Updated technical guidelines for the environmentally sound management of wastes consisting of, containing or contaminated with polychlorinated biphenyls (PCBs), polychlorinated terphenyls (PCTs) or polybrominated biphenyls (PBBs)

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Abbreviations and acronyms

ABS	acrylonitrile-butadiene-styrene copolymers (plastics)
ESM	environmentally sound management
HASP	health and safety plan
HCB	hexachlorobenzene
IPCS	International Programme on Chemical Safety
PBB	polybrominated biphenyl
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibenzofuran
PCN	polychlorinated naphthalene
PCT	polychlorinated terphenyl
POP	persistent organic pollutant
TEQ	toxic equivalent
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme

Units of measurement

mg	milligram
kg	kilogram
Mg	megagram (1,000 kg or 1 tonne)
mg/kg	milligram(s) per kilogram. Corresponds to parts per million (ppm) by mass.
ppm	parts per million

I. Introduction

A. Scope

1. This document supersedes the Basel Convention's technical guidelines on wastes comprising or containing PCB, PCT and PBB (Y10) of February 1997.

2. The present technical guidelines provide guidance for the environmentally sound management (ESM) of wastes consisting of, containing or contaminated with polychlorinated biphenyls (PCBs) pursuant to decisions V/8, VI/23, VII/13 and VIII/16 of the Conference of the Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, decisions OEWG-I/4, OEWG-II/10 and OEWG-III/8 of the Open-ended Working Group of the Basel Convention, and taking into account resolution 5 of the Conference of Plenipotentiaries of the Stockholm Convention on Persistent Organic Pollutants and decisions INC-6/5 and INC-7/6 of the Intergovernmental Negotiating Committee for an International Legally Binding Instrument for Implementing International Action on Certain Persistent Organic Pollutants and decisions SC-1/21 and SC-2/6 of the Conference of the Parties to the Stockholm Convention.

3. Along with PCBs, these technical guidelines address polychlorinated terphenyls (PCTs) and polybrominated biphenyls (PBBs) as a class or category of substances owing to similarities in the physico-chemical and toxicological properties of these substances. Topics addressed include waste management, treatment and disposal. It should be noted that neither PCTs nor PBBs are subject to the Stockholm Convention.

4. Unintentionally produced PCBs are not covered by these technical guidelines. They are addressed in the technical guidelines for the environmentally sound management of wastes containing or contaminated with unintentionally produced polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), hexachlorobenzene (HCB) or polychlorinated biphenyls (PCBs).

5. The present document should be used in conjunction with the document entitled "*General technical guidelines for environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants* ("the general technical guidelines") (UNEP, 2006). That document provides more detailed information on the nature and occurrence of wastes consisting of, containing or contaminated with PCBs, PCTs or PBBs for purposes of their identification and management.

B. Description, production, use and wastes

1. Description

(a) PCBs

6. PCBs are aromatic compounds formed in such a manner that the hydrogen atoms on the biphenyl molecule (two benzene rings bonded together by a single carbon-carbon bond) may be replaced by up to 10 chlorine atoms. In theory there are 209 congeners, although only about 130 congeners have actually been found in commercial chemical formulations (Holoubek, 2000). Typically, four to six of the 10 possible substitution sites are occupied by a chlorine atom (Environment Canada, 1988). The more highly chlorinated PCB congeners are virtually insoluble in water and highly resistant to degradation.

7. PCBs include 12 congeners for which the World Health Organization has assigned toxicity equivalency factors because they exhibit dioxin-like toxicity.

(b) PCTs

8. PCTs also constitute a group of halogenated hydrocarbons. They are very similar in chemical structure to PCBs except that they contain three phenyl rings instead of two. Therefore, they can have up to 14 chlorine atoms attached. The number of possible PCT congeners is very large; however, only a few occur in commercial chemical formulations. PCTs and PCBs have very similar chemical and physical properties. PCTs are virtually insoluble in water and highly resistant to degradation. One difference between PCTs and PCBs is that PCTs are generally less volatile.

(c) PBBs

9. PBBs are the bromine analogues of PCBs and thus have 209 possible congeners. Only a few, however, occur in commercial chemical formulations (IPCS, 1994). They are solids or waxy substances at room temperature. They are virtually insoluble in water and highly resistant to degradation.

10. Congenors of PBBs have not been assigned toxicity equivalency factors by the World Health Organization.

2. Production

(a) PCBs

11. PCBs have excellent dielectric properties, longevity, non-flammability and resistance to thermal and chemical degradation. For this reason, prior to national bans, they were manufactured for use in electrical equipment, heat exchangers, hydraulic systems and several other specialized applications.

