handling plants.

4.1.2 Arising out of metal recovery operations some further but unknown quantities of PCB wastes are subjected to varying degrees of heat treatment. These are principally associated with scrap, small capacitors which are recovered from domestic waste when it passes through a transfer depot or treatment plant and from industrial separation operations. Though the principal metal used in small capacitor construction is aluminium, the metal separation process is not completely effective and some PCB associated with non-ferrous components finds its way into ferrous scrap. It is likely that the PCB content of such scrap which undergoes reprocessing in steel furnaces, where temperatures reach [illegible] may escape to atmosphere [illegible]

4.1.3 Little PCBs will be destroyed [illegible] some will escape to the atmosphere [illegible] the exhaust system and after release to the atmosphere. Some break-down by virtue of the material acting as a chlorine donor will probably occur.

4.1.4 Nowadays a major proportion of metal scrap is treated at fragmentation plants where items are fed in intact, and after cleaning, which may involve incineration, the ferrous scrap is separated magnetically. The capacitors would probably be shattered in the process and some PCBs would escape to the environment without destruction.

4.2 Landfill

4.2.1 A high proportion of the small capacitor scrap, arising from use in the starter circuits of fluorescent light fittings and fractional horse-power electric motor applications, is disposed of to landfill separately or in redundant appliances. One of the main routes is via domestic refuse which is taken direct to landfill, where domestic electrical equipment is not normally recovered for scrap and the item is buried at the bottom of a layer of refuse.

4.2.2 Small quantities of contaminated rags, paper, sawdust, Fuller's Earth etc arising at manufacturing and handling plants also go to landfill.

4.3 Recovery

A small but increasing amount of PCB waste, principally from transformer applications and to some extent from large capacitors, is recovered by a process involving clarification and vacuum distillation. In the case of large capacitors it is worthwhile draining off excess fluid for recovery and incineration. Some PCB is recovered from small capacitor manufacturing rejects by vacuum distillation and the change from paper to polypropylene windings (which do not absorb PCB) is increasing their recovery potential.

4.4 Other methods

4.4.1 Some materials have been stored pending the availability of acceptable disposal methods and the accumulated backlog is still being dealt with mainly by incineration.

4.4.2 With respect to dumping at sea PCBs are in effect proscribed materials under the Oslo and London conventions to which the UK is a signatory and in consequence of this a licence to dump at sea required by the Dumping at Sea Act 1974 would not be granted.

5 RECOMMENDED HANDLING PROCEDURES TO FACILITATE RECLAMATION, STORAGE, TREATMENT AND FINAL DISPOSAL

5.1 Labelling of products and wastes

Modern transformers and large capacitors containing PCBs carry labels informing purchasers of the need for adequate disposal. Problems may arise however with the disposal of older unlabelled equipment. Retrospective labelling by manufacturers should be carried out wherever possible but with units for which there are no adequate records identification may be assisted by examining the original capital cost and siting of the unit and by the fact that the operating and maintenance procedures for PCB-filled units are different from those filled with hydrocarbon oils.

5.2 Methods of storage and containment

Special care should be taken in the transportation of as manufactured bulk liquid PCBs and waste liquid PCBs. They should be carried in adequately sealed and well-labelled heavy-duty containers and preferably not in standard drums. Precautions are especially important in the case of the highly chlorinated type of PCB used in transformers. Labelling of containers should be consistent with the recommendations of the CIGRE Code of Practice on the transport and use of dangerous materials. (Conférence Internationale des Grandes Réseaux Electrique à Haute Tension: Study Committee No 15: Working Group 02 'The Properties of Askarels and recommendations for their use in electrical equipment' 1974.) It is essential that PCBs for reclamation should be kept in sealed containers to avoid contamination of the external environment.

5.3 Handling

5.3.1 A good standard of housekeeping should be maintained when handling PCBs.

5.3.2 The transfer of liquid PCBs from portable containers to storage tanks in the factory or to the incinerator at the disposal site should be carefully conducted, and the container completely drained to ensure it is not a residual source of pollution.

5.3.3 In the factory, leaks, spills and splashes should be avoided, and the working area should be floored with solid concrete, with a suitable coating if necessary. Pipes and tubes should be visible and easily accessible for supervision and maintenance.

