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**Matters related to the work programme of the
Open-ended Working Group for 2018–2019:
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 short-chain
chlorinated paraffins**

Note by the Secretariat

As referred to in the note by the Secretariat on technical guidelines (UNEP/CHW/OEWG.11/4), 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 short-chain chlorinated paraffins. The present note, including its annex, has not been formally edited.

* UNEP/CHW/OEWG.11/1/Rev.1.

Annex

Draft technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with short-chain chlorinated paraffins

(Draft of 7 May 2018)

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Abbreviations and acronyms

BAT	best available techniques
BEP	best environmental practices
CA	polychlorinated n-alkanes
CAS	Chemical Abstracts Service
CP	Chlorinated paraffins
EC	European Commission
ESM	environmentally sound management
EU	European Union
EVA	ethylene-vinyl acetate
I-TEQ	International Toxic Equivalent
LCCP	long-chain chlorinated paraffins based on C18-20 (liquids), C>20 (liquids) and C20 wax grades (average carbon chain length approximately C25)
LOEC	Lowest Observed Effect Concentrations
MCCP	medium-chain chlorinated paraffins based on C14-17 paraffin
NOEC	No-Observed Effect Concentration
OECD	Organization for Economic Co-operation and Development
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibenzofuran
POP	persistent organic pollutant
POPRC	Persistent Organic Pollutants Review Committee
PVC	polyvinylchloride
SCCPs	Short-chain chlorinated paraffins, with straight-chain chlorinated hydrocarbons with chain lengths ranging from C10 to C13 and a content of chlorine greater than 48 per cent by weight
TEQ	toxic equivalent
UNEP	United Nations Environment
XRF	X-ray fluorescence

Units of measurement

mg	milligram (10^{-3} gram)
mg/kg	milligram(s) per kilogram. Corresponds to parts per million (ppm) by mass
μg	microgram (10^{-6} gram)
$\mu\text{g}/\text{kg}$	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 short-chain chlorinated paraffins, pursuant to several decisions adopted by the bodies of two multilateral environmental agreements on chemicals and wastes.¹ In these guidelines, short-chained chlorinated paraffins are covered that are considered POPs in accordance with the Stockholm Convention.

2. Short-chain chlorinated paraffins (SCCPs), defined as straight-chain chlorinated hydrocarbons with chain lengths ranging from C10 to C13 and a content of chlorine greater than 48 per cent by weight, were listed in Annex A (elimination) to the Stockholm Convention in 2017, through an amendment that entered into force in 2018. Additionally, a limit for the presence of SCCPs in other chlorinated paraffin (CP) mixtures was set at 1% by weight.

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, [...]) (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).

B. Description, production, use and wastes

1. Description

4. SCCPs belong to a larger group of chlorinated paraffins (CPs), or polychlorinated n-alkanes (CA), which are complex mixtures of substances with the general molecular formula $C_xH_{(2x-y+2)}Cl_y$. CPs are characterised by the carbon-chain length range of their n-alkanes and by the chlorine content of the product. An average chain length for the hydrocarbon feedstock or an average molecular weight is often stated as well. For example, a chlorinated paraffin referred to as C12, 60% chlorine, would be a product with an average chain length of 12 carbons with approximately 60% chlorine. (IARC, 1990, Glüge et al, 2016).

5. The chain lengths of commercial paraffin products are between ten and 38 carbon atoms and chlorine contents between 10 and 72% by weight. According to their chain length, CPs are divided into short-chain CPs (short-chain CPs, C10–C13²), medium-chain CPs (MCCPs, C14–C17) and long-chain CPs (LCCPs, C17–C30) (IARC, 1990, Glüge et al, 2016).

6. In Annex A to the Stockholm Convention, only short chain CPs with chain lengths ranging from C10 to C13 and a content of chlorine greater than 48 per cent by weight (see structural formula of an example in Figure 1) are listed.

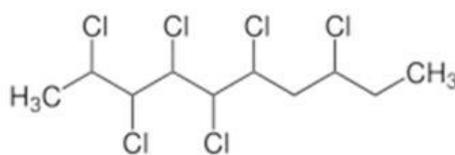


Figure 1: Example of a molecule that can be found within an SCCP mixture (2,3,4,5,6,8-hexachlorodecane, C10).