12. The main period of manufacture occurred from 1930 to the late 1970s in the United States of America; up to 1974 in China (China State Environmental Protection Agency, 2002); up to the early 1980s in Europe, up to 1993 in Russia (Artic Monitoring and Assessment Programme, 2000); and from 1954 to 1972 in Japan.

13. PCBs were manufactured as mixtures of congeners, for example as progressive chlorination of batches of biphenyl until a certain target percentage of chlorine by weight was achieved. The manufactured PCBs were rarely used at full strength. For example, they were added in small quantities to ink, plastics, paints and carbon paper or were used in formulations of up to 70 per cent PCBs in hydraulic fluid, transformer fluid and heating fluids. At room temperature, the majority of them are oily liquids or waxy solids.

14. Prominent trade names of PCB products include those listed below. (See annex I for a more detailed list of PCB trade names and synonyms and section IV.D of the present report for considerations regarding precautions to take when using trade names in inventory exercises.)

Apirolio (Italy)
Aroclor (United States)
Clophen (Germany)
Delor (Czechoslovakia)
Elaol (Germany)
Fenchlor (Italy)
Kanechlor (Japan)
Phenoclor (France)
Pyralene (France)
Pyranol (United States)
Pyroclor (United States)
Santotherm (Japan)
Sovol (USSR)
Sovtol (USSR)

15. In the Aroclor series, a four-digit number follows the word Aroclor. The first two digits of the number are either 10 or 12. The number 12 indicates a normal Aroclor while the number 10 indicates a distillation product of an Aroclor. The second two digits of the four-digit code indicate the percentage of chlorine in the mixture by weight. Therefore, Aroclor 1254 contains approximately 54 per cent chlorine by weight.

16. Commercial PCB products and articles were sold for their industrial properties rather than for their chemical composition (IPCS, 1992). They contained a number of impurities and were often mixed with solvents, such as tri- and tetrachlorobenzenes. Those PCBs mixed with tri- and tetrachlorobenzenes were called askarel. Contaminants in commercial mixtures include PCDFs and chlorinated naphthalenes. Studies have found from 0.8 milligrams per kilogram (mg/kg) to 40 mg/kg of PCDFs in commercial mixtures (IPCS, 1992). PCBs are also formed unintentionally in some thermal and chemical processes.

17. The cumulative worldwide production of PCBs has been estimated at 750,000–2 million tonnes.

(b) PCTs

18. PCTs were manufactured in much smaller quantities than PCBs and were given the same or similar trade names. They were used for the same sorts of applications as PCBs, although most were used in waxes, plastics, hydraulic fluids, paints and lubricants (Jensen and Jørgensen, 1983). In the United States, Aroclor series PCTs are indicated by the digits 54 in the first two spaces of the four-digit code, e.g., Aroclor 5432, 5442 and 5460 (IPCS, 1992). See annex I for examples of trade names and section IV.D for a discussion of trade names in inventory identification.

19. Examples of trade names are Aroclor (United States) and Kanechlor KC-C (Japan).

20. PCTs were produced in the United States, France, Germany, Italy and Japan until the early 1980s, when all production is thought to have ceased. The cumulative world production is estimated to have been 60,000 tonnes between 1955 and 1980 (UNECE, 2002).

(c) PBBs

21. Information on the production of PBBs is scarce. It is estimated that at least 11,000 tonnes of PBBs were produced worldwide, but production figures from some countries known to have produced PBBs are not available (IPCS, 1994). PBBs were manufactured in the United States until 1979, in Germany until the mid-1980s, and in France until at least the mid-1990s. PBBs may still be in production in Asia (Lassen, Løkke and Andersen, 1999).

22. The first PBB compound produced was hexabromobiphenyl, which was commercially known as FireMaster in the United States. FireMaster was produced from 1970 to 1974. Analysis has shown that FireMaster contained up to 80 per cent hexa- and up to 25 per cent heptabromobiphenyl. In France, a commercial mixture of PBBs was sold as Adine 0102. In Germany, highly brominated PBBs were produced and sold as Bromkal 80-9D. See annex I for examples of trade names and section IV.D for a discussion of trade names in inventory identification.

3. Use

(a) PCBs

23. PCBs were used in a very wide variety of industrial and consumer applications. The uses were categorized by the World Health Organization as completely closed, nominally closed and open-ended (IPCS, 1992). The uses included:

(a) Completely closed systems:

(i) Electrical transformers;

(ii) Electrical capacitors (including lamp ballasts);

(iii) Electrical switches, relays and other;

(iv) Electrical cables;

(v) Electric motors and magnets (very small amounts);

(b) Nominally closed systems:

(i) Hydraulic systems;

(ii) Heat transfer systems (heaters, heat exchangers);

(c) Open-ended systems:

(i) Plasticizer in polyvinyl chloride, neoprene and other artificial rubbers;

(ii) Ingredient in paint and other coatings;

(iii) Ingredient in ink and carbonless copy paper;

(iv) Ingredient in adhesives;

(v) Pesticide extender;

(vi) Ingredient in lubricants, sealants and caulking material;

(vii) Fire retardant in fabrics, carpets, polyurethane foam, etc.;

(viii) Lubricants (microscope oils, brake linings, cutting oils, other lubricants).

