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**Open-ended Working Group of the Basel Convention  
on the Control of Transboundary Movements of  
Hazardous Wastes and Their Disposal  
Tenth meeting**

Nairobi, 30 May–2 June 2016

Item 3 (b) (i) a. of the provisional agenda\*

**Matters related to the work programme of the  
Open-ended Working Group for 2016–2017:  
scientific and technical matters: technical guidelines:  
technical guidelines on the environmentally sound  
management of wastes consisting of, containing or  
contaminated with persistent organic pollutants**

**Draft technical guidelines on the environmentally sound management  
of wastes consisting of, containing or contaminated with  
pentachlorophenol and its salts and esters**

**Note by the Secretariat**

As referred to in the note by the Secretariat on technical guidelines (UNEP/CHW/OEWG.10/5), the small intersessional working group on persistent organic pollutant wastes prepared the draft technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with pentachlorophenol and its salts and esters, as set out in the annex to the present note. The present note, including its annex, has not been formally edited.

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\* UNEP/CHW/OEWG.10/1.

## **Annex**

### **Draft technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with pentachlorophenol and its salts and esters**

(Draft of 3 May 2016)

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## Abbreviations and acronyms

ACQ	alkaline copper quaternary
BAT	best available techniques
BEP	best environmental practices
CAS	Chemical Abstracts Service
CCA	chromated copper arsenate
EC	European Commission
ESM	environmentally sound management
EU	European Union
HCB	hexachlorobenzene
IEC	International Electrotechnical Commission
Na-PCP	sodium pentachlorophenate
OECD	Organisation for Economic Co-operation and Development
PBT	polybutylene terephthalate
PCA	pentachloroanisole
PCB	polychlorinated biphenyl
PCDD(s)	polychlorinated dibenzo-p-dioxin(s)
PCDF(s)	polychlorinated dibenzo-furan(s)
PCP	pentachlorophenol
PCP-L	pentachlorophenyl laurate
POP	persistent organic pollutant
UNEP	United Nations Environment Programme
XRF	X-ray fluorescence

## Units of measurement

mg/kg	milligram(s) per kilogram. Corresponds to parts per million by mass
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## I. Introduction

### A. Scope

1. The present technical guidelines provide guidance on the environmentally sound management (ESM) of wastes consisting of, containing or contaminated with pentachlorophenol (PCP) and its salts and esters, pursuant to several decisions adopted by the bodies of two multilateral environmental agreements on chemicals and wastes.<sup>1</sup>
2. PCP and its salts and esters were listed in Annex A to the Stockholm Convention in 2015, through an amendment that entered into force in 2016.
3. The present technical guidelines should be used in conjunction with the General technical guidelines for the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants) (UNEP, [...]) (hereinafter referred to as “general technical guidelines”). The general technical guidelines are intended to serve as an umbrella guide for the ESM of wastes consisting of, containing or contaminated with persistent organic pollutants (POPs) and provide more detailed information on the nature and incidence of wastes consisting of, containing or contaminated with POPs for purposes of their identification and management.
4. In addition, the use of PCP as a pesticide will be addressed in more detail in the [future update of] Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with the pesticides aldrin, alpha hexachlorocyclohexane, beta hexachlorocyclohexane, chlordane, chlordecone, dieldrin, endrin, heptachlor, hexachlorobenzene, lindane, mirex, pentachlorobenzene, [pentachlorophenol,] perfluorooctane sulfonic acid, technical endosulfan and its related isomers or toxaphene or with hexachlorobenzene as an industrial chemical (UNEP, [...]).

### B. Description, production, use and wastes

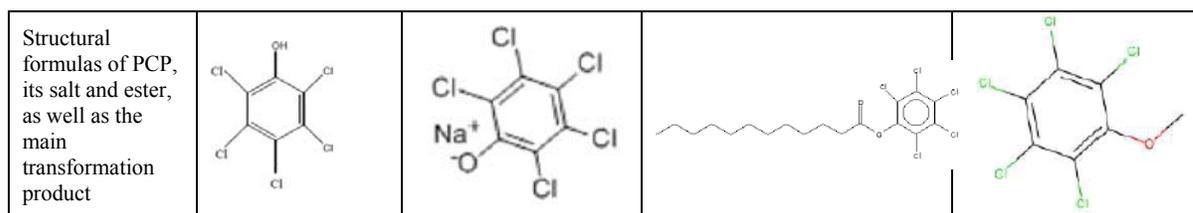
#### 1. Description

5. PCP is a chlorinated aromatic hydrocarbon of the chlorophenol family, consisting of a chlorinated benzene ring and hydroxyl group. Pentachlorophenol and its salts and esters cover pentachlorophenol (PCP, CAS No: 87-86-5), sodium pentachlorophenate (Na-PCP, CAS No: 131-52-2 and 27735-64-4 (as monohydrate)) and pentachlorophenyl laurate (PCP-L, CAS No: 3772-94-9), when considered together with their transformation product pentachloroanisole (PCA, CAS No: 1825-21-4) (Table 1), according to decision SC-7/13 of the Conference of the Parties to the Stockholm Convention.

**Table 1:** Structural formulas of PCP, its salt Na-PCP, ester PCP-L, and metabolite PCA

	Pentachlorophenol	Sodium pentachlorophenate	Pentachlorophenyl laurate	Pentachloroanisole
Chemical name and abbreviation	2,3,4,5,6-pentachlorophenol (PCP)	Na-PCP	PCP-L	PCA
CAS number	87-86-5	131-52-2 and 27735-64-4 (as monohydrate)	3772-94-9	1825-21-4
Molecular formula	C <sub>6</sub> HCl <sub>5</sub> O	C <sub>6</sub> Cl <sub>5</sub> ONa	C <sub>18</sub> H <sub>23</sub> Cl <sub>5</sub> O <sub>2</sub>	C <sub>7</sub> H <sub>3</sub> Cl <sub>5</sub> O
Molecular Mass	266.34 g/mol	288.32 g/mol	448.64 g/mol	280.362 g/mol

<sup>1</sup> Decisions BC-12/3 and BC-13/[...] of the Conference of the Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal; decision OEWG-10/5 of the Open-ended Working Group (OEWG) of the Basel Convention; and decision SC-7/13 of the Conference of the Parties to the Stockholm Convention on Persistent Organic Pollutants.



6. Pure PCP consists of light tan to white, needle-like crystals and is relatively volatile. Technical grade PCP is typically about 86% pure (Institute of Environmental Protection, 2008). The technical grade PCP formulation currently used in Canada consists of 86% PCP, 10% other chlorophenols and related compounds and 4% inerts (Environment Canada, 2013). PCP, Na-PCP and PCP-L have been available in form of solid blocks, flakes, granulate, powder or as a dilutable liquid (UNEP/POPS/POPRC.9/13/Add.3, UBA, 2015).

7. Other chlorophenol-based preservatives produced may also contain significant amounts of PCP (6-10%, Valo et al., 1984).

8. PCP and its metabolite PCA are detected in air, water, soil and biota throughout the world, including in remote regions, although there are uncertainties regarding the source(s) detected at remote locations, as they may also be a result of the degradation of chlorinated hydrocarbons including PCB, HCB, HCH, and PCNB (Fellin et al., 1996, Barrie et al., 1998, Berger et al., 2004, Hoferkamp et al., 2010, Hung et al. 2010, Su et al. 2011, Zheng et al., 2011). PCP is detected in the blood, urine, seminal fluid, breast milk and adipose tissue of humans (Veningerova et al., 1996, Sandau, 2002, Larsdotter et al., 2005, Zheng et al., 2011, Zheng et al., 2012). Biomonitoring information shows similar levels of PCP in humans from remote and more populated areas. It also demonstrates exposure, and therefore potential hazard, to fetuses, infants and adults. Compared to other chlorinated compounds, PCP is one of the most dominant contaminants measured in blood plasma. Where long-term monitoring data exists, concentrations of PCP decreasing in air and biota (Zheng et al., 2011, Rylander et al., 2012). (UNEP/POPS/POPRC.9/13/Add.3)

9. PCP is hepatotoxic, carcinogenic, immunotoxic, neurotoxic and toxic to the reproduction. It should be noted that some of these hazards can be induced by an endocrine mode of action and there is a lack of scientific consensus related to the existence of a threshold for this mode of action. PCP is also highly toxic to aquatic organisms. Reported environmental monitoring concentrations are generally lower than those levels expected to cause an environmental effect particularly in remote areas. However, given the widespread distribution of PCP and PCA, which may result from transformation of PCP, and that measurable levels of PCP/PCA are frequently found in biota and that PCP and PCA have an endocrine mode of action, environmental effects cannot be excluded. (UNEP/POPS/POPRC.9/13/Add.3)

## 2. Production

10. PCP was first introduced for use as wood preservative in the 1930's. Commercial significance has been reported since 1950's and 1960's (Environment Canada, 2013, Naturvårdsverket, 2009, USWAG, 2008, Kitunen, 1990).

