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**Conference of the Parties to the Basel Convention  
on the Control of Transboundary Movements of  
Hazardous Wastes and Their Disposal  
Thirteenth meeting**

Geneva, 24 April–5 May 2017

Agenda item 4 (b) (i)

**Matters related to the implementation of the Convention:  
scientific and technical matters: technical guidelines**

## **Technical guidelines**

### **Addendum**

#### **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**

At its thirteenth meeting, the Conference of the Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal adopted, in decision BC-13/4 on technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants, the Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with pentachlorophenol and its salts and esters, on the basis of the draft technical guidelines contained in document UNEP/CHW.13/6/Add.3. The technical guidelines referred to above were prepared by the Secretariat, in consultation with the small intersessional working group on the development of technical guidelines on persistent organic pollutants wastes and taking into account comments received from Parties and others and comments provided at the tenth meeting of the Open-ended Working Group of the Basel Convention. The technical guidelines were further revised on 1 March 2017 taking into account the outcome of the face-to-face meeting of the small intersessional working group on the development of technical guidelines on persistent organic pollutants wastes held from 20 to 22 February 2017 in Bonn, Germany (see document UNEP/CHW.13/INF/62). The text of the final version of the technical guidelines, as adopted, is set out in the annex to the present note. The present note, including its annex, has not been formally edited.

## **Annex**

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

**Revised final version (5 May 2017)**

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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
I-TEQ	International Toxic Equivalent
Na-PCP	sodium pentachlorophenate
OECD	Organisation for Economic Co-operation and Development
PBT	polybutylene terephthalate
PCA	pentachloroanisole
PCB	polychlorinated biphenyl
PCDD(s)	polychlorinated dibenzo- <i>p</i> -dioxin(s)
PCDF(s)	polychlorinated dibenzo-furan(s)
PCP	pentachlorophenol
PCP-L	pentachlorophenyl laurate
POP	persistent organic pollutant
TEQ	toxic equivalent
UNEP	United Nations Environment Programme
XRF	X-ray fluorescence

## Units of measurement

mg	milligram (10 <sup>-3</sup> gram)
mg/kg	milligram(s) per kilogram. Corresponds to parts per million (ppm) by mass
µg	microgram (10 <sup>-6</sup> gram)
µg/kg	microgram(s) per kilogram. Corresponds to parts per billion (ppb) by mass

## I. Introduction

### A. Scope

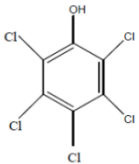
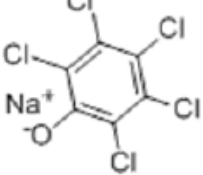
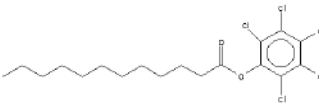
1. The present technical guidelines provide guidance on the environmentally sound management (ESM) of wastes consisting of, containing or contaminated with pentachlorophenol (PCP) and its salts and esters, pursuant to several decisions adopted by the bodies of two multilateral environmental agreements on chemicals and wastes.<sup>1</sup>
2. PCP and its salts and esters were listed in Annex A (elimination) to the Stockholm Convention in 2015, through an amendment that entered into force in 15 December 2016.
3. The present technical guidelines should be used in conjunction with the General technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants” (UNEP, 2017a) (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).
4. In addition, the use of PCP as a pesticide is addressed in more detail in the 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, hexachlorobutadiene, lindane, mirex, pentachlorobenzene, pentachlorophenol and its salts, perfluorooctane sulfonic acid, technical endosulfan and its related isomers or toxaphene or with hexachlorobenzene as an industrial chemical (UNEP, 2017b).

### 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) (see structural formulas in Table 1), according to note (vi) in part I of Annex A of the the Stockholm Convention.