24. Although electrical transformers containing PCBs are defined as a “completely closed” application, industrial practices caused these PCBs to be transferred to other types of equipment, thus creating additional points of contact with the environment. A common practice was to top up or recharge non-PCB (mineral oil) transformers with PCBs when no other fluid was available.

25. PCB oils were also added to or disposed of with non-PCB fluids such as heating or cooling fluid, hydraulic fluid, brake fluid, engine oil and off-specification fuels. There are numerous anecdotal reports of employees in electrical utilities using PCB fluids to wash their hands and taking PCB fluids home for use in home heaters, hydraulic systems and motors (as a lubricant). Since most fluorescent lamp ballasts made before PCBs were banned contained PCBs, many homes and businesses that installed fluorescent lamps unknowingly acquired PCBs.

(b) PCTs

26. PCTs were used in almost exactly the same applications as PCBs but in much smaller amounts. Little is known, however, about remaining quantities because inventories have not been developed (UNECE, 2002). It is known that very small amounts of PCTs were used in electrical equipment (Jensen and Jørgensen, 1983).

(c) PBBs

27. The principal use of PBBs was as a fire retardant. PBBs were added to acrylonitrile-butadiene-styrene copolymers (plastics) (ABS) (10 per cent PBBs), coatings, lacquers and polyurethane foam (IPCS, 1994).

4. Wastes

28. Wastes consisting of, containing or contaminated with PCBs, PCTs or PBBs are found in a number of physical forms, including:

(a) Equipment containing or contaminated with PCBs or PCTs (capacitors, circuit breakers, electrical cables, electric motors, electromagnets, heat transfer equipment, hydraulic equipment, switches, transformers, vacuum pumps, voltage regulators);

(b) Solvents contaminated with PCBs or PCTs;

(c) End-of-life vehicles and shredder light fraction (fluff) containing or contaminated with PCBs;

(d) Demolition wastes containing or contaminated with PCBs (painted materials, resin-based floorings, sealants, sealed glazing units);

(e) Oils consisting of, containing or contaminated with PCBs or PCTs (dielectric fluids, heat transfer fluids, hydraulic fluids, motor oil);

(f) Electrical cables isolated by polymers containing or contaminated with PCBs or PBBs;

(g) Soils and sediments, rock and aggregates (e.g., excavated bedrock, gravel, rubble) contaminated with PCBs, PCTs or PBBs;

(h) Sludge contaminated with PCBs, PCTs or PBBs;

(i) Plastics containing or contaminated with PBBs and equipment containing such materials;

(j) Fire suppression equipment containing or contaminated with PBBs;

(k) Containers contaminated through the storage of waste consisting of, containing or contaminated with PCBs, PCTs or PBBs.

29. It should be noted that the categories above mainly apply to PCBs, which were produced in much larger quantities than PBBs or PCTs and have been stored as wastes awaiting disposal. PBBs and PCTs are rarely found in large bulk situations and therefore do not have the potential to form large amounts of waste.

II. Relevant provisions of the Basel and Stockholm conventions

A. Basel Convention

30. Article 1 ("Scope of Convention") outlines the waste types subject to the Basel Convention. Subparagraph 1 (a) of that Article sets forth a two-step process for determining whether a "waste" is a "hazardous waste" subject to the Convention: first, the waste must belong to any category contained in Annex I to the Convention ("Categories of Wastes to be Controlled"), and second, the waste must possess at least one of the characteristics listed in Annex III to the Convention ("List of Hazardous Characteristics").

31. Annex I lists some of the wastes that may consist of, contain or be contaminated with PCBs, PCTs or PBBs. These include:

Y6	Wastes from the production, formulation and use of organic solvents
Y8	Waste mineral oils unfit for their originally intended use
Y9	Waste oils/water, hydrocarbons/water mixtures, emulsions
Y10	Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)
Y11	Waste tarry residues arising from refining, distillation and any pyrolytic treatment
Y12	Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish
Y13	Wastes from production, formulation and use of resins, latex, plasticizers, glues/adhesives
Y14	Waste chemical substances arising from research and development or teaching activities which are not identified and/or are new and whose effects on man and/or the environment are not known
Y18	Residues arising from industrial waste disposal operations
Y39	Phenols; phenol compounds including chlorophenol
Y41	Halogenated organic solvents
Y42	Organic solvents excluding halogenated solvents
Y45	Organohalogen compounds other than substances referred to in this Annex (e.g., Y39, Y41, Y42, Y43, Y44)

32. Annex I wastes are presumed to exhibit an Annex III hazardous characteristic such as H11 "Toxic (Delayed or Chronic)", H12 "Ecotoxic", or H6.1 "Poisonous (Acute)" unless, through "national tests", they can be shown to not exhibit such characteristics. National tests may be useful for identifying a particular hazard characteristic listed in Annex III until such time as the hazardous characteristic is fully defined. Guidance papers for each Annex III hazardous characteristic are currently being developed under the Basel Convention.