11. PCP is manufactured at least in Mexico and formulated in the U.S. The main share of the PCP market and use is in North America. (UNEP/POPS/POPRC.10/10/Add.1). 1,800 tonnes of Na-PCP was produced in India (ICC, 2014). PCP or Na-PCP have earlier been produced at least in China, Denmark, France, Germany, the Netherlands, Poland, Spain, Switzerland, and the United Kingdom. PCP-L has been produced at least in China and the United Kingdom (UNECE, 2010, ICC, 2014). Tradenames of products containing PCP are listed in Annex III to this technical guidelines.

12. In the early 1980's 50 000 - 90 000 tonnes of PCP per year were produced globally. Since then, use has been restricted in many countries and the production is significantly lower. (UNEP/POPS/POPRC.10/10/Add.1). In 2009, KMG Bernuth in the USA formulated 7,257 tonnes of PCP marketed for wood preservation purposes in the USA, Canada, and Mexico (UNECE, 2010).

13. PCP is produced by reacting chlorine with phenol at high temperatures in the presence of a catalyst. There are three main routes of production (UNEP, 2013):

(a) Reaction of Cl<sub>2</sub> with phenol or chlorophenols in the presence of catalysts (aluminum, antimony, their chlorides, and others);

- (b) Alkaline hydrolysis of hexachlorobenzene (HCB) in aqueous solutions, and
- (c) Thermolysis of hexachlorocyclohexane (HCH).

14. PCP is also a transformation product and metabolite of other organochlorines such as HCB, HCH (lindane) and PCNB (quintozene). The extent of these potential sources cannot be quantified. In addition, contaminants including HCB, pentachlorobenzene, polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are produced in the manufacturing process. (UNEP/POPS/POPRC.9/13/Add.3, UNEP/POPS/POPRC.10/10/Add.1, USWAG 2008).

15. Significant PCDD and lesser PCDF formation has been associated with the production of chlorophenol-based wood preservatives. The most recent analysis showed average concentrations of 634,000 µg TEQ per tonne of PCP (Tondeur et al., 2010) and of 12,500 µg per tonne of PCP-Na (the People's Republic of China, 2007). Levels of 130–26,000 ng I-TEQ PCDDs and PCDFs /g active ingredient PCP have been reported in Japan (Masunaga et al., 2001). In Sweden the accumulated quantity of PCDDs released into the environment from the use of chlorophenols in wood treatment was estimated at between 70 - 360 kg of dioxin (I-TEQ) (Naturvårdsverket, 2009). In Poland high levels of PCDDs and PCDFs were detected in free-range eggs, originating from PCP-treated wood, which was used as structural components in the 40-year-old farm building adapted to a henhouse (Piskorska-Pliszczynska et al. 2016).

16. PCP-L has been produced using PCP as a starting material (OSPAR, 2001). Tradenames include Penta-ate, Pentachlorophenolate sodium, Pentachlorophenol sodium salt, Pentachlorophenoxy sodium, Pentaphenolate, Phenol pentachloro- sodium derivative monohydrate, Sodium PCP, Sodium pentachlorophenolate, and Sodium pentachlorophenoxide (Institute of Environmental Protection, 2008).

17. Other chlorinated phenol preservatives also contained PCP. The tetrachlorophenol wood preservative Ky-5 used in Finland and Sweden was manufactured between 1940 and 1984, consisting of mainly of 2,4,6-trizolium chlorophenol (7 to 15%), 2,3,4,6-tetrachlorophenol (ca. 80%) and PCP (6 to 10%) (Valo et al 1984).

18. Parties to the Stockholm Convention must prohibit and/or eliminate the production of PCP and its salts and esters, unless they have notified the Secretariat of their intention to produce it for use in utility poles and cross-arms with the time-limited specific exemption listed in Annex A to the Convention. A number of parties may also continue to produce PCP and its salts and esters for any purpose until they decide to ratify the amendment through which the chemical was listed in Annex A. Information on use of the production exemption can be found in the register of specific exemptions of the Stockholm Convention on the Convention website ([www.pops.int](http://www.pops.int)). Information on the status of ratification by the parties of the amendment listing PCP and its salts and esters in the Stockholm Convention can be found on the website of the Treaty Section of the United Nations (<https://treaties.un.org/>).

19. [Currently there are no registrations for the PCP exemption.]

### 3. Use

20. PCP is one of the three major industrial wood preservatives (the other two are Chromated Copper Arsenate CCA and creosote). PCP has had a variety of other applications (e.g., biocide, pesticide, disinfectant, defoliant, anti-sapstain agent, anti-microbial agent and is used in the production of pentachlorophenyl laurate (PCP-L). Na-PCP was often used for wood treatment due to its better water solubility compared to PCP. Na-PCP readily dissociates to PCP. The ester PCP-L was used in textiles.

21. PCP, its salts and esters have been used for many different purposes, but the use was discontinued in many countries by the 1990s. Already in 1996 it was restricted at least in 30 countries (EC, 1996).

22. Currently use of PCP appears to be allowed worldwide only for wood preservation uses. PCP and Na-PCP are used in industrial wood preservation, especially treatment of utility poles, cross-arms, and outdoor construction material in non-residential constructions. In the lumber and timber market, PCP is used less in favor of CCA and alkaline copper quaternary (ACQ) preservatives (USEPA, 2008). Na-PCP is used also for preservation paint products during storage (ICC, 2014). No country has reported use of PCP-L (UNEP/POPS/POPRC.10/10/Add.1).

23. For PCP pressure wood preservation, the preservative (PCP/oil solution) is applied in a pressure cylinder. Specific treatment parameters (e.g. temperature, pressure and duration) are dictated by the species of wood, the wood product and the initial moisture content of the wood.

After conditioning, an empty-cell treatment process is generally used to apply the oil-borne PCP preservative. Following the drain cycle at the end of the impregnation process, a vacuum is applied to encourage the removal of excess preservative and pressurized air from the wood cells. This process minimizes preservative “bleeding” from the treated product. Alternatively, an expansion bath or final steam cycle, followed by a vacuum, may be used to minimize surface exudations and long-term bleeding and to improve the surface cleanliness of the material. The treated wood is withdrawn from the treating cylinder and stored on a drip pad until drippage has essentially stopped. From there the wood is either taken for storage in the yard or shipped by truck or rail car. (Environment Canada, 2013).

24. For anti-sapstain dip or spray treatment with chemicals like Na-PCP, the active compounds are supplied as powders or water-based concentrates for mixing or dilution, for use at solution concentrations 2-5 %. These are made up in large tanks in which the timber is immersed for short periods (10-20 seconds). After treatment, the timber is stacked to drain and to allow excess solution to dry. Treated timber may then be kiln- or air-dried and packaged for dispatch. (Kitunen, 1990, OSPAR, 2001 and references therein).

25. PCP-L was earlier used in the preservation of textiles, which are subject to attack by fungi and bacteria during storage and use. These include wool, cotton, flax and jute fabrics and yarns used in covers, tarpaulins, awnings, tents, webbing and netting and also sisal and manila ropes. In the early 1990’s PCP-L was used in jute fabrics from which PCP-L could migrate to the fibres of woollen carpets. PCP-L use continued in military applications still in 2000’s because it was reported as an effective preservative against a wide range of decay-causing organisms, and it was proved to be compatible with many of the other treatments and materials required for military use. (OSPAR, 2001 and references therein). These products are considered to have a relatively long life time (15-20 years).