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

	Pentachlorophenol	Sodium pentachlorophenate	Pentachlorophenyl laurate
Chemical name and abbreviation	2,3,4,5,6-pentachlorophenol (PCP)	Na-PCP	PCP-L
CAS number	87-86-5	131-52-2 and 27735-64-4 (as monohydrate)	3772-94-9
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>
Molecular Mass	266.34 g/mol	288.32 g/mol	448.64 g/mol
Structural formulas of PCP, its salt and ester, as well as the main transformation product			

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

<sup>1</sup> Decisions BC-12/3 and BC-13/4 of the Conference of the Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal; decision OEWG-10/4 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.

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; German Federal Environment Agency, 2015).

7. Other chlorophenol-based preservatives produced may also contain significant amounts of PCP. Pulp and paper mill effluents may also contain unintentionally produced PCP from chlorine bleaching (Chandra et al., 2008).

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 et al, 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. Due to the concentration of PCP/PCA observed in humans, adverse effects for human health related to the toxicities listed above cannot be excluded. Where long-term monitoring data exists, concentrations of PCP are decreasing in air and biota (Zheng et al., 2011; Rylander et al., 2012; UNEP/POPS/POPRC.9/13/Add.3).

9. According to the Stockholm Convention Persistent Organic Pollutants Review Committee risk profile (UNEP/POPS/POPRC.9/13/Add.3;) 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.

## 2. Production

10. 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/>).

11. There are three main routes of PCP 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).

12. Na-PCP and PCP-L in turn are produced using PCP as a starting material (OSPAR, 2001; German Federal Environment Agency, 2015).

13. In the early 1980s 50,000 – 90,000 tonnes of PCP per year were produced globally. In 1987, the world production of PCP was estimated at the order of 30,000 tonnes per year (WHO, 1987). Since then, the production is significantly lower because of use restrictions in many countries (UNEP/POPS/POPRC.10/10/Add.1). There is no information on the current production trends. PCP and Na-PCP are currently produced for industrial wood preservation, especially treatment of utility poles, cross-arms, and outdoor construction material in non-residential constructions. Na-PCP was also produced in Samara region, Russian Federation, with annual capacity of 2,400 tonnes (Kluev et al., 2001).

14. PCP was first introduced for use as wood preservative in 1936. Commercial significance has been reported since 1950s and 1960s (Kitunen, 1990; USWAG, 2008; Swedish Environmental Protection Agency, 2009; Environment Canada, 2013).
15. As of 2014, PCP and its salts were manufactured at least in Mexico and India. In 2009, KMG Bernuth in the USA formulated 7,257 tonnes of PCP from Mexico for wood preservation purposes in the USA, Canada, and Mexico (UNECE, 2010). 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 annually in India (Indian Chemicals Council, 2014).
16. Historically PCP or Na-PCP have been produced at least in Brazil, China, former Czechoslovakia, Denmark, France, Germany, Poland, Spain, Switzerland, former USSR and the United Kingdom. In the European Union (EU) production of PCP and its salts stopped in 1992, while production PCP-L continued until year 2000 (WHO, 1987; EC, 1994a; EC, 1994b; EC, 1996; UNECE, 2010; UNEP/POPS/POPRC.9/13/Add.3; German Federal Environment Agency, 2015). PCP-L has been produced at least in China and the United Kingdom (UNECE, 2010; Indian Chemicals Council, 2014). PCP containing tetrachlorophenol formulation Ky-5 used in Finland and Sweden was produced between 1940 and 1984. In Brazil, production of PCP and Na-PCP started in 1966, and it was banned in 2006. The total production was estimated at 10,600 tonnes of PCP, 27,900 tonnes of Na-PCP until 1978 (Castelo Branco, 2016). Tradenames of products that contain or have contained PCP, Na-PCP or PCP-L are listed in Annex II to these technical guidelines.
17. PCP can be formed as a transformation product and metabolite from other organochlorines such as HCB, HCH (lindane) and PCNB (quintozene). Atmospheric oxidation of HCB has been confirmed as a global secondary source of PCP (Kovacevic et al., 2016). The extent of these potential sources of PCP into the environment cannot be quantified. In addition, contaminants including HCB, pentachlorobenzene, polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are produced in the manufacturing process of PCP (UNEP/POPS/POPRC.9/13/Add.3; UNEP/POPS/POPRC.10/10/Add.1, USWAG 2008). Significant environmental contamination from illegal dumping of production PCP and other chlorinated chemicals production waste has been reported for Cubãtao, Sao Paulo, Brazil (Castelo Branco, 2016).
18. Significant PCDD and lesser PCDF formation have been associated with the production of chlorophenol-based wood preservatives. PCP treated wood can thus be a source of PCDDs/PCDFs (Bulle et al., 2010; Fries et al., 2002; Lee et al., 2006; 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). The most recent analysis showed average concentrations of 634 µg TEQ per kg of PCP (Tondeur et al., 2010) and of 12,5 µg per kg of PCP-Na (the People's Republic of China, 2007). Levels of 0,130–26 µg I-TEQ PCDDs and PCDFs /kg 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 PCDDs/PCDFs (I-TEQ) (Swedish Environmental Protection Agency, 2009).