33. List A of Annex VIII describes wastes that are "characterized as hazardous under Article 1 paragraph 1(a) of this Convention" although "Designation of a waste on Annex VIII does not preclude the use of Annex III (hazard characteristics) to demonstrate that a waste is not hazardous" (Annex I, paragraph (b)). List B of Annex IX lists wastes which "will not be wastes covered by Article 1, paragraph 1 (a), of this Convention unless they contain Annex I material to an extent causing them to exhibit an Annex III characteristic". The following Annex VIII waste categories in particular are applicable to PCBs, PCTs or PBBs:

A1180	Waste electrical and electronic assemblies or scrap[1] containing components such as accumulators and other batteries included on list A, mercury-switches, glass from cathode-ray tubes and other activated glass and PCB-capacitors, or contaminated with Annex I constituents (e.g., cadmium, mercury, lead,

[1] This entry does not include scrap assemblies from electric power generation.

polychlorinated biphenyl) to an extent that they possess any of the characteristics contained in Annex III (note the related entry on list B B1110)[2]

A3180 Wastes, substances and articles containing, consisting of or contaminated with polychlorinated biphenyl (PCB), polychlorinated terphenyl (PCT), polychlorinated naphthalene (PCN) or polybrominated biphenyl (PBB), or any other polybrominated analogues of these compounds, at a concentration level of 50 mg/kg or more[3]

34. List A of Annex VIII includes a number of wastes or waste categories that have the potential to contain or be contaminated with PCBs, PCTs or PBBs, including:

A1090 Ashes from the incineration of insulated copper wire

A1100 Dusts and residues from gas cleaning systems of copper smelters

A2040 Waste gypsum arising from chemical industry processes, when containing Annex I constituents to the extent that it exhibits an Annex III hazardous characteristic (note the related entry on list B B2080)

A2060 Coal-fired power plant fly ash containing Annex I substances in concentrations sufficient to exhibit Annex III characteristics (note the related entry on list B B2050)

A3020 Waste mineral oils unfit for their originally intended use

A3040 Waste thermal (heat transfer) fluids

A3050 Wastes from production, formulation and use of resins, latex, plasticizers, glues/adhesives, excluding such wastes specified on list B (note the related entry on list B B4020)

A3070 Waste phenols, phenol compounds including chlorophenol in the form of liquids or sludges

A3120 Fluff – light fraction from shredding

A3150 Waste halogenated organic solvents

A3160 Waste halogenated or unhalogenated non-aqueous distillation residues arising from organic solvent recovery operations

A4070 Wastes from the production, formulation and use of inks, dyes, pigments, paints, lacquers and varnish, excluding any such waste specified on list B (note the related entry on list B B4010)

A4100 Wastes from industrial pollution control devices for cleaning of industrial off-gases but excluding such wastes specified on list B

A4130 Waste packages and containers containing Annex I substances in concentrations sufficient to exhibit Annex III hazard characteristics

A4140 Wastes consisting of or containing off-specification or outdated 4 chemicals corresponding to Annex I categories and exhibiting Annex III hazard characteristics

A4150 Waste chemical substances arising from research and development or teaching activities which are not identified and/or are new and whose effects on human health and/or the environment are not known

A4160 Spent activated carbon not included on list B (note the related entry on list B B2060)

35. For further information, see section II.A of the general technical guidelines.

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[2] PCBs are at a concentration level of 50 mg/kg or more.

[3] The 50 mg/kg level is considered to be an internationally practical level for all wastes. However, many individual countries have established lower regulatory levels (e.g., 20 mg/kg) for specific wastes.

[4] "Outdated" means unused within the period recommended by the manufacturer.

B. Stockholm Convention[5]

36. The present document covers intentionally produced PCBs whose production and use are to be eliminated and, as wastes, are to be managed and disposed of in an environmentally sound manner in accordance with the provisions of articles 3 and 6 and Annex A of the Stockholm Convention.