26. PCP, Na-PCP and PCP-L have all been used in the past also for instance as preservative in oil-based paintlike products, as preservative in glues (leather, toilet paper etc.) and in adhesives, as an intermediate product for the synthesis of pharmaceuticals, as an intermediate product in obtaining colouring substances (anthraquinon colorants and intermediates), in mushroom farms for wooden trays where mushrooms are grown, in slime control in pulp and paper production and as an agricultural chemical in weed control (for instance as a fungicide or on crops as a defoliant). (OSPAR, 2001).

27. Currently, PCP is not used in the Australia, China, European Union, New Zealand, Russian Federation, Serbia, Sri Lanka or Switzerland (UNEP/POPS/POPRC.9/13/Add.3), although products and articles treated with PCP are likely still in use even in those countries. For example, Swedish Environment Protection Agency estimated in 2009 that 340 tonnes of PCP, mainly in pressure impregnated wood, was still in use despite the ban in 1978 (Naturvårdsverket, 2009).

The information collected for Stockholm Convention Risk Profile showed that every country with wood preservation uses reported also has additional restrictions and/or regulations in place for managing the wood preservation industry, including Belize, Canada, Mexico and the United States. In addition, PCP use in wood treatments is banned or heavily restricted in Indonesia, Morocco, Sri Lanka, and Ecuador (UNEP/POPS/POPRC.10/10/Add.1).

28. In Europe PCP, its salts and esters have been used in a variety of different sectors (EC, 1994a, EC, 1994b, EC, 1996, UNEP/POPS/POPRC.9/13/Add.3, UBA, 2015):

(a) Wood preservative (fungicide and anti-blueing agent), including remedial treatment of timber, in situ treatment of buildings of cultural and historic interest. In Germany PCP treated wood was used commonly inside houses, in buildings with a high percentage of wood materials such as barracks, halls, silos, etc. Upper layers of treated wood could contain PCP in concentration in a range of several 1,000 mg/kg (UBA, 2015). In other EU countries PCP was applied mainly outside.

(b) Impregnation of industrial/heavy duty textiles (wool cotton, flax and jute fabrics and yarns used in covers, tarpaulins, awnings, tents, webbing and netting and also sisal and manila ropes) until 2002 (ESWI, 2011);

(c) Preservative in oil-based paint, glues, adhesives, joint sealants, casting compounds, and varnishes;

(d) Intermediate in the synthesis of pharmaceuticals;

(e) Intermediate product in colouring substances;

(f) Slime control bactericide in tanning and pulp and paper industries;

- (g) Molluscicide in the treatment of industrial water, in particular cooling water;
  - (h) Weed control in agriculture;
  - (i) Preservative in mushroom production;
  - (j) Surface biocide for masonry.
29. In 1996 almost 90 % of the total EU consumption of PCP, Na-PCP and PCP-L was through the use of Na-PCP for sapstain control in France, Portugal and Spain. In Portugal three product types are treated with Na-PCP: pallet boards, construction timber and fencing panels (Royal Haskoning, 2002). All PCP uses were terminated in 2008 but many countries had restricted it much earlier.
30. In Mexico PCP is registered for use on adhesives, tannery, paper and textile (UNEP/POPS/POPRC.9/13/Add.3).
31. In Canada PCP is registered for the treatment of wood for utility poles, cross-arms, outdoor construction timbers, pilings and railway ties, although it is indicated that PCP-treated railway ties have not been installed since 1993. With approximately 15 million wood poles in a distribution network the predominant use of PCP is for the treatment of wood utility poles and cross-arms. Canada has reported an increase of the amount of PCP used, from 372 tonnes in 2008 to 537 tonnes in 2012. (UNEP/POPS/POPRC.10/10/Add.1). Historical uses include antisapstain and specialty applications (paints, stains, wood joinery products, industrial water treatment products, oil field biocides and material preservatives). All sapstain control and all other uses (e.g., domestic wood preservatives) were withdrawn in 1990. (UNEP/POPS/POPRC.9/13/Add.3)
32. PCP was one of the most widely used biocides in the United States before 1987 when PCP uses as an herbicide, defoliant, mossicide and disinfectant were removed from product labels. (USEPA, 2016). PCP is predominantly used to treat utility poles and cross-arms, where only pressure and thermal treatments of PCP are allowed. There are an estimated 130–135 million preservative-treated wood utility poles in service in the United States, representing over 90% of the pole market and presenting a replacement rate of 2 to 3% (approximately 3-5 million poles) per year (USWAG, 2005). In 1995, about 45% of poles were treated with PCP, whereas in 2002 this figure was around 56% (USEPA, 2008). PCP has also been used for treatment of sap stain, herbicide, in rice and sugar production, in water treatment (especially as a slimicide in cooling towers), as a pre-harvest defoliant in cotton and as a general pre-emergence herbicide. It has also been utilized in numerous products including adhesives, construction materials (asbestos shingles, roof tiles, brick walls, concrete blocks, insulation, pipe sealing compound and wallboard), leather and paper, oil production, and even as bird repellent (Cirelli, 1977, USEPA, 2008). The consumption in the United States has fallen since the 1970's due to environmental concerns and in response to increasing competitiveness within the utility industry (USEPA, 2008). Many non-wood preservative uses were banned in 1987. In 2002, approximately 5 000- 5 500 tonnes were used for the treatment of utility poles, lumber and timbers (construction). (UNEP/POPS/POPRC.9/13/Add.3)
33. In Australia, historical uses include uses as an anti-sapstain fungicide and timber preservative.
34. In Japan PCP was historically used as a herbicide in rice paddy fields (Minomo et. al 2011). It was also used as a fungicide for agricultural use. As of 1990, registration of all the products containing PCP as agricultural chemicals was withdrawn. In 2003, use of PCP as an agricultural chemical was banned. The total production of PCP until 1989 in Japan was 175,700 tonnes.
35. In India, the use of PCP in the tanning industry was prevalent (UNEP/POPS/POPRC.9/13/Add.3). According to the Indian Chemical Council Na-PCP is used in India mainly as a wood preservative but also for the preservation of water-based 'distemper paints' while in storage. (UNEP/POPS/POPRC.10/10/Add.1)
36. PCP is not used in China. Na-PCP was used for wood preservation for the purpose of railway construction, but there is no further use due to upgrading of construction material. Na-PCP was also used as molluscicide, but this application has been banned. (UNEP/POPS/POPRC.10/10/Add.1)
37. More detailed information on current uses as informed by countries is provided in Appendix V of UNEP/POPS/POPRC.9/INF/7.
38. Parties to the Stockholm Convention shall prohibit and/or eliminate the use of PCP and its salts and esters, except if they have notified the Secretariat of their intention to use PCP for utility poles and cross-arms with the time-limited specific exemption listed in Annex A to the Convention. A number of parties may also continue to use PCP and its salts and esters for any purpose until they decide to ratify the amendment through which the chemical was listed in Annex A. Information on

use of the exemption can be found in the register of specific exemptions of the Stockholm Convention on the Convention website ([www.pops.int](http://www.pops.int)). Information on the status of ratification by the parties of the amendment listing PCP and its salts and esters in the Stockholm Convention can be found on the website of the Treaty Section of the United Nations (<https://treaties.un.org/>).

39. The concentration of PCP in the treated product is dependent on the treatment method and the material (Table 2). In dip treatment, PCP is applied in 2-5% solution (OSPAR, 2001). In Canada, the PCP concentration of 5-8% in petroleum oil is used in pressure treatment (Environment Canada, 2013).