5.3.4 Where there are large quantities of PCBs, bunds and dump tanks should be provided to prevent PCBs passing into the drains if the dielectric fluid is mishandled. Strict precautions should be taken to ensure that PCBs do not enter sewerage systems or water courses.

5.3.5 When handling PCBs protective gloves and clothing should be worn and care taken to avoid contact with skin and eyes; cuts and abrasions in particular should be carefully covered. Smoking, eating or drinking should be forbidden and the hands washed thoroughly after the operation.

6 POSSIBILITIES AND RECOMMENDATIONS FOR RECLAMATION AND MINIMIZING WASTES

6.1 Possibilities for extending reclamation

6.1.1 At present it is not profitable to re-use PCBs from some applications. For example, the bulk of the liquid in small capacitors, a major PCB application, is absorbed on the paper windings and although the PCB can be distilled off and recovered the operation requires care. An alternative process involving solvent extraction is used in Germany.

6.1.2 Reclamation of liquid PCBs is readily achieved by clarification and vacuum distillation at a cost substantially lower than the cost of manufacture. In some dielectric fluids the PCB is mixed with other materials such as chlorinated hydrocarbons and mineral oils and stabilisers which make recovery by normal separation techniques difficult. Also the service is only offered at one centre in the UK and transport costs may in some cases make recovery only marginally cheaper. The process is best suited to transformer fluids and should be considered as the preferred method for them.

6.2 Use of alternative materials

6.2.1 *Transformers*
The use of transformers containing PCB in potentially high-risk situations is not expanding significantly due to the development of alternative dielectrics and transformer designs. The substantially higher costs of these alternatives are however inhibiting a general change-over to their use.

6.2.2 *Small Capacitors*
There is an accelerating [illegible] capacitors for fluorescent [illegible] polypropylene has been introduced [illegible] fittings although it is at present about 10 per cent more expensive than the PCB-filled type. It is possible that the use of PCB-filled capacitors in this application may be largely discontinued within the next three to five years.

6.2.3 *Motors*
There is also some evidence that the use of capacitor start motors in domestic appliances is diminishing due to design changes.

7 TREATMENT AND DISPOSAL METHODS

7.1 PCB wastes should where possible be recovered

7.2 Failing this they should where practicable be disposed of by high temperature incineration in units fitted with gas scrubbing systems and capable of achieving sustained high temperatures. Municipal incinerators are not suitable for this purpose. For complete destruction of PCBs by incineration, the vapour must be maintained for a sufficient time at a sufficiently high temperature with sufficient excess oxygen in the combustion gases. A US publication, (Reference 1), indicates that satisfactory destruction of PCBs may be achieved by incineration for two seconds at 1100 °C with 3 per cent excess oxygen and further suggests that stack emissions should not exceed 1 mg/m³ PCB. Most incinerators do not achieve the appropriate conditions but in the UK there are at least four operated by private contractors which, it is claimed, do. Two of these are capable of handling both liquids and solids but the other two can only accept liquids. Tests on emissions from one liquid and one liquid plus solids incinerator indicated that the units were capable of achieving levels lower than those stated above. The UK manufacturer of PCBs uses this method for the wastes arising in manufacture and will recommend a suitable incinerator. The incinerator is registrable under the Alkali Acts on account not only of the hydrogen chloride content of the gaseous discharge, but also its classification as a chemical incinerator.

7.3 The wastes arising from manufacture, from uses as a dielectric in transformers and from imports may be disposed of by reclamation or incineration but about a third of the *PCB waste arises from capacitors and to* a minor extent from the older uses of PCBs. With large power correction capacitors it is worthwhile to drain off the excess fluid for recovery or incineration. It is possible to incinerate the residual core material either directly or after a preliminary (vacuum) distillation or solvent wash to recover the PCB from the windings.

7.4 Recovery of PCBs is quite impracticable for the small capacitors fitted to electrical appliances. They cannot be easily identified, since they are not labelled, and in any case the task could be unduly laborious. Sometimes capacitors attached to electric motors are reused when the motors are recovered but more usually the articles are disposed of through the ordinary processes of refuse disposal and scrap recovery/disposal. When domestic refuse is taken direct to landfill, electric light fittings and domestic electrical equipment contained in it are not normally recovered for scrap and the items are buried at the bottom of a layer of refuse. There is no information on the proportion of small capacitors containing PCB which goes to landfill.