37. Annex A, Part II ("Polychlorinated biphenyls") outlines specific requirements with respect to PCBs, as follows:

> "Each Party shall
>
> (a) With regard to the elimination of the use of polychlorinated biphenyls in equipment (e.g., transformers, capacitors or other receptacles containing liquid stocks) by 2025, subject to review by the Conference of the Parties, take action in accordance with the following priorities:
>
> (i) Make determined efforts to identify, label and remove from use equipment containing greater than 10 per cent polychlorinated biphenyls and volumes greater than 5 litres;
>
> (ii) Make determined efforts to identify, label and remove from use equipment containing greater than 0.05 per cent polychlorinated biphenyls and volumes greater than 5 litres;
>
> (iii) Endeavour to identify and remove from use equipment containing greater than 0.005 percent polychlorinated biphenyls and volumes greater than 0.05 litres;
>
> (b) Consistent with the priorities in subparagraph (a), promote the following measures to reduce exposures and risk to control the use of polychlorinated biphenyls:
>
> (i) Use only in intact and non-leaking equipment and only in areas where the risk from environmental release can be minimised and quickly remedied;
>
> (ii) Not use in equipment in areas associated with the production or processing of food or feed;
>
> (iii) When used in populated areas, including schools and hospitals, take all reasonable measures to protect from electrical failure which could result in a fire, and regular inspection of equipment for leaks;
>
> (c) Notwithstanding paragraph 2 of article 3, ensure that equipment containing polychlorinated biphenyls, as described in subparagraph (a), shall not be exported or imported except for the purpose of environmentally sound waste management;
>
> (d) Except for maintenance and servicing operations, not allow recovery for the purpose of reuse in other equipment of liquids with polychlorinated biphenyls content above 0.005 per cent;
>
> (e) Make determined efforts designed to lead to environmentally sound waste management of liquids containing polychlorinated biphenyls and equipment contaminated with polychlorinated biphenyls having a polychlorinated biphenyls content above 0.005 per cent, in accordance with paragraph 1 of Article 6, as soon as possible but no later than 2028, subject to review by the Conference of the Parties;
>
> (f) In lieu of note (ii) in Part I of this Annex, endeavour to identify other articles containing more than 0.005 per cent polychlorinated biphenyls (e.g., cable-sheaths, cured caulk and painted objects) and manage them in accordance with paragraph 1 of Article 6;
>
> (g) Provide a report every five years on progress in eliminating polychlorinated biphenyls and submit it to the Conference of the Parties pursuant to Article 15".

38. For further information, see section II.B of the general technical guidelines.

[5] This section does not apply to PCTs and PBBs.

III. Issues under the Stockholm Convention to be addressed cooperatively with the Basel Convention[6]

A. Low POP content

39. The provisional definition for low POP content for PCBs is 50 mg/kg.[7] For further information, see section III.A of the general technical guidelines.

B. Levels of destruction and irreversible transformation

40. For the provisional definition for levels of destruction and irreversible transformation, see section III.B of the general technical guidelines.

C. Methods that constitute environmentally sound disposal

41. See section G of chapter IV below and section IV.G of the general technical guidelines.

IV. Guidance on environmentally sound management (ESM)

A. General considerations

1. Basel Convention

42. One of the principal vehicles for the promotion of ESM is the preparation and dissemination of technical guidelines such as the present document and the general technical guidelines. For further information see section IV.A.1 of the general technical guidelines.

43. Parties planning or reviewing a national ESM programme should consult, inter alia, the Basel Convention guidance document "*Preparation of a National Environmentally Sound Plan for PCB and PCB-Contaminated Equipment: Training Manual*" (UNEP, 2003a).

2. Stockholm Convention

44. The term "environmentally sound management" is not defined in the Stockholm Convention. Environmentally sound methods for disposal of wastes consisting of, containing or contaminated with PCBs are, however, to be determined by the Conference of the Parties in cooperation with the appropriate bodies of the Basel Convention.

45. Parties should consult "*Guidance for developing a NIP for the Stockholm Convention*" (UNEP 2005).

3. Organisation for Economic Co-operation and Development

46. For information regarding the Organisation for Economic Co-operation and Development and ESM, see subsection IV.A.3 of the general technical guidelines.

B. Legislative and regulatory framework

47. Parties to the Basel and Stockholm Convention should examine national controls, standards and procedures to ensure that they are in keeping with the conventions and their obligations under them, including those that pertain to ESM of wastes consisting of, containing or contaminated with PCBs.

48. Elements of a regulatory framework applicable to PCBs, PCTs and PBBs could also include the following:

(a) Environmental protection legislation setting release limits and establishing environmental quality criteria;

(b) Prohibitions on the manufacture, sale, import and export (for use) of PCBs, PCTs and PBBs;

(c) Phase-out dates for PCBs that remain in service, inventory or storage;

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[6] This section does not apply to PCTs and PBBs.