**Table 2:** Typical concentrations of PCP, Na-PCP and PCP-L in different materials

Material	PCP, Na-PCP and PCP-L	Source
Dip treated wood	0.1 kg/m <sup>3</sup> (average absorption)	Naturvårdsverket, 2009
Typical preservative retention in pressure treated wood	3.4 – 16 kg PCP/m <sup>3</sup> of treated wood 4.8 – 7.2 kg PCP/m <sup>3</sup> (southern pine) 5 kg/m <sup>3</sup>	Environment Canada, 2013 USWAG, 2008 Naturvårdsverket, 2009
Average PCP concentration in treated and air-dried wood	625 ppm	ESWI, 2011
Textiles	2 % (20 000 ppm)	OSPAR, 2001
Leather	0.1% <sup>2</sup> (1000 ppm) 0.25% (2500 ppm)	Abrams, 1948
Cooling water	28 ppm (Na-PCP)	Cirelli, 1977

#### 4. Wastes

40. Action aimed at waste streams of importance in terms of volume and concentration will be essential to eliminating, reducing and controlling the environmental load of PCP and its salts and esters from waste management activities. In that context, the following should be recognized:

(a) The major worldwide use for PCP and its salts and esters is as a heavy-duty wood preservative (UNEP/POPS/POPRC.9/13/Add.3). Utility poles, cross-arms, and other timber products for construction have a long service-life. For life-cycle analyses, the service life of a pole treated with PCP has been estimated at 60-70 years Canada (Bolin & Smith, 2011, Canada 2014). In buildings the service life can be even longer. In tropical countries the trees may not last as long: an untreated timber may have a natural durability of 4 years, but a life-span of 20 years if treated with Na-PCP (Indian Chemicals Council, 2014);

(b) Typical PCP-L applications have been for military purposes, tropical textiles and tents. These products have been considered to have a relatively long life time (15-20 years) and are therefore also considered to be a relevant waste streams (ESWI, 2011);

(c) PCP and its salts and esters are released from products and articles during the service life through runoff from wood surfaces as well as evaporation. (UNEP/POPS/POPRC.9/13/Add.3). Therefore the concentration of the chemical in the article may decrease over time. Depending on the solvent, temperature, pH, and type of wood 30 – 80 % of PCP may evaporate within 12 months from dip- or brush-treated wood. Releases from textiles during the service life depend on the type of textile, the environmental conditions and the application. PCP-L is very insoluble in water and has a low vapour pressure. It has been estimated that it takes 10 years for the PCP-L concentration to drop from 2 % to less than 1 %, at which level the preservative effect is considerably reduced. (OSPAR, 2001 and references therein). In utility poles, PCP concentration has been reported to decrease by 50% during 25 years of service (Naturvårdsverket, 2009);

(d) During the treatment of wood, there may be runoff to soil during the treatment process, transfer or drying (UNEP/POPS/POPRC.9/13/Add.3) or accidental releases (Kitunen, 1990). Soils close to sawmills that used PCP heavily have been found highly contaminated with PCP many years after use was discontinued (The Clean Environment Commission 1984, Kitunen, 1990, Naturvårdsverket, 2009, BOPRC, 2016). Also high PCP concentrations have been measured in soils around southern pine utility poles in service (max 5800 mg/kg) (EPRI, 1997). PCP adsorbs in the top soil with high organic content while the lower chlorinated chlorophenols penetrate deeper into soil. Soils contaminated with chlorophenols have also been reported to have PCDDs/PCDFs in

<sup>2</sup> NB: very little information available. The only reference found was [http://www.leatherchemists.org/forum/forum\\_posts.asp?TID=1605&PN=135](http://www.leatherchemists.org/forum/forum_posts.asp?TID=1605&PN=135)

the top soil with high organic content similarly to PCP. (Kitunen, 1990);

(e) Many countries have already established arrangements for disposal of treated wood that is not reused;

(f) In the 1980's PCP was found in consumer products such as wool carpets. International Wool Secretariat tested 140 wool carpets, of which 88 % had PCP content below 5 ppm and 3 carpets contained above 50 ppm. PCPs were predominantly concentrated in the backing material, not in the wool or polyester pile (Wimbush, 1989).

41. Wastes may contain variable concentrations of PCP and its salts and esters, depending on the quantities in which they were originally introduced in specific products and the quantities released during product use and waste management. Waste consisting of, containing or contaminated with PCP and its salts and esters (hereinafter referred to as "PCP wastes") may be found in:

- (a) PCP, its salts and esters chemicals:
  - (i) Obsolete or unused PCP, Na-PCP, and PCP-L (liquid or blocks);
- (b) Liquid and solid wastes from pressure treatment facilities that use PCP, Na-PCP or PCP-L:
  - (i) condensates, washwaters and infiltrating waters;
  - (ii) sludges from tanks, sumps and pressure cylinders;
  - (iii) sludges from wastewater treatment processes (e.g. flocculated material)
  - (iv) containers or wrappings and pallets from bulk PCP;
  - (v) filters from cleaning vacuum;
  - (vi) clean up absorbents;
- (c) Contaminated soils;
- (d) Articles treated with PCP, its salts and esters:
  - (i) Treated wood (utility poles, cross-arms, sleepers, fences, shingles, walkways, building components, piers, docks, porches, flooring and laminated beams);
  - (ii) Treated textiles and ropes (especially for outdoor use, such as awnings, tents, sails, tarpaulins, yarn (wool, cotton, linen and jute) etc.);
  - (iii) Treated leather;
- (e) Municipal and industrial sludge and landfill leachate.

42. The most important PCP wastes vary depending on the use history in the country. In the countries where PCP has been used as PCP/oil solution in high-pressure impregnation to produce utility poles and cross-arms with very long service-life, they can be expected to be a major waste source to the distant future. Also use of treated wood for construction can be expected to have a long service-life, especially indoors. However, in countries where PCP use has been predominantly dip treatment of sawn timber as sapstain agent, it may be impossible to identify the eventual waste streams as the timber is not considered "preserved" and may have been used similarly to untreated timber. The concentrations after dip-treatment are expected to be low (see Table 2), but the concentrations in contaminated soils can be very high (concentrations of up to 390 mg PCP/kg in topsoil have been measured in Kitunen et al., 1985 and Kitunen & Salkinoja-Salonen, 1990). Textiles may have service life of several decades and there is little information on the use of PCP, Na-PCP or PCP-L in those applications. However, action on PCP content in carpets *etc.* was already taken in many countries in the 1990's and such materials may already have been landfilled or incinerated.

43. The most important PCP waste streams in terms of potential volume are expected to be:

- (a) Utility poles and cross-arms (USWAG, 2005, Canada, 2014);
- (b) Railway sleepers;
- (c) Construction wood, especially outdoor applications;
- (d) Textiles, such as wool, cotton, flax and jute fabrics and yarns used in covers, tarpaulins, awnings, tents, webbing and netting, and sisal and manila ropes;
- (e) Military applications.

44. The most important PCP waste streams in terms of potential releases or concentration of PCP and its salts and esters are expected to be:

- (a) Pure PCP, Na-PCP and PCP-L from production, pesticides and obsolete stocks;
- (b) Preservative use solutions (water or oil solutions) of PCP, its salts and other chlorophenols with PCP as a component;
- (c) PCP solid blocks for preservative use;
- (d) Packages used for PCP and its salts and esters;
- (e) Textiles treated with PCP and its salts and esters.

45. PCP wastes can be generated in a diverse range of applications, at different stages of life cycle and through different release media. Knowledge of release media guides the analysis and choice of methods that may be used to manage such wastes. Table 3 provides an overview of relevant information regarding the life cycle of wastes containing PCP and its salts and esters.