### 3. Use<sup>2</sup>

19. 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/>).
20. PCP is one of the three major industrial wood preservatives (the other two are Chromated Copper Arsenate (CCA) and creosote), but it has also been used for a variety of other applications (e.g., a general herbicide, biocide, pesticide, disinfectant, defoliant, anti-sapstain agent, anti-microbial agent and is used in the production of Na-PCP as well as PCP-L). Na-PCP was often used

<sup>2</sup> "Use" covers the use of chemicals PCP and its salts and esters for the production of products and articles, as well as the use of those products and articles.

for wood treatment due to its better water solubility compared to PCP. Na-PCP readily dissociates to PCP. PCP-L was developed especially for application on fabrics.

21. Currently use of PCP appears to be allowed worldwide only for wood preservation in the production of impregnated timber. 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 (Indian Chemicals Council, 2014). As of 2014, no country had reported use of PCP-L any longer (UNEP/POPS/POPRC.10/10/Add.1).

22. 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).

23. Na-PCP is used for anti-sapstain dip or spray treatment. The active compounds are supplied as powders or water-based concentrates for mixing or dilution, for use at solution concentrations of 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).

24. 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 1990s PCP-L was used in jute fabrics from which PCP-L could migrate to the fibres of woollen carpets. PCP-L use continued for preservation of heavy duty military textiles (e.g. used in transport and tents) still in 2000s 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, Institute of Environmental Protection, 2008; German Federal Environment Agency, 2015).

25. PCP, Na-PCP and PCP-L have all been used at least until 1980s also for example as preservative in oil-based paintlike products, as preservative in starches, dextrans and glues (leather, toilet paper, carpets etc.) and in adhesives, as an intermediate product for the synthesis of pharmaceuticals, as an intermediate product in obtaining colouring substances (anthraquinone colorants and intermediates), in mushroom farms for wooden trays where mushrooms are grown, in slime control in pulp and paper production, cooling tower water, and as an agricultural chemical in weed control (for instance as a fungicide or on crops as a defoliant) (OSPAR, 2001; Institute for Environmental Protection, 2008).

26. PCP, its salts and esters have been used for many different purposes in different countries and regions (see Table 2), but the use was discontinued in many countries by the 1990s. Already in 1996 it was restricted at least in 30 countries (EC, 1996).

27. Currently, there are no new uses of PCP in Australia, China, in the EU, 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, the 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 (Swedish Environmental Protection Agency, 2009).

28. The information collected for the Stockholm Convention Risk Profile showed that every country with wood preservation uses has reported also additional restrictions and/or regulations in place for managing the wood preservation industry, including Belize, Canada, Mexico and the United States of America (USA). 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) and



Brazil. In Europe PCP, its salts and esters have been used in a variety of different sectors until 2008. (EC, 1994a; EC, 1994b; EC, 1996; UNEP/POPS/POPRC.9/13/Add.3; German Federal Environment Agency, 2015).