[7] Determined according to national or international methods and standards.

(d) Hazardous materials and waste transportation requirements;

(e) Specifications for containers, equipment, bulk containers and storage sites;

(f) Specification of acceptable analytical and sampling methods for PCBs, PCTs and PBBs;

(g) Requirements for waste management and disposal facilities;

(h) A general requirement for public notification and review of proposed government regulations, policy, certificates of approval, licences, inventory information and national emissions data;

(i) Requirements for identification and remediation of contaminated sites;

(j) Requirements for health and safety of workers;

(k) Other potential legislative controls, as for waste prevention and minimization, inventory development and emergency response).

49. The timing of the phase-out of PCBs (and to a lesser extent PCTs and PBBs) will probably be the most critical legislative concern for most countries, given that most of them already have some form of legislative framework dealing with PCBs.

50. For further information, see section IV.B of the general technical guidelines.

C. Waste prevention and minimization

51. Both the Basel and Stockholm Conventions advocate waste prevention and minimization, while PCB compounds are targeted in the Stockholm Convention for complete phase-out. PCBs, PCTs and PBBs should be taken out of service and disposed of in an environmentally sound manner.

52. Quantities of waste containing these compounds should be minimized through isolation and source separation to prevent mixing and contamination of other waste streams. For example, PCBs in electrical equipment, painted materials, resin-based floorings, sealants and sealed glazing units can contaminate large amounts of demolition waste if not separated prior to demolition.

53. Mixing of wastes with a PCB content above a defined low POP content with another material solely for the purpose of generating a mixture with a POP content below the defined low POP content is not environmentally sound. Nevertheless, mixing of materials before waste treatment may be necessary in order to optimize treatment efficiencies.

54. For further information, see paragraph 6 and section IV.C of the general technical guidelines.

D. Identification and inventories

1. Identification

55. PCBs, PCTs and PBBs have historically been found in a number of locations, including:

(a) Electrical utilities: transformers, capacitors, switches, voltage regulators, circuit breakers, light ballasts and cables;

(b) Industrial facilities: transformers, capacitors, voltage regulators, circuit breakers, light ballasts, heat transfer fluids, hydraulic fluids and fire suppression systems;

(c) Railroad systems: transformers, capacitors, voltage regulators and circuit breakers;

(d) Underground mining operations: hydraulic fluids and earthing coils;

(e) Military installations: transformers, capacitors, voltage regulators, hydraulic fluids and fire suppression systems;

(f) Residential/commercial buildings: capacitors, circuit breakers, light ballasts and fire suppression systems; elastic joints and fillers, sealing glues; paints; concrete and plaster

(g) Research laboratories: vacuum pumps, light ballasts, capacitors and circuit breakers;

(h) Electronics manufacturing plants: vacuum pumps, light ballasts, capacitors and circuit breakers;

(i) Waste-water discharge facilities: vacuum pumps and well motors;

(j) Automotive service stations: reused oil.

56. It should be noted that even experienced technical persons may not be able to determine the nature of an effluent, substance, container or piece of equipment by its appearance or markings. PCB equipment, for example, was typically not labelled according to the type of dielectric fluid it contained. Experienced inspectors may be able to determine the original contents from other information on the nameplate by using guidance manuals such as "*Guidelines for the Identification of PCB and Materials Containing PCB*" (UNEP, 1999) or by contacting the manufacturer.

57. The information on production, use and waste types provided in section I.B of the present document may be useful in identifying PCBs, PCTs and PBBs.

58. For further information, see subsection IV.D.1 of the general technical guidelines.

2. Inventories

59. A complete inventory of all PCBs, PCTs and PBBs is impossible to compile, mainly because of the dispersed nature of the uses of these chemicals (e.g., in inks, plasticizers, paint, flame retardants in small components, and lubricants).

60. For further information, see subsection IV.D.2 of the general technical guidelines.

E. Sampling, analysis and monitoring

61. For general information, see section IV.E. of the general technical guidelines.

1. Sampling

62. For information on sampling, see section IV.E.1 of the general technical guidelines.

63. The types of matrices that are of special interest for analysis of PCBs, PCTs and PBBs include:

(a) Askarel (PCBs and PCTs) liquid from transformers or other equipment or in bulk storage;

(b) Mineral oil from transformers contaminated with PCBs or in bulk storage;

(c) Waste motor oil and other waste oils, fuels and organic liquids;

(d) Fire suppressants and retardants (PBBs).

2. Analysis

64. For information on analysis, see subsection IV.E.2 of the general technical guidelines.

65. For PCBs, there may be a special interest in determining dioxin-like PCBs. To do so, internationally accepted methods like those for analysing PCDDs/PCDFs should be applied.