**Table 3:** Overview of the production and application of PCP and its salts and esters and their release media into the environment (based on UNEP/POPS/POPRC.9/13/Add.3 and UNEP/POPS/POPRC.10/10/Add.1). Some of the applications are believed to have ceased more than 20 years ago and it may be unlikely such waste could be found elsewhere but landfill

Group	Source materials /Substance used	Applications /Processes	End product	Release media
<b>PCP, Na-PCP, and PCP-L PRODUCTION</b>				
<b>Chemical production</b>	Chlorine, phenols, catalytes	Chemical synthesis	PCP, Na-PCP, PCP-L	<ul style="list-style-type: none"> <li>• Solid waste</li> <li>• Landfill leachate</li> <li>• Water</li> <li>• Sludge</li> <li>• Air</li> </ul>
	PCP (intermediate use)	Synthesis of pharmaceuticals and colouring substances <sup>3</sup>	Pharmaceuticals and colouring substances with potential PCP residues	
<b>PRODUCTION OF ARTICLES TREATED WITH PCP AND ITS SALTS AND ESTERS</b> (The boxes below include articles that have become wastes. Such wastes may also be generated at production sites, such as leftovers, cutting waste, etc.)				
<b>Pressure impregnated timber</b>	PCP and Na-PCP	Pressure impregnation or thermal treatment of timber	Utility poles and cross-arms Railway sleepers Outdoor construction materials Pallets	<ul style="list-style-type: none"> <li>• Solid waste</li> <li>• Landfill leachate</li> <li>• Liquid industrial and household waste</li> <li>• Wastewater</li> <li>• Sludge</li> <li>• Air</li> </ul>
<b>Freshly sawn and unseasoned timber</b>	PCP and Na-PCP (also other chlorophenol fungicides with PCP as a constituent)	Short-term fungicidal use, dip and spray treatment, domestic wood preservation	General purpose timber	<ul style="list-style-type: none"> <li>• Solid waste</li> <li>• Landfill leachate</li> <li>• Liquid industrial and household cleaning waste</li> <li>• Wastewater</li> <li>• Sludge</li> <li>• Air</li> </ul>

<sup>3</sup> To be verified: intermediate product in obtaining colouring substances (OSPAR 2001).

In-situ treatment of wooden materials	PCP, Na-PCP	Fungicidal treatment of existing structures	Existing wooden materials	<ul style="list-style-type: none"> <li>• Solid waste</li> <li>• Landfill leachate</li> <li>• Liquid industrial and household cleaning waste</li> <li>• Wastewater</li> <li>• Sludge</li> <li>• Air</li> </ul>
Construction materials	Na-PCP	Surface biocide for masonry and other construction materials	Masonry Asbestos shingles Roof tiles Brick walls Concrete blocks Insulation Pipe sealing compound Wallboard	<ul style="list-style-type: none"> <li>• Solid waste</li> <li>• Landfill leachate</li> <li>• Liquid industrial and household cleaning waste</li> <li>• Wastewater</li> <li>• Sludge</li> <li>• Air</li> </ul>
Fibers and textiles	PCP-L	Preservation of production materials and protection against mildew	wool cotton flax jute yarns used in covers, tarpaulins awnings tents webbing netting sisal and manila ropes	<ul style="list-style-type: none"> <li>• Solid waste</li> <li>• Landfill leachate</li> <li>• Liquid industrial and household cleaning waste</li> <li>• Wastewater</li> <li>• Sludge</li> <li>• Air</li> </ul>
Leather	Na-PCP	Protection from molding	Leather	<ul style="list-style-type: none"> <li>• Solid waste</li> <li>• Landfill leachate</li> <li>• Liquid industrial and household cleaning waste</li> <li>• Wastewater</li> <li>• Sludge</li> <li>• Air</li> </ul>
Biocidal use as preservative	PCP, Na-PCP and PCP-L as a preservative for materials	Preservative for oil-based paint, glues and adhesives (especially those based on starch, vegetable protein, and animal protein)	(i) paints; (ii) glues, and; (iii) adhesives	<ul style="list-style-type: none"> <li>• Solid waste</li> <li>• Landfill leachate</li> <li>• Liquid industrial and household cleaning waste</li> <li>• Wastewater</li> <li>• Sludge</li> <li>• Air</li> </ul>
Pesticidal use as herbicide or fungicide	PCP, Na-PCP	Spraying		<ul style="list-style-type: none"> <li>• Solid waste</li> <li>• Landfill leachate</li> <li>• Liquid industrial and household cleaning waste</li> <li>• Wastewater</li> <li>• Sludge</li> <li>• Air</li> </ul>

## II. Relevant provisions of the Basel and Stockholm Conventions

### A. Basel Convention

46. Article 1 (“Scope of the Convention”) defines the waste types subject to the Basel Convention. Subparagraph 1 (a), of that Article sets forth a two-step process for determining if a “waste” is a “hazardous waste” subject to the Convention. First, the waste must belong to any category contained in Annex I of the Convention (“Categories of wastes to be controlled”). Second, the waste must possess at least one of the characteristics listed in Annex III of the Convention (“List of hazardous characteristics”).

47. Annex I and II lists some of the wastes which may consist of, contain or be contaminated with PCP and its salts and esters:

- (a) Pesticide PCP wastes could include:
  - (i) Y2: Wastes from the production and preparation of pharmaceutical products;
  - (ii) Y4: Wastes from the production, formulation and use of biocides and phytopharmaceuticals;
  - (iii) Y5: Wastes from the manufacture, formulation and use of wood preserving chemicals;
  - (iv) Y6: Wastes from the production, formulation and use of organic solvents;
  - (v) Y18: Residues arising from industrial waste disposal operations;
  - (vi) Y45: Organohalogen compounds other than substances referred to in this Annex I (e.g., Y39, Y41, Y42, Y43, Y44);
- (b) Waste of PCP, Na-PCP or PCP-L as an industrial chemical could include:
  - (i) Y5: Wastes from the manufacture, formulation and use of wood preserving chemicals;
  - (ii) Y6: Wastes from the production, formulation and use of organic solvents;
  - (iii) Y12: Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish;
  - (iv) Y13: Wastes from production, formulation and use of resins, latex, plasticizers, glues/adhesives;
  - (v) Y15: Wastes of an explosive nature not subject to other legislation;
  - (vi) Y39: Phenols, phenol compounds including chlorophenols;
  - (vii) Y41: Halogenated organic solvents;
  - (viii) Y43: Any congener of polychlorinated dibenzo-furan;
  - (ix) Y44: Any congener of polychlorinated dibenzo-p-dioxin;
  - (x) Y46: Wastes collected from households.

48. Annex I wastes are presumed to exhibit one or more Annex III hazard characteristics, which may include H3 Flammable liquids, H6.1 “Poisonous (Acute), H11 “Toxic (Delayed or chronic)”; H12 “Ecotoxic”; or H13 (Capable, by any means, after disposal, of yielding another material, e.g. leachate, which possesses any of the characteristics listed above)”, unless, through “national tests,” they can be shown not to exhibit these characteristics. National tests may be useful for identifying a particular hazard characteristic in Annex III of the Convention until such time as the hazardous characteristic is fully defined. Guidance papers for Annex III hazardous characteristics H11, H12 and H13 were adopted on an interim basis by the Conference of the Parties to the Basel Convention at its sixth and seventh meeting.

49. List A of Annex VIII of the Convention describes wastes that are “characterized as hazardous under Article 1, paragraph 1 (a), of this Convention.” However, “their designation of a waste on this Annex does not preclude, in a particular case, the use of Annex III [List of hazardous characteristics] to demonstrate that a waste is not hazardous” (Annex I, paragraph (b)). List A of Annex VIII includes a number of wastes or waste categories that have the potential to contain or be contaminated with PCP, its salts and esters, including:

- (a) 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);
- (b) A3070: Waste phenols, phenol compounds including chlorophenol in the form of liquids or sludges;
- (c) A3090: Waste leather dust, ash, sludges and flours when containing hexavalent chromium compounds or biocides (note the related entry on list B B3100);
- (d) A3100: Waste paring and other waste of leather or of composition leather not suitable for the manufacture of leather articles containing hexavalent chromium compounds or biocides (note the related entry on list B B3090);
- (e) A4010: Wastes from the production, preparation and use of pharmaceutical products but excluding such wastes specified on list B;
- (f) A4030: Wastes from the production, formulation and use of biocides and phytopharmaceuticals, including waste pesticides and herbicides which are off-specification, outdated, or unfit for their originally intended use;
- (g) A4040: Wastes from the manufacture, formulation and use of wood-preserving chemicals;
- (h) A4070: Wastes from the production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish excluding any such wastes specified on list B (note the related entry on list B B4010);
- (i) A4110: Wastes that contain, consist of or are contaminated with any of the following:
  - (i) Any congener of polychlorinated dibenzo-furan;
  - (ii) Any congener of polychlorinated dibenzo-p-dioxin;
- (j) A4130: Waste packages and containers containing Annex I substances in concentration sufficient to exhibit Annex III hazard characteristic);
- (k) A4140: Waste consisting of or containing off specification or outdated chemicals corresponding to Annex I categories and exhibiting Annex III hazard characteristics;
- (l) A4160: Spent activated carbon not included on list B (note the related entry on list B B2060).