**Table 2:** Current and historical uses of PCP, Na-PCP and PCP-L in different countries and regions (Institute of Environmental Protection, 2008; UNEP/POPS/POPRC.9/13/Add.3).<sup>3</sup>

Country	PCP uses	Other information
Australia	Anti-sapstain fungicide and timber preservative.	
Brazil	Wood preservative, preservative for sisal ropes, and termiticide.	Uses and import were banned in 2006 after a toxicology and ecotoxicology review by health and environmental authorities. Brazil imported 2,300 t of PCP and Na-PCP between 1989 and 2003 (Almeida et al., 2007).  PCP is also known as “pó da China” in literature and in academic articles.
Canada	Treatment of wood for utility poles, cross-arms, outdoor construction timbers, pilings and railway ties. Historical uses include anti-sapstain and specialty applications (paints, stains, wood joinery products, industrial water treatment products, oil field biocides and material preservatives).	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). All sapstain control and all other uses (e.g., domestic wood preservatives) were withdrawn in 1990 (UNEP/POPS/POPRC.9/13/Add.3)
China	Historical use for wood preservation for railway construction and as molluscicide	
EU	Historical uses as:  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 thousand milligrams per kilogram (German Federal Environment Agency, 2015). In other EU countries PCP was applied mainly outside of houses. 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	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 (Royal Haskoning, 2002). Portugal reported use for treatment of pallet boards, construction timber and fencing panels.  All PCP uses were terminated in 2008 but many member states had restricted it much earlier.

<sup>3</sup> The use of PCP as a pesticide is addressed in more detail in the technical guidelines on the environmentally sound management of POPs pesticides (UNEP, 2017b).

	ropes) until 2002 (European Commission, 2011);  Preservative in oil-based paint, glues, adhesives, joint sealants, casting compounds, and varnishes;  Intermediate in the synthesis of pharmaceuticals;  Intermediate product in colouring substances;  Slime control bactericide in tanning and pulp and paper industries;  Molluscicide in the treatment of industrial water, in particular cooling water;  Weed control in agriculture;  Preservative in mushroom production;  Surface biocide for masonry.	
India	PCP in tanning industry (UNEP/POPS/POPRC.9/13/Add.3).  Na-PCP 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).	
Japan	Historical use as herbicide in rice paddy fields (Minomo et. al 2011) and fungicide for agricultural use.	As of 1990, registration for production, processing and import of all 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.
Mexico	Adhesives, tannery, paper and textile.	
USA	Historical uses as a herbicide, defoliant, mossicide and disinfectant (USEPA, 2016).  Currently PCP is predominantly used to treat utility poles and cross-arms, where only pressure and thermal treatments of PCP are allowed.  PCP has also been used for treatment of sapstain, 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;;UNEP/POPS/POPRC.9/13/Add.3)	There are an estimated 130–135 million preservative-treated wood utility poles in service, 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). The domestic consumption in the USA has fallen since the 1970s 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)
Former	Historical use in preservation of commercial timber, paints, varnishes, paper, textiles, ropes,	In the former USSR, Na-PCP was used for commercial timber

USSR	and leather, and as nonselective herbicide and a desiccant on cotton plants (WHO, 1987).	treatment for 30 years (Troyanskaya & Veliamidova, 2009).
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29. More detailed information on current uses as informed by countries is provided in Appendix V of UNEP/POPS/POPRC.9/INF/7. The concentration of PCP in the treated product is dependent on the treatment method and the material (Table 3). 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 of wood (Environment Canada, 2013).