66. For screening purposes, test kits are available for the quantification of PCBs in oils and soils (based on immunoassays or chlorine determination). If the result is negative, a confirmatory PCB analysis is not necessary. If the result is positive, confirmatory chemical analysis should be performed, or the waste may be regarded as waste containing or contaminated with PCBs.

3. Monitoring

67. Monitoring programmes should be implemented for facilities managing wastes consisting of, containing or contaminated with PCBs, PCTs and PBBs. For further information see subsection IV.E.3 of the general technical guidelines.

F. Handling, collection, packaging, labelling, transportation and storage

68. For general information on handling, collection, packaging, labelling, transportation and storage, see the first paragraph of section F of the general technical guidelines.

1. Handling

69. For information, see subsection IV.F.1 of the general technical guidelines.

2. Collection

70. A significant fraction of total national inventories of PCBs, PCTs and PBBs may be held in small quantities by small business owners and homeowners (for example, in PCB fluorescent light ballasts, other small electrical devices, heat exchangers and heaters containing PCB or PCT fluids, PBBs in fire suppression systems, small containers of pure products and small stockpiles). It is difficult for small-quantity owners to dispose of these materials. For example, the regulatory situation may require that they must be a registered waste generator, logistical considerations may prevent or discourage pick-up (e.g., no industrial waste pick-up allowed or available in a residential neighbourhood), and costs may be prohibitive. National, regional and municipal governments should consider establishing collection stations for those small quantities so that each small-quantity owner does not have to make individual transport and disposal arrangements.

71. Collection arrangements and collection depots for wastes consisting of, containing or contaminated with PCBs, PCTs or PBBs should be separate from those for all other wastes.

72. It is imperative that collection depots do not become long-term storage facilities for wastes consisting of, containing or contaminated with PCBs, PCTs or PBBs. The risk of environmental and human health impairment is higher for large amounts of wastes, even if properly stored, than for small quantities scattered over a large area.

73. For further information, see subsection IV.F.2 of the general technical guidelines.

3. Packaging

74. Wastes consisting of, containing or contaminated with PCBs, PCTs or PBBs should be properly packaged before storage or transport:

(a) Liquid wastes should be placed in double-bung steel drums or other approved containers;

(b) Regulations governing transport often specify containers of a certain quality (e.g., 16-gauge steel coated inside with epoxy resin/polymer); consequently, containers used for storage should meet transport requirements given that they may be transported in the future;

(c) Large, drained equipment may be stored as is or may be placed inside a large container (overpack drum) or heavy plastic wrap if leakage is a concern;

(d) Small pieces of equipment, whether drained or not, should be placed in drums with an absorbent material. Numerous small pieces of equipment may be placed in the same drum so long as an adequate amount of absorbent material is present in the drum. Loose absorbents may be purchased from safety suppliers. Sawdust or peat moss may also be used;

(e) Drums and equipment may be placed on pallets for movement by forklift truck and for storage. Drums and equipment should be strapped to the pallets before they are moved.

75. For further information, see section IV.F.3 of the general technical guidelines.

4. Labelling

76. All containers and equipment containing or contaminated with PCBs, PCTs or PBBs should be clearly labelled with both a hazard-warning label and a label which gives the details of the equipment or container. The details should include the contents of the container or equipment (exact counts of equipment or volume of liquid), the type of waste, the name of the site from which it originated so as to allow traceability, the date of repackaging where appropriate and the name and telephone number of the responsible person.

77. For further information, see subsection IV.F.4 of the general technical guidelines.

5. Transportation

78. For information, see subsection IV.F.5 of the general technical guidelines.

6. Storage

79. Whereas many countries have adopted storage regulations or developed storage guidelines concerning PCBs, most do not have specific storage regulations or guidance concerning PCTs and PBBs. Nevertheless, it can be assumed that storage procedures should be similar since the properties

and toxicities of PCTs and PBBs are similar. Although recommended practice varies somewhat from country to country, there are many common elements to safe storage of these wastes.

80. For further information, see subsection IV.F.6 of the general technical guidelines.

G. Environmentally sound disposal

1. Pre-treatment

81. Cutting and milling of capacitors for purposes of size reduction should be carried out only immediately before destruction in a dedicated facility.

82. For further information on pre-treatment, see subsection IV.G.1 of the general technical guidelines.

2. Destruction and irreversible transformation methods

83. For information, see subsection IV.G.2 of the general technical guidelines.

3. Other disposal methods when neither destruction nor irreversible transformation is the environmentally preferable option

84. For information, see subsection IV.G.3 of the general technical guidelines.

4. Other disposal methods when the POP content is low

85. For information, see subsection IV.G.4 of the general technical guidelines.

H. Remediation of contaminated sites

86. For information, see subsection IV.H of the general technical guidelines.

I. Health and safety

87. For further information, including on the distinction between higher- and lower-risk situations, see section IV.I of the general technical guidelines.