7.5 There is no direct evidence of degradation of PCBs in landfill, though slow degradation may well occur. It seems likely, given that the PCBs (which have low water solubility) are [illegible] retained from which release will be slow, and that free PCBs are absorbed on sediments, that most landfill sites pose no potential threat to water and that landfill disposal is a satisfactory method. The extra effort to segregate the capacitors is not justified, (see paragraph 7.4). It is suggested however, that undue concentrations at any one landfill site should be avoided. As a rough guide

a if 5 million items are scrapped annually, and

b if they are disposed of with 35 million tonnes of domestic and industrial waste annually –

one may expect one item in every 7 tonnes, approximately equivalent to between forty-five and sixty items per 1,000m³ of landfilled domestic refuse. If the level as revealed by occasional observation were, say, one item per tonne or greater, there might be a case for investigating the cause and, if reasonably practicable, for diverting some of the items elsewhere. Such undue concentrations could be presumed to be the result of an industrial disposal.

7.6 Small intermittent quantities which cannot be conveniently handled by incineration may be disposed of by landfill provided similar guidelines on levels and concentrations as at (7.5) above are observed.

8 CODE OF PRACTICE FOR PCBs

In the light of the foregoing the following is presented as a self-contained Code of Practice giving basic rules without supporting arguments. For the purposes of this document wastes containing more than 0.1 per cent PCBs are regarded as PCBs.

8.1 Polychlorinated biphenyls (PCBs) are a mixture of chlorinated biphenyls the degree of chlorination being adjusted to the use (the higher chlorinated PCBs in transformers, the lower in capacitors) and for the purpose of control this description also includes chlorinated ter- and higher phenyls. They are excellent dielectrics, are stable to thermal, chemical and biological degradation and are fire resistant. Annex 1 gives a list of trade names under which they are or have been marketed (1.1, 1.2).

8.2 Following the widespread detection of PCBs in the environment and particularly in predatory birds feeding on aquatic organisms, a consequence of their resistance to degradation and to their fat solubility, and following an incident in Japan where the ingestion of PCB-contaminated rice caused injury to humans and death to poultry, the Council of the OECD in February 1973 agreed to regulate their use by its members by

a abandoning their use in open systems and dispersive uses

b limiting their use in closed systems to cases where they are recoverable or non-flammability is an overriding requirement, or there is no adequate substitute.

In the UK the control is further reinforced by a voluntary scheme imposed in March 1971 by the sole manufacturer who restricts its commercial sales to dielectric applications and research purposes (1.3–6, 3.1–4)

8.3 In consequence, future uses in the UK are now confined to power correction capacitors and transformers (called controllable closed systems), because they are sealed, big, of long life and contain sufficient PCB to offer the incentive of economic recovery. Their use in non-controlled systems (small capacitors) is being abandoned as adequate substitutes become available except where fire resistance is of overriding importance (2.4–9, 6.1, 6.2).

8.4 The acute toxicity is low, similar to that of DDT, the chronic toxicity is moderate. Some aquatic organisms are very sensitive to their presence in water. PCBs concentrate in the livers of higher life forms due to their fat solubility and affect predatory birds and other organs directly and evidence is available to suggest they can also affect the breeding success of these and many other species. The aims of control of disposal of wastes are:

a to restrict levels in human foods to the lowest practicable, and,

b to reduce the levels in the environment, especially the aquatic environment, by all reasonably practicable measures (3.1–4).

8.5 An estimate of present and future waste arisings is given in Annex 2.

8.6 In all operations involving transfer of PCBs eg during draining of transformers and power capacitors or transfer to store to await disposal, care should be taken to avoid contact with skin and eyes. Cuts and abrasions should be covered and protective clothing and gloves worn. Hands should be washed after the operation. Smoking, drinking and eating should be prohibited in the operational area. Transfers should preferably take place on hard, undrained, bunded surfaces. Spills should be absorbed at once in sawdust or other, preferably flammable, absorbents. Every precaution should be taken to prevent ingress of PCB into sewerage systems or water courses (5.3).

8.7 Liquid wastes from transformers and power correction capacitors should be removed as completely as possible and sent for reclamation or incinerated to the standards specified in 8.9 below (4.1, 4.3, 7.2, 7.3).

8.8 Wastes should be transported in labelled heavy-duty, specially secured containers, preferably not in standard drums (5.2).