50. List B of Annex IX lists wastes that will not be wastes covered by Article 1, paragraph 1 (a), unless they contain Annex I material to an extent causing them to exhibit an Annex III characteristic. List B of Annex IX includes a number of wastes or waste categories that have the potential to contain or be contaminated with PCP and its salts and esters, including:

- (a) B2040: Other wastes containing principally inorganic constituents<sup>4</sup>;
- (b) B2060: Spent activated carbon not containing any Annex I constituents to the extent they exhibit Annex III characteristics, for example, carbon resulting from the treatment of potable water and processes of the food industry and vitamin production (note the related entry on list A A4160));
- (c) B3020: Paper, paperboard and paper product wastes<sup>5</sup>;
- (d) B3030: Textile waste<sup>6</sup>;
- (e) B3035: Waste textile floor coverings, carpets.

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

## B. Stockholm Convention

52. The present guidelines cover intentionally-produced PCP and its salts and esters, whose production and use are to be eliminated in accordance with Article 3 and part I of Annex A to the Stockholm Convention.

<sup>4</sup> Refer to Annex IX to the Basel Convention to see the full entry.

<sup>5</sup> Ibid 4.

<sup>6</sup> Ibid 4.

53. Part VIII of Annex A to the Stockholm Convention outlines specific requirements for utility poles and cross-arms manufactured under the exemption, as follows:

“Each Party that has registered for the exemption pursuant to Article 4 for the production and use of pentachlorophenol for utility poles and cross-arms shall take the necessary measures to ensure that utility poles and cross-arms containing pentachlorophenol can be easily identified by labelling or other means throughout their life cycles. Articles treated with pentachlorophenol should not be reused for purposes other than those exempted.”

54. Further information on the register of specific exemptions for PCP is available from:

[www.pops.int](http://www.pops.int).

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

### **III. Issues under the Stockholm Convention to be addressed cooperatively with the Basel Convention**

#### **A. Low POP content**

56. The provisional definition of low POP content for PCP and its salts and esters is [] mg/kg.<sup>7</sup>

57. The low POP content described in the Stockholm Convention is independent from the provisions on hazardous waste under the Basel Convention.

58. Wastes with a content of PCP and its salts and esters above [] mg/kg must be disposed of in such a way that the POP content is destroyed or irreversibly transformed in accordance with the methods described in subsection IV.G.2. Otherwise, they may be disposed of in an environmentally sound manner when destruction or irreversible transformation does not represent the environmentally preferable option in accordance with the methods described in subsection IV.G.3.

59. Wastes with a content of PCP and its salts and esters at or below [] mg/kg should be disposed of in accordance with the methods referred to in subsection IV.G.4 of the general technical guidelines (outlining disposal methods when POP content is low), taking into account section IV.I.1 below (pertinent to higher-risk situations).

60. For further information on low POP content, refer to section III.A of the general technical guidelines.

#### **B. Levels of destruction and irreversible transformation**

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

#### **C. Methods that constitute environmentally sound disposal**

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

### **IV. Guidance on environmentally sound management (ESM)**

#### **A. General considerations**

63. For further information, see section IV.A of the general technical guidelines.

#### **B. Legislative and regulatory framework**

64. Parties to the Basel and Stockholm Conventions should examine their national strategies, policies, controls, standards and procedures to ensure that they are in agreement with the two conventions and their obligations under them, including those that pertain to ESM of PCP wastes.

65. Elements of a regulatory framework applicable to PCP and its salts and esters should include measures to prevent the generation of wastes and to ensure the ESM of generated wastes. Such elements could include:

- (a) Environmental protection legislation establishing a regulatory regime, setting release

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<sup>7</sup> Determined according to national or international methods and standards.

limits and establishing environmental quality criteria;

- (b) Prohibitions on the production, sale, use, import and export of PCP and its salts and esters, except in the case of parties that have notified the Secretariat of their intention to use or produce PCP in accordance with the time-limited specific exemption listed in Annex A to the Stockholm Convention;
- (c) A requirement that best available technologies (BAT) and best environmental practices (BEP) be employed in the production and use of PCP, in cases where parties have notified the Secretariat of their intention to use or produce PCP in accordance with the time-limited exemption listed in Annex A to the Stockholm Convention;
- (d) Measures to ensure that PCP wastes cannot be disposed of in ways that that may lead to recovery, recycling, reclamation, direct reuse or alternative uses other than those exempted in Annex A to the Stockholm Convention;
- (e) Adequate ESM controls to separate materials containing PCP and its salts and esters from materials that can be recycled (e.g., non-treated timber and textiles);
- (f) Measures necessary to ensure that utility poles and cross-arms containing PCP can be easily identified by labelling or other means throughout their life cycles. Articles treated with PCP should not be reused for purposes other than those exempted;
- (g) Transportation requirements for hazardous materials and waste;
- (h) Specifications for containers, equipment, bulk containers and storage sites for obsolete unused PCP, its salts and esters;
- (i) Specification of acceptable analytical and sampling methods for PCP, its salts and esters;
- (j) Requirements for waste management and disposal facilities;
- (k) Definitions of hazardous waste and conditions and criteria for the identification and classification of PCP wastes as hazardous wastes;
- (l) A general requirement for public notification and review of proposed government waste-related regulations, policies, certificates of approval, licences, inventory information and national releases and emissions data;
- (m) Requirements for identification, assessment and remediation of contaminated sites;
- (n) Requirements concerning the health and safety of workers; and
- (o) Legislative measures on, e.g., waste prevention and minimization, inventory development and emergency response.

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

### **C. Waste prevention and minimization**

67. Both the Basel and Stockholm conventions advocate waste prevention and minimization. The production and use of PCP, its salts and esters are to be eliminated under the Stockholm Convention, unless they fall under the exemptions listed in part I of Annex A to the Convention.

68. Minimization of waste and especially hazardous waste formation is addressed in Best Available Techniques (BAT) for wood preservation with chemicals defined for the Nordic countries (NCM, 2014). Articles treated with PCP should not be reused for purposes other than those exempted in Stockholm Convention Annex A.

69. Quantities of waste containing PCP, its salts and esters should be minimized through isolation and separation of those wastes from other wastes at source in order to prevent their mixing with, and contamination of, other waste streams.

70. The mixing and blending of wastes with PCP, its salts and esters content above [ ] mg/kg with other materials solely for the purpose of generating a mixture with a PCP, its salts and esters content at or below [ ] mg/kg are not environmentally sound. Nevertheless, the mixing or blending of materials as a pre-treatment method may be necessary in order to enable treatment or to optimize treatment efficiency.

71. For further information, see section IV.C on waste prevention and minimization of the general technical guidelines.

## D. Identification of wastes

72. Article 6, paragraph 1 (a), of the Stockholm Convention requires each party to, *inter alia*, develop appropriate strategies for the identification of products and articles in use and wastes consisting of, containing or contaminated with POPs. The identification of wastes containing PCP, its salts and esters is the starting point for their effective ESM.