7. Because of the complex nature of CPs, it is not always possible to separate SCCPs from other CPs in chemical references. SCCP commercial products consist of mixtures of isomers and congeners, and the chlorine content of a product does not allow for identification of compounds present in the mixture (Danish Environmental Protection Agency, 2014). CAS numbers, which are

¹ Decisions BC-13/4 and BC-14/[...] of the Conference of the Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal; decision OEWG-11/[...] of the Open-ended Working Group (OEWG) of the Basel Convention; and decision SC-8/11 of the Conference of the Parties to the Stockholm Convention on Persistent Organic Pollutants.

² Please note that outside the scope of this guideline, this definition would also cover other short chain chlorinated paraffins than those covered by the Stockholm Convention restrictions, i.e. C10-C13 with chlorination degree of 48% or below.

commonly used to identify chemicals, often cover both POP-CPs as well as non-POP-CPs such as short chain CPs with less than 48% chlorine or MCCPs. Annex A to the Stockholm Convention contains examples of substances that may contain short-chain chlorinated paraffins with chlorine content greater than 48% by weight (Table 1). In addition, the POPRC risk profile (UNEP/POPS/POPRC.11/10/Add.2) mentions other CAS numbers, which contain SCCPs e.g. CAS No 63449-39-81. The EU Regulation on POPs³ addresses short-chain chlorinated paraffins with CAS number 85535-84-8. This CAS number represents the commercial SCCP product that is produced by the chlorination of a single hydrocarbon fraction consisting of n-alkanes that have a carbon chain length distribution consisting of 10, 11, 12 and 13 carbon atoms; however, this CAS number # does not specify the degree of chlorination of the SCCPs and may therefore include substances which are not included in Annex A to the Stockholm Convention. Examples of trade names of SCCPs products are contained in Annex I.

Table 1: Examples of CAS numbers that may contain SCCPs according to the Stockholm Convention Annex A.

CAS number	Description
85535-84-8	Alkanes C10-C13, chloro
68920-70-7	Alkanes, C6-18, chloro
71011-12-6	Alkanes, C12-13, chloro
85536-22-7	Alkanes, C12-14, chloro
85681-73-8	Alkanes, C10-14, chloro
108171-26-2	Alkanes, C10-12, chloro

8. The physical and chemical properties of the SCCPs are determined by the chlorine content (typically 49-70% for commercial substances). There are a wide number of possible chlorinated paraffins (of different chain length, degrees of chlorination and position of the chlorine atoms along the carbon chain) present in any given commercial product. Thus, care has to be taken when interpreting some of the physico-chemical data. Increasing the chlorine content leads to an increase in viscosity and a decrease in volatility. SCCPs are relatively inert substances, which are resistant to chemical attack and are hydrolytically stable. They possess good thermal stability. However, if held at high temperatures (>200C) for long periods they will darken and release detectable quantities of hydrogen chloride (ECB, 2000). CPs, including short chain CPs, are practically insoluble in water, lower alcohols, glycerol and glycols, although they can form emulsions and/or suspensions. They are soluble in chlorinated solvents, aromatic hydrocarbons, ketones, esters, ethers, mineral oils and some cutting oils (IARC, 1990, Fiedler, 2010). Measured water solubilities of individual C10-12 chlorinated alkanes ranged from 400 - 960 µg/L (Drouillard et al. 1998, UNEP/POPS/POPRC.11/10/Add.2), while estimated solubilities of C10 and C13 chlorinated alkane mixtures ranged from 6.4 - 2370 µg/L (BUA 1992, UNEP/POPS/POPRC.11/10/Add.2).

9. SCCPs are persistent, bioaccumulative, and toxic, particularly to aquatic organisms, and undergo long range environmental transport. SCCPs have been measured in sediments also in Arctic lakes. Although concentrations in water in remote areas are low, SCCPs are measured in Arctic biota at levels comparable to known POPs indicating widespread contamination. Notably, SCCPs are present in Arctic terrestrial and marine mammals, which are in turn food for northern indigenous people. SCCPs are measured in human breast milk both in temperate and Arctic populations. SCCPs have also been detected in food (e.g. in Denmark, Germany, France, Italy, Japan, the UK, the USA). (UNEP/POPS/POPRC.11/10/Add.2).

10. According to the Stockholm Convention Persistent Organic Pollutants Review Committee (POPRC) risk profile (UNEP/POPS/POPRC.11/10/Add.2) SCCPs both empirical (laboratory and field) and modelled data indicate that SCCPs can accumulate in biota. High concentrations of SCCPs in upper trophic level organisms, notably in marine mammals and aquatic freshwater biota (e.g., beluga whales, ringed seals and various fish), is additional evidence of bioaccumulation. SCCPs are particularly toxic to aquatic invertebrates, with a reported chronic No-Observed Effect

³ Regulation (EC) No 850/2004 of the European Parliament and of the Council of 29 April 2004 on Persistent Organic Pollutants and Amending Directive 79/117/EEC, see <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02004R0850-20160930&qid=1512650945378&from=FI>.