1. Higher-risk situations

88. For information on higher-risk situations, see subsection IV.I.1 of the general technical guidelines. Potential higher-risk situations specific to PCBs, PCTs or PBBs may include:

(a) Electrical rooms with large or multiple PCB transformers, circuit breakers or capacitors;

(b) Sites at which PCB-containing transformers, circuit breakers, hydraulic equipment or vacuum pumps have been used or maintained.

2. Lower-risk situations

89. For information on lower risk situations, see subsection IV.I.2 of the general technical guidelines. Lower-risk situations specific to PCBs, PCTs, PBBs may include:

(a) Those that involve only products or articles that contain or are contaminated with PCBs in small quantities or at low concentrations (e.g., light ballasts containing PCBs in fluorescent fixtures);

(b) Electrical transformers or other equipment with low-level PCB-contaminated mineral oil;

(c) Consumer goods containing PBBs as flame retardants.

J. Emergency response

90. Emergency response plans should be in place for PCBs, PBBs and PCTs that are in service, in storage, in transport and at a disposal site. Further information on emergency response plans is given in section IV.J of the general technical guidelines and in "*Preparation of a National Environmentally Sound Plan for PCB and PCB-Contaminated Equipment: Training Manual*" (UNEP, 2003a).

K. Public participation

91. Parties to the Basel or Stockholm Convention should have an open public participation process. For further information see section IV.K of the general technical guidelines.

Annex I

Synonyms and trade names for PCBs, PCTs and PBBs

Chemical	Some synonyms and trade names[8]
PCBs	Abestol, Aceclor, Adkarel, ALC, Apirolio (Italy), Apirorlio, Areclor, Arochlor, Arochlors, Aroclor/Arochlor(s) (USA), Arubren, Asbestol (USA), Ask/Askarel/Askael, Auxol, Bakola, Biclor, Blacol (Germany), Biphenyl, Clophen (Germany), Cloresil, Chlophen, Chloretol, Chlorextol (USA), Chlorfin, Chlorinal/Chlorinol, Chlorinated biphenyl, Chlorinated diphenyl, Chlorobiphenyl, Chlorodiphenyl, Chlorofen (Poland), Chlorphen, Chorextol, Chorinol, Clophen/Clophenharz (Germany), Cloresil, Clorinal, Clorphen, Crophene (Germany), Decachlorodiphenyl, Delofet O-2, Delor (Slovakia), Delor/Del (Slovakia), Delorene, Delorit, Delotherm DK/DH (Slovakia), Diaclor (USA), Diarol, Dicolor, Diconal, Disconon, DK (Italy), Ducanol, Duconal, Duconol, Dykanol (USA), Dyknol, Educarel, EEC-18, Elaol (Germany), Electrophenyl, Elemex (USA), Elinol, Eucarel, Euracel, Fenchlor (Italy), Fenclor (Italy), Fenocloro, Gilotherm, Hexol, Hivar, Hydelor, Hydol, Hydrol, Hyrol, Hyvol (USA), Inclor, Inerteen (USA), Inertenn, Kanechlor (Japan), Kaneclor, Kennechlor (Japan) , Kenneclor, Leromoll, Magvar, MCS 1489, Montar, Monter, Nepoli, Nepolin, Niren, NoFlamol, No-Flamol (USA), Non-Flamol, Olex-sf-d, Orophene, Pheaoclor, Pheneclor, Phenochlor, Phenoclor (France), Plastivar, Polychlorinated diphenyl, Polychlorinated diphenyls, Polychlorobiphenyl, Polychlorodiphenyl, Prodelec, Pydraul, Pyraclor, Pyralene (France), Pyranol (USA), Pyroclor (USA), Pyrochlor, Pyronol, Safe-T-Kuhl, Saft-Kuhl, Saf-T-Kohl, Saf-T-Kuhl (USA), Santosol, Santotherm (Japan), Santothern, Santovac, Sat-T-America, Siclonyl, Solvol, Sorol, Soval, Sovol (USSR), Sovtol, Tarnol (Poland), Terphenychlore, Therminal, Therminol, Turbinol
PCTs	Aroclor (US), Clophen Harz (W), Cloresil (A,B,100), Electrophenyl T-50 and T60, Kanechlor KC-C (Japan), Leromoll, Phenoclor, Pydraul
PBBs	Adine 0102, BB-9, Berkflam B_{10}, Bromkal 80, Firemaster BP-6, Firemaster FF-1, Flammex B-10, hbb, hexabromobiphenyl, HFO 101, obb, BB-8

[8] The list of trade names is not intended to be exhaustive.

Annex II

Bibliography

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