73. For general information on identification and inventories, see section IV.D of the general technical guidelines.

### 1. Identification

74. PCP wastes can be found in:

(a) In residues from PCP, Na-PCP and PCP-L production and at sites where such pesticides were produced, formulated and stored;

(b) In storage facilities and at sites where PCP, Na-PCP and PCP-L were used or applied, e.g., at sawmills, wood preservation facilities, leather tanneries, textile production facilities, farms;

(c) In homes and historical buildings, outlets for pesticides, shopping centres, schools, hospitals, industrial facilities, office and apartment buildings, etc.;

(e) In contaminated materials, including protective clothing, application equipment and accessories, empty packaging materials, containers, floors, walls and windows;

(f) In facilities for the collection, recycling and recovery of timber, textiles, and leather and waste management facilities for pesticides;

(g) In soils, sediments and sewage sludges and in water that has been contaminated by, for example, spills;

(h) In commercial products containing PCP, Na-PCP or PCP-L, such as utility poles, cross-arms, railway sleepers, impregnated timber for outdoor applications, pallets, paints, glues, PCP-pesticides, construction materials; and

(i) At dumpsites and in landfills.

75. It should be noted that even experienced technical personnel may not be able to determine the nature of an effluent, substance, container or piece of equipment by its appearance or markings. Consequently, parties may find the information on production, use and types of waste provided in section I.B of the present guidelines useful in identifying articles and mixtures containing PCP, its salts and esters.

76. Specifically in a disposal facility of impregnated wood waste it can be difficult in practice to determine whether or not the wood waste is impregnated because of paint or weathering. In case of uncertainty, it should therefore be sorted as impregnated wood/hazardous waste under the precautionary principle. In practice, there is also a mixing of older impregnated wood, since the estimated average life expectancy of treated wood is 30 years. This means that the continued sorting of impregnated wood is important during the demolition of old wooden structures or other projects with uncertain wood composition. (NCM, 2014).

### 2. Inventories

77. When developing inventories on PCP wastes, it is important to consider the service lives of articles where they have been used and the timing of their placement on the market in relation to restrictions. The use of PCP, its salts and esters in articles largely depends on local practices and wood production. Service lives of preserved timber products depends on the type of use and on the kind of timber treated.

78. In several countries many historical applications of PCP, its salts and esters have ceased already decades ago due the national restrictions and introduction of alternatives with better environmental and health profile. Therefore a thorough consideration of potential uses is important to focus the inventory activities correctly.

## E. Sampling, analysis and monitoring

79. For general information on sampling, analysis and monitoring, see section IV.E of the general technical guidelines.

80. Sampling, analysis and monitoring procedures, as well as waste collection and handling processes, should be established for articles that may contain PCP, its salts and esters.

## 1. Sampling

81. Sampling serves as an important element for identifying and monitoring environmental concerns and human health risks.

82. Standard sampling procedures should be established and agreed upon before the start of the sampling campaign. Sampling should comply with specific national legislation, where it exists, or with international regulations and standards.

83. Types of matrices that are typically sampled for include:

(a) Liquids:

- (i) Liquid pesticide/fungicide formulations;
- (ii) Leachates from landfills;
- (iii) Biological fluids (urine, blood, in the case of worker health monitoring).

(b) Solids:

- (i) Solid formulations and production wastes;
- (ii) Soils, sediments and municipal and industrial sludges;
- (iii) Materials where PCP, its salts or esters have been used: e.g. timber, textiles, leather, building materials;
- (iv) Packaging.

## 2. Analysis

84. Analysis refers to the extraction, purification, separation, identification, quantification and reporting of PCP, its salts and esters concentrations in the matrix of interest. In order to obtain meaningful and acceptable results, analytical laboratories should have the necessary infrastructure (housing) and proven experience.

85. The development and dissemination of reliable analytical methods and the accumulation of high-quality analytical data are important to understand the environmental impact of hazardous chemicals, including POPs. In addition they are needed to determine whether the waste is classified hazardous.

86. PCP can be detected by color reactions including use of UV spectroscopy or thin layer chromatography. Analytical detection of PCP, its salts or esters is typically performed by capillary gas chromatography after derivatization with methyl or ethyl ether or acetic anhydride to form PCP-acetate (Buhr et al., 2000). Commonly used detectors include electron capture detectors (ECD) or mass selective detectors. Gas chromatographic standard methods are available for analysis of PCP and its esters in timber (Becker et al, 2002, USEPA Method 8270, New Zealand BS 5666-6:1983). In addition, X-ray fluorescence (XRF) based methods have been developed for analyzing PCP product strength, as well as its content in the impregnation solution, timber and saw dust.

87. Accurate methods for measuring PCP concentrations in textile samples by isotope dilution liquid chromatography-mass spectrometry exist (Su & Zhang, 2011). The limit of detection (LOD) was 1.0 ng/g and the limit of quantification (LOQ) 5.0 ng/g. Methods have also been published for determination of PCP in cotton, cotton products, leather and leather products (Mou et. al 1999). ISO 17070:2006 specifies a method for determining the content of PCP, its salts and esters in leather.

## 3. Monitoring

88. Monitoring and surveillance serve as elements for identifying and tracking environmental concerns and human health risks. Information collected from monitoring programmes feeds into science-based decision-making processes and is used for the evaluation of the effectiveness of risk management measures, including regulations.

89. Monitoring programmes should be implemented in facilities managing PCP, its salts and esters, as well as wastes containing them.

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

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

91. In cases where PCP wastes are considered hazardous wastes, they should be handled, collected, packaged, labelled, transported and stored as such in accordance with applicable provisions of national legislation. Individuals involved in the handling, collection, packaging, labelling, transportation and storage of hazardous waste should receive proper training.

92. In cases where waste containing PCP, its salts and esters was a household consumer product or article (e.g., textiles, leather, tarpaulin), specific handling, collection, packaging, labelling, transportation and storage considerations may not be required; such waste should be handled, collected, packaged, labelled, transported and stored in accordance with the environmentally sound management provisions of national legislation for that type of waste.

### **1. Handling**

93. The main concerns when handling PCP wastes are human exposure, accidental releases to the environment and contamination of other waste streams with PCP, its salts and esters. PCP wastes should be handled separately from other waste types in order to prevent contamination of other waste streams.

94. When conducting repairs in or renovation or demolition of older buildings, renovators and contractors should pay attention to the possibility of PCP, its salts and esters being contained in wooden materials, asbestos shingles, roof tiles, brick walls, concrete blocks, insulation, pipe sealing compound, wallboard and textiles (covers, awnings). Should these materials contain PCP, its salts and esters, they should be carefully removed and isolated to prevent dust from spreading to surrounding areas. The work should be conducted wearing appropriate protective equipment such as suitable gloves, disposable coveralls, protective goggles and respiratory protection masks that meet international standards.

95. Organizations handling waste containing PCP, its salts and esters should have in place a set of procedures for handling such wastes and workers should be trained in such procedures.

### **2. Collection**

96. Collection arrangements that include depots for PCP wastes should provide for the separation of PCP wastes from other wastes. In case the country has existing arrangement for separate collection of impregnated wood, these may also receive PCP wastes. Some of PCP wastes, however, may be difficult to identify as PCP-treated material.

97. Collections depots should not become long-term storage facilities for PCP wastes.

### **3. Packaging**

98. In cases where PCP wastes are considered hazardous wastes they should be properly packaged in accordance with the applicable provisions of national legislation.

### **4. Labelling**

99. In cases where PCP wastes are considered hazardous wastes, every container should be clearly labelled with a hazard warning label and a label providing details of the container and a unique serial number. Such details should include container contents (e.g., exact counts of equipment, volume, weight, type of waste carried), the name of the site from which the waste originated so as to allow its traceability, the date of any repackaging and the name and telephone number of the person responsible for the repackaging operation.

100. Each Party that has registered for the exemption pursuant to Article 4 of the Stockholm Convention for the production and use of PCP for utility poles and cross-arms shall take the necessary measures to ensure that utility poles and cross-arms containing PCP can be easily identified by labelling or other means throughout their life cycles.

### **5. Transportation**

101. In cases where PCP wastes are considered hazardous wastes, they should be transported in accordance with applicable provisions of national legislation.

**6. Storage**

102. PCP wastes should be stored in designated sites and appropriate measures should be taken to prevent the scattering, release and underground seepage of PCP, its salts and esters, and to control the spread of odors.

103. Appropriate measures, such as the installation of partitions, should be taken to avoid contamination of other materials and wastes with PCP, its salts and esters.