**Table 3:** 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) (150-280 mg/kg) <sup>4</sup>	Swedish Environmental Protection Agency, 2009
Typical preservative retention in pressure treated wood	3.4 – 16 kg PCP/m <sup>3</sup> of treated wood (5 100-45 700 mg/kg) <sup>5</sup> 4.8 – 7.2 kg PCP/m <sup>3</sup> (southern pine) (7 200-20 500 mg/kg) <sup>6</sup> 5 kg/m <sup>3</sup> (7 500 -14 200 mg/kg) <sup>7</sup>	Environment Canada, 2013 USWAG, 2008 Swedish Environmental Protection Agency, 2009
Average PCP concentration in treated and air-dried wood	625 mg/kg	European Commission, 2011
Textiles	2 % (20 000 mg/kg)	OSPAR, 2001
Wool carpets	>50 mg/kg	Wimbush, 1989
Leather	0.1% <sup>8</sup> (1000 mg/kg) 0.25% (2500 mg/kg)	Abrams, 1948
Cooling water	28 mg/l (Na-PCP)	Cirelli, 1977

#### 4. Wastes

30. 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 in 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). PCP was the main active ingredient in certain wood preservatives for home use, and was added to products such as stains and paints;

(b) Typical PCP-L applications have been for military textiles, 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 (European Commission, 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 brushtreated 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

<sup>4</sup> Indicative for pine density 350-660 kg/m<sup>3</sup>

<sup>5</sup> Indicative for pine density 350-660 kg/m<sup>3</sup>

<sup>6</sup> Indicative for pine density 350-660 kg/m<sup>3</sup>

<sup>7</sup> Indicative for pine density 350-660 kg/m<sup>3</sup>

<sup>8</sup> NB: very little information available. The only reference available 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)

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 (Swedish Environmental Protection Agency, 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; Swedish Environmental Protection Agency, 2009; BOPRC, 2016). Also high PCP concentrations have been measured in soils around southern pine utility poles in service (max 5 800 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 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.

31. 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 and preparations:
  - (i) Obsolete or unused PCP, Na-PCP, and PCP-L (liquid or blocks);
  - (ii) Filtration sludge from Na-PCP production.
- (b) Liquid and solid wastes from woodtreatment 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 vacuum cleaning equipment;
  - (vi) Clean up absorbents;
- (c) Products and 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, wool, cotton, flax and jute fabrics and yarns;
  - (iv) Treated starches, dextrans, glues and adhesives;
  - (v) Cooling tower water.
- (d) Contaminated soils;
- (e) Municipal and industrial sludge and landfill leachate.

32. 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, including ammunition crates (USEPA, 1984), textiles in heavy-duty transport, and tents.

33. 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) Other solid waste from wood preservation facilities (including sludges from sumps, concentrate and work solution tanks, and pressure cylinders, sludges from wastewater treatment processes (e.g. flocculated materials) and filters from cleaning vacuum);
- (d) PCP solid blocks for preservative use;
- (e) Packages used for PCP and its salts and esters;
- (f) Textiles treated with PCP and its salts and esters.

34. 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 4 provides an overview of relevant information regarding the life cycle of wastes containing PCP and its salts and esters.

**Table 4:** 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 (including filtration sludge)</li> <li>• Landfill leachate</li> <li>• Waste water</li> <li>• Sludge</li> <li>• Air</li> </ul>
	PCP (intermediate use)	Synthesis of pharmaceuticals and colouring substances <sup>9</sup>	Pharmaceuticals and colouring substances with potential PCP residues	
<b>PRODUCTION OF ARTICLES USING PCP, 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 waste</li> <li>• Wastewater</li> <li>• Sludge</li> <li>• Air</li> </ul>
<b>In-situ treatment of wooden materials</b>	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>
<b>Construction materials</b>	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>

<sup>9</sup> PCP is reported to occur as an intermediate product in obtaining colouring substances (OSPAR 2001), but there is no information on PCP residues.