8.9 Manufacturing wastes and other contaminated solid wastes (eg capacitors from which the liquid PCB has been drained) should be destroyed in incinerators fitted with gas scrubbing [illegible] capable of operating at sustained temperatures greater than [illegible] should be at least two seconds with a [illegible] per cent. Stack gases and gas scrubber liquids should be sampled according to a schedule agreed with the regulatory authorities (Alkali Inspectorate and the appropriate Water Authority or, in Scotland, the River Purification Authority (4.1, 7.2).

8.10 No special precautions need to be taken in the disposal of small capacitors unless there is undue concentration at one particular landfill site or scrap recovery facility. If the concentration is more than one capacitor per tonne of refuse, (approximately equivalent to 300 to 400 items per $1,000 m^2$) an investigation should be made to ascertain the reason, and disposal arranged so as to approach an average concentration of not more than one unit per 7 tonnes of refuse (7.5).

8.11 Wastes not discussed above should be :

a recovered where at all possible

b destroyed in a suitable incinerator if recovery is impracticable

c buried at low concentrations in landfill if neither recovery nor incineration is possible.

ANNEX 1

Trade names

Principal trade names used for PCB-based dielectric fluids which are usually classified as ASKARELS

AROCLOR (UK, USA)

PYROCLOR (UK)

INERTEEN (USA)

PYRANOL (USA)

PYRALENE (FRANCE)

CLOPHEN (GERMANY)

APIROLIO (ITALY)

KANECLOR (JAPAN)

SOLVOL (USSR)

Other names were used for PCB products intended for historical applications : these include :

SANTOTHERN FR (UK) Heat transfer prior to 1972

THERMINOL FR (USA) Heat transfer prior to 1972

PYDRAUL (USA) Hydraulic applications before 1972

PHENOCLOR (FRANCE)

FENCLOR (ITALY)

The trade names SANTOTHERN, THERMINOL and PYDRAUL are still in use but these now refer to non-chlorinated products.

In the case of SANTOTHERN and THERMINOL only the FR series contained PCBs and present-day products are not labelled as FR. In the case of PYDRAULS, the present series of hydraulic fluids which do not contain halogenated compounds are designated B C or E.

ANNEX 2

Quantities of PCBs

	Manufacture	Transformers	Large capacitors	Small capacitors	Historical
Total PCBs used per annum		300 tonnes	500 tonnes	600 tonnes (likely to decrease)	
No. of units manufactured per annum		300 (only 200 for home market)	150,000–200,000	15m	
Average wt of PCB per unit		1 tonne	3 kg (range 0·75 –30 kg)	50g	
Life of unit		30 years	25 years	5–10 years	
Quantities of wastes* arising (1974)	400 tonnes (liquid)	10 tonnes (liquid)	**	250 tonnes	100 tonnes 1972–73
Estimate of future quantities of waste	Not likely to increase	1985 – 130 tonnes 2000 – 250 tonnes	1990 – 130 tonnes 2000 – 400 tonnes	1980 – 600 tonnes 1990 – 100 tonnes	

* Plus up to 250 tonnes of imported material.
** Currently little waste as capacitors not brought into service until 1950s.

ANNEX 3

References

(1) National Electrical Manufactures Association — 1973 — Official Standards Proposal *PUB no CP-P1-73* *TR-P3-73* (Section 2, page 8)

Some further, detailed information about the properties, use and disposal of PCBs is contained in the literature listed below:

(2) CIGRE — 1974 — 'Properties of Askarels and recommendations for their use in electrical equipment' *Study Committee No. 15 Working Group 02.*

(3) OECD — 1973 — Document Press A(73) of February 14. *'Polychlorinated Biphenyls and the Environment'* (COM-72-10.419) distributed by the National Technical Information Service, US Department of Commerce, 5285 Port Royal Road, Springfield Va 22151, USA.

(4) J Freudenthal and P A Greve — 1973 — 'Polychlorinated terphenyls in the Environment' *Bull. Environ. Contam. Toxic* Volume 10 No. 2 pp. 108–111.

(5) K L E Kaiser and P T S Wong — 1973 — 'Bacterial Degradation of Polychlorinated Biphenyls I. Identification of some metabolic products from Aroclor 1242' *Bull. Environ. Contam. Toxic* Volume 11 No. 3.

(6) O Hutzinger, S Safe, V Zitko — 1974 — *The Chemistry of PCB* Chemical Rubber Co. 1974

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