104. Storage areas for PCP wastes should have adequate access roads for vehicles.

105. Large amounts of PCP wastes in storage should be protected from fire, as those wastes are often inherently flammable.

**G. Environmentally sound disposal****1. Pre-treatment**

106. For information, see subsection IV.G.1 of the general technical guidelines.

**2. Destruction and irreversible transformation methods**

107. Destruction and irreversible transformation methods for the environmentally sound disposal of wastes with a content of PCP, its salts and esters above [] mg/kg include, according to the general technical guidelines, at least:

- (a) [Cement kiln co-incineration;]
- (b) [Hazardous waste incineration; and]
- (c) [Advanced Solid waste incineration (ASWI).]

108. For further 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**

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

**4. Other disposal methods when the POP content is low**

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

**H. Remediation of contaminated sites**

111. Soil contamination can take place over a long period of operation by accumulation and also from spills events. Contaminated sites may also have high levels of PCDDs and PCDFs due to the release of contaminants in PCP products (Kitunen, 1990, Naturvårdsverket, 2009, UNEP/POPS/POPRC.9/13/Add.3).

112. For information, see section IV.H of the general technical guidelines.

**I. Health and safety**

113. For information, see section IV.I of the general technical guidelines.

**1. Higher-risk situations**

114. For general information, see subsection IV.I.1 of the general technical guidelines.

115. Higher-risk situations occur at sites where high concentrations or high volumes of PCP wastes are found and a high potential for exposure of workers or the general population exists. Direct dermal exposure to and inhalation of fine dust or particles containing PCP, its salts and esters in the workplace are of particular concern. For example, industrial workers at wood preservation facilities, historical buildings, and general population using wood preservatives in homes may be exposed to high amounts.

116. While articles containing PCP, its salts and esters are not documented to exhibit specific risks to the environment and human health during their handling, collection, transportation and storage, it

is important to bear in mind that large quantities of such wastes, even if properly stored, are more likely to present risks than smaller quantities scattered over large areas.

117. PCP treated wood can be a source of dioxins and furans (Bulle et al. 2010; Fries et al. 2002; Lee et al. 2012; Lorber et al. 2002). Concentrations of dioxin and furans, present as impurities, decreased after legal measures were taken in the U.S. and Europe between 1987 and 1999 (UNEP/POPS/POPRC.9/13/Add.3).

118. Higher-risk situations specific to PCP, its salts and esters may occur:

- (a) At sites where PCP, its salts and esters are produced;
- (b) At sites where wood, leather and textiles treated with PCP, its salts and esters are processed, including installation of utility poles and cross-arms;
- (c) At construction waste management facilities;
- (e) At wood, textile and leather waste management facilities.

**2. Lower-risk situations**

119. For information on lower-risk situations, see subsection IV.I.2 of the general technical guidelines.

**J. Emergency response**

120. Emergency response plans should be in place at sites where PCP, its salts and esters are produced (where allowed), used, stored, transported or disposed of. Further information on emergency response plans is given in section IV.J of the general technical guidelines.

**K. Public participation**

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

## Annex I to the technical guidelines

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## Annex II to the technical guidelines

### Analytical Methods ISO

DIN EN ISO 17070:2015-05 (replaces DIN EN ISO 17070:2007-01)

Titel (deutsch): Leder - Chemische Prüfungen - Bestimmung des Gehalts an Tetrachlorphenol-, Trichlorphenol-, Dichlorphenol-, Monochlorphenol-Isomeren und Pentachlorphenol (ISO 17070:2015); Deutsche Fassung EN ISO 17070:2015

Titel (englisch): Leather - Chemical tests - Determination of tetrachlorophenol-, trichlorophenol-, dichlorophenol-, monochlorophenol-isomers and pentachlorophenol content (ISO 17070:2015);

DIN EN ISO 15320:2011-11

Zellstoff, Papier und Pappe - Bestimmung von Pentachlorphenol in einem wässrigen Extrakt (ISO 15320:2011); Deutsche Fassung EN ISO 15320:2011

Pulp, paper and board - Determination of pentachlorophenol in an aqueous extract (ISO 15320:2011);

VDI 4301 Blatt 2:2000-06

Titel (deutsch): Messen von Innenraumluftverunreinigungen - Messen von Pentachlorphenol (PCP) und  $\gamma$ -Hexachlorcyclohexan (Lindan) - GC/MS-Verfahren

Indoor air pollution measurement - Measurement of pentachlorophenol (PCP) and  $\gamma$ -hexachlorcyclohexane (lindane) - GC/MS-method

PD CEN/TR 14823:2003-11-06

Titel (deutsch): Dauerhaftigkeit von Holz und Holzprodukten. Quantitative Bestimmung von Pentachlorphenol in Holz. Gaschromatographische Verfahren

Titel (englisch): Durability of wood and wood-based products. Quantitative determination of pentachlorophenol in wood. Gas chromatographic method

German only

DIN-Fachbericht CEN/TR 14823:2004

Titel (deutsch): Dauerhaftigkeit von Holz und Holzprodukten - Quantitative Bestimmung von Pentachlorphenol in Holz - Gaschromatographisches Verfahren; Deutsche Fassung CEN/TR 14823:2003

VDI 4301 Blatt 3:2003-06

Messen von Innenraumluftverunreinigungen - Messen von Pentachlorphenol (PCP) und  $\gamma$ -Hexachlorcyclohexan (Lindan) - GC/ECD-Verfahren

## Annex III to the technical guidelines

### Trade names of commercial formulations containing PCP

List of countries where PCP formulations have been on the market is indicative.

Trade name	Countries
Acutox	
Anti-Pa IV Husbock	SE
Block Penta	USA
BP Hylosan	SE
Chem-Penta	
Chem-Tol	
Chlon	
Chlorophen	USA
Cryptogil Oil	
Cryptogil OL	
Dirotox	
Dow Pentachlorophenol DP-2 Antimicrobial	
Dowcide 7/EC-7/G	USA
Dowicide 6	USA
Dowicide 7	USA
Dowicide 7 Antimicrobial	USA
Dowicide G	USA, SE
Dura Treat II	
Dura Treat 40	USA
Durotox	
EP 30	
Forpen-50 Wood Preservative	
Fungifen	
Gantix HB Ijus	SE
Glazd Penta	
Grundier Arbezol	
Gullviks Husbockscupral	SE
Husbocks-Cuprinol	SE
1-hydroxypentachlorobenzene	
KMG Technical Penta Flakes	USA, CAN
KMG Technical Penta Blocks	USA, CAN
KMG Penta OL Blocks	USA, CAN
KP Cuprinol	SE
Ky-5 (tetrachlorophenol)	FI, SE
Lautor A	
Lauxtol	
Lauxtol A	
Liroprem	
OnTrack We Herbicide	
Ortho Triox Liquid Vegetation Killer	
Osmose Wood Preserving Compound	
PCP	USA
Penchlorol	USA

<b>Trade name</b>	<b>Countries</b>
Penta	USA
Penta C 30	
Penta Concentrate	
Penta Plus 40	
Penta Pres 1 10	
Penta Ready	
Penta solignum	SE
Penta WR	
Penta WR1-5	
Penwar	
Pentachlorofenol	SE
Pentachlorophenate	
2, 3, 4, 5, 6 pentachlorophenol	
Pentachlorophenol DP-2	
Pentachloropheno	
Pentachlorphenol	
Pentacon	
Penta-kil	
Pentasol	
Pentchloral	
Penwar	
Peratox	
Permacide	
Permagard	
Permasan	
Permatox	
Permatox DP-2	
Permatox Penta	
Permite	
Persasan	
Prevenol	
Priltox	
Santobrite	
Santophen	
Santophen 20	USA
Sautox	
Sinituho	FI
Sontox	USA
Term-i-Trol	
Thompson's Wood Fix	
Watershed Wood Preservative	
Weed and Brush Killer	
Weedone	
Withophen P	DE
Withophen N	DE
Woodtreat	
Woodtreat A	
Xyladecor	DE
Xylamon	DE