<b>Fibers and textiles</b>	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>
<b>Leather</b>	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>
<b>Biocidal use as preservative</b>	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)	paints, glues, and 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>
<b>Pesticidal use<sup>10</sup></b>	PCP, Na-PCP	Spraying	Algaecides, bactericides, fungicides, herbicides, insecticides, molluscicides, defoliant, germicide	<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

35. 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”).

36. 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) 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;

<sup>10</sup> The use of PCP as a pesticide is addressed in more detail in the technical guidelines on the environmentally sound management of POPs pesticides (UNEP, 2017b).

- (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) Y39: Phenols, phenol compounds including chlorophenols;
  - (vi) Y41: Halogenated organic solvents;
  - (vii) Y43: Any congener of polychlorinated dibenzo-furan;
  - (viii) Y44: Any congener of polychlorinated dibenzo-p-dioxin;
  - (ix) Y46: Wastes collected from households.
- (b) 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);

37. 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.

38. 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:
- Any congener of polychlorinated dibenzo-furan;
  - 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).

39. 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) 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));
- (b) B3020: Paper, paperboard and paper product wastes;<sup>11</sup>
- (c) B3030: Textile waste;<sup>12</sup>
- (d) B3035: Waste textile floor coverings, carpets;
- (e) B4020: Wastes from production, formulation and use of resins, latex, plasticizers, glues/adhesives.<sup>13</sup>

40. For further information, see section II.A of the General technical guidelines.

## **B. Stockholm Convention**

41. 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.

42. 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.”

43. Further information on the register of specific exemptions for PCP is available from: [www.pops.int](http://www.pops.int).

44. For further information, see section II.B of the General technical guidelines.

<sup>11</sup> Refer to Annex IX to the Basel Convention to see the full entry.

<sup>12</sup> *Ibid* 11.

<sup>13</sup> *Ibid* 11.

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

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

45. The provisional definition of low POP content for PCP and its salts and esters is 100 mg/kg.<sup>14</sup>

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

47. Wastes with a content of PCP and its salts and esters above 100mg/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.

48. Wastes with a content of PCP and its salts and esters at or below 100mg/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).

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

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

50. 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**

51. See section IV.G below and section IV.G of the General technical guidelines.

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

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

52. For further information, see section IV.A of the General technical guidelines.

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

53. 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.

54. 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 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

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<sup>14</sup> Determined according to national or international methods and standards.

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.

55. For further information, see section IV.B of the General technical guidelines.

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

56. Both the Basel and Stockholm conventions advocate waste prevention and minimization. The production and use of PCP and 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.

57. 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 (Nordic Council of Ministers, 2014). Articles treated with PCP should not be reused for purposes other than those exempted in Stockholm Convention Annex A.

58. 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.

59. The mixing and blending of wastes with PCP, its salts and esters content above 100 mg/kg with other materials solely for the purpose of generating a mixture with a PCP, its salts and esters content at or below 100 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.

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

### **D. Identification of wastes**

61. 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.

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

#### **1. Identification**

63. PCP wastes can be found:

- (a) In residues from PCP, Na-PCP and PCP-L production and at sites where such chemicals 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.;

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

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

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

(g) 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

(h) At dumpsites and in landfills.

64. 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.

65. 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 (Nordic Council of Ministers, 2014).

## 2. Inventories

66. 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.

67. In several countries many historical applications of PCP and 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

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

69. 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

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

71. 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.

72. 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) Foodstuff (e.g. guar gum);
  - (v) Packaging.

## 2. Analysis

73. 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.

74. 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.

75. PCP can be detected by color reactions including use of UV spectroscopy or thin layer chromatography. 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. Compound-specific detection of PCP, its salts or esters can be performed by capillary gas chromatography after derivatization with methyl or ethyl ether or acetic anhydride to form PCP-acetate (Buhr et al., 2000) or without derivatization using liquid chromatography. Commonly used detectors include electron capture detectors (ECD) or mass selective detectors.

76. Production or consumer goods relevant methods are available, such as gas chromatographic methods for analysis of chlorophenols, salts and esters including PCP in leather and leather and fur technology (ISO 17070:2015), PCP and its esters in timber (Becker et al, 2002; USEPA Method 8270; New Zealand BS 5666-6:1983) or pentachlorophenol residues in cotton, cotton products textiles and leather, and leather products (Mou et. al, 1999). A liquid chromatography-mass spectrometry method using isotope dilution was developed for measuring PCP concentrations in textile samples (Su & Zhang, 2011). The limit of detection (LOD) was 1.0 ng/g and the limit of quantification (LOQ) 5.0 ng/g.

77. For more information on analytical methods, see Annex III.

## 3. Monitoring

78. Monitoring and surveillance serve as means 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.

79. 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

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

81. 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.

82. 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**

83. 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.

84. 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.

85. 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**

86. 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.

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

**3. Packaging**

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

89. PCP wastes should be placed into leak-proof, sealed drums, where appropriate after draining.

**4. Labelling**

90. 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.

91. 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**

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

**6. Storage**

93. 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.

94. 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.

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

96. 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**

97. Liquid PCP wastes (e.g. washwaters, condensates) should be processed to remove oil and PCP before being discharged. Treatment techniques can include: gravity separation, oil/water API separation, plate separation, activated sludge treatment, activated carbon treatment, physical-chemical treatment (i.e. flocculation), evaporation/condensation.

98. For further information, see subsection IV.G.1 of the General technical guidelines.

### **2. Destruction and irreversible transformation methods**

99. 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**

100. For information, see subsection IV.G.3 of the General technical guidelines.

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

101. For information, see subsection IV.G.4 of the General technical guidelines.

## **H. Remediation of contaminated sites**

102. 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; Swedish Environmental Protection Agency, 2009; UNEP/POPS/POPRC.9/13/Add.3).

103. For information, see section IV.H of the General technical guidelines.

## **I. Health and safety**

104. For information, see section IV.I of the General technical guidelines.

### **1. Higher-risk situations**

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

106. 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.<sup>15</sup> Direct dermal exposure to and inhalation of fine dust or particles containing PCP, its salts and esters in the workplace or home are of particular concern. For example, industrial workers at wood preservation facilities, historical buildings, and general population using wood preservatives in largely uncontrolled manner in homes may be exposed to high amounts.

107. 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.

108. 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;
- (d) At wood, textile and leather waste management facilities.

### **2. Lower-risk situations**

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

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<sup>15</sup> For example, health impacts were identified for workers of organochlorine production facility in Brazil (ACPO, 2004).

**J. Emergency response**

110. 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**

111. 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

### Trade names of commercial formulations that contain or have contained PCP, its salts or esters<sup>1</sup>

List of identified trade names that contain or have contained PCP, its salts or esters and countries where they have been placed on the market.<sup>2</sup>

1-Hydroxy-2,3,4,5,6-pentachlorobenzene; 1-Hydroxypentachlorobenzene; 2,3,4,5,6-pentachlorophenol; Acutox; Albapin; Anti-Pa IV Husbock (SE); Arbezol; Block Penta (USA); BP Hylosan (SE); Chem-Penta; Chem-Pentas; Chem-Tol; Chlon; Chlorophen (USA); Chlorophenasic acid; Chlorophenate; Cryptogil Na; Cryptogil Oil; Cryptogil OL; Dirotax; Dow Dormant Fungicide (Na-PCP); Dow Pentachlorophenol DP-2 Antimicrobial; Dowicide 7/EC-7/G (USA); Dowicide 6 (USA); Dowicide 7 (USA); Dowicide 7 Antimicrobial (USA); Dowicide G (Na-PCP) /G-St (USA); SE Dura Treat II; Dura Treat 40 (USA); Durotox; EP 30; Forpen-50 Wood Preservative; Fingifen; Fongol; Fungifen; G-St (polymeric form); Gantix HB Ijus (SE); Glazd Penta; Grundier Arbezol; Gullviks Husbockscupral (SE); Husbocks-Cuprinol (SE); 1-hydroxypentachlorobenzene; Jimo-Cupim (BR); KMG Technical Penta Flakes (CAN, USA); KMG Technical Penta Blocks (USA); CAN KMG Penta OL Blocks (CAN, USA); KP Cuprinol (SE); Ky-5 (tetrachlorophenol) (FI, SE); Lautor A; Lauptol; Lauptol A; Liropren; Mystox D (polymeric form); Moosuran; Napclor-G (polymeric form); NCI-C 54933; NCI-C 55378; NSC 263497; OnTrack We Herbicide; Ortho Triox Liquid Vegetation Killer; Osmose Wood Preserving Compound; Panta-Kil; BR PCP (USA); Penchlorol (USA); Penta (USA); Penta-ate; BR 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); Pentachlorofenolo; Pentachlorophenate; Pentachlorophenate sodium; 2, 3, 4, 5, 6 pentachlorophenol; Pentachlorophenol DP-2; Pentachloropheno; Pentachlorphenol; Pentachlorophenol sodium salt; Pentachlorophenoxy sodium; Pentaclorofenol; BR Pentacon; Penta-kill; Pentanol; Pentaphenate; Pentasol; Pentchloral; Penton 70; Pentor 70; Penwar; Peratox; Perchlorophenol; Permacide; Permagad; Permagard; Permasan; Permatox; Permatox DP-2; Permatox Penta; Permite; Persasan; Phenol pentachloro-sodium derivative monohydrate; Phenol, 2,3,4,5,6-pentachloro-; Phenol, pentachloro-; PKhF; Pol Nu; Pole topper; Pole topper fluid; Prevenol; Preventol P; Priltax; Santobrite (Na-PCP polymeric form); Santophen; Santophen 20 (USA); Sapco-25 Weedbeads (Na-PCP polymeric form); Satophen; Sautox; Sinituho (FI); Sodium PCP; Sodium pentachlorophenate; Sodium pentachlorophenolate; Sodium pentachlorophenoxide; Sontox (USA); Term-i-Trol; Thompson's Wood Fix; Watershed Wood Preservative; Weed-beads; Weed and Brush Killer; Weedone; Withophen P (DE); Withophen N (DE); Witophen N; Witophen P; Woodtreat; Woodtreat A ; Xyladecor (DE); Xylamon (DE); Xylophene Na

<sup>1</sup> Over time the composition of the formulations may have changed.

<sup>2</sup> The formulations may have been placed on the market in other countries as well.

## **Annex III to the technical guidelines**

### **Analytical Methods for PCP analytics (ISO)**

ISO 17070:2015

Leather - Chemical tests - Determination of tetrachlorophenol-, trichlorophenol-, dichlorophenol-, monochlorophenol-isomers and pentachlorophenol content;

ISO 15320:2011

Pulp, paper and board - Determination of pentachlorophenol in an aqueous extract;

VDI 4301 Sheet 2:2000-06

Indoor air pollution measurement - Measurement of pentaclorophenol (PCP) and  $\gamma$ -hexachlorcyclohexane (lindane) - GC/MS-method; see <http://www.beuth.de/de/technische-regel/vdi-4301-blatt-2/31317771>

VDI 4301 Sheet 3:2003-06

Measurement of indoor air pollution - Measurement pentaclorophenol (PCP) and  $\gamma$ -hexachlorcyclohexane (lindane) - GC/ECD method; see <https://www.beuth.de/de/technische-regel/vdi-4301-blatt-3/62994869>

PD CEN/TR 14823:2003-11-06

Durability of wood and wood-based products. Quantitative determination of pentachlorophenol in wood. Gas chromatographic method.

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