Concentration (NOEC) of 5 µg/L for *Daphnia magna* and a chronic NOEC of 7.3 µg/L for the mysid shrimp. Severe liver histopathology has been observed in trout, with Lowest Observed Effect Concentrations (LOEC) ranging from 0.79 to 5.5 µg/g in whole fish tissue. The International Agency for Research on Cancer considers some SCCPs (average C12, average 60% chlorination) to be possible carcinogens (groups 2B), although questions have been raised regarding the mechanisms for induction of tumors and the relevance for human health of the studies on which this classification was derived. The EU risk assessment from 2008 concludes that effects on the liver, thyroid, and kidney have been shown to occur in mammalian species exposed to SCCPs. The effects are manifested as organ weight increases and histological changes after exposure for weeks or months, but may turn into carcinomas and adenomas after chronic exposure (ECB, 2008, UNEP/POPS/POPRC.11/10/Add.2).

2. Production

11. Parties to the Stockholm Convention shall prohibit and/or eliminate the production of SCCPs, unless they have notified the Secretariat of their intention to produce it for the time-limited specific exemptions listed in Annex A to the Convention. In addition, Parties for which the amendment did not enter into force automatically may continue to produce SCCPs for any purpose until they have ratified the amendment through which the chemical was listed in Annex A. Information on production of SCCPs can be found in the register of specific exemptions of the Stockholm Convention on the Convention website (www.pops.int). Information on the status of ratification by the Parties of the amendment listing SCCPs in the Stockholm Convention can be found on the website of the Treaty Section of the United Nations (<https://treaties.un.org/>).

12. Chlorinated paraffins, including SCCPs, have been produced commercially since the 1930s. Production took place only in the USA until 1977, when the production began in Europe as well as Japan (Glüge, 2016). Ordinary commercial chlorinated paraffins are not single compounds but mixtures, each containing several homologous n-alkanes corresponding to their manufacture from n-paraffin fractions with several different degrees of chlorination. There are a wide number of possible CPs of different chain length, degrees of chlorination and position of the chlorine atoms along the carbon chain present in any given commercial product (ECB, 2000).

13. The mixtures of chlorinated n-alkanes are produced by reacting normal paraffin fractions obtained from petroleum distillation with gaseous chlorine exothermically at 80-1200 C in the liquid phase. Ultraviolet light is often used to promote chlorination, particularly at higher chlorine levels. The linings of the reactor vessels must be inert (e.g., glass or steel) to avoid the formation of metal chlorides, which cause darkening of the product by decomposition. Additional procedures include solvent stripping and grinding of the products as necessary (Zitko & Arsenault, 1974, IARC, 1990).

14. Confirmed SCCP production has taken place at least in Italy, Germany, Romania, Slovakia and the UK (German Federal Environment Agency, 2015). According to the information collected by POPRC in 2015, CPs of various chain lengths were produced in the Russian Federation, India, China, Japan and Brazil. (UNEP/POPS/POPRC.11/10/Add.2).

15. Sverko et al. (2012) indicated total production estimates for SCCPs in the United States and Europe ranging from 7 500 to 11 300 t per year. Information submitted to POPRC in 2007 indicated that 150 t/year of SCCPs was produced in Brazil. (UNEP/POPS/POPRC.11/10/Add.2). Glüge et al (2016) estimated the current worldwide production of SCCPs at 165 000 t/year, whereas the global production of all CPs was estimated at 1 million tonnes. Share of SCCPs from total CP production was estimated at 15-20 %.

16. Information on production often includes paraffins of all chain-lengths and degrees of chlorination and it may therefore not be possible to specifically address the production of SCCPs. For example, in industrial mixtures from China, distinctions between CPs are made based on chlorination degrees rather than on carbon chain lengths (UNEP/POPS/POPRC.11/10/Add.2). Therefore, the figures often include short-chained paraffins (C10-C13), but also other chain-length paraffins such as medium-chained chlorinated paraffins (MCCP), which are often used as alternatives to SCCPs. Nevertheless, as the reported environmental concentrations of SCCPs are higher in China than in other regions, it can be assumed that SCCPs are produced in China (van Mourik et al, 2016, Zhang et al., 2017).

17. Currently the largest volume producer of CP is China (UNEP/POPS/POPRC.11/10/Add.2), and it was estimated that China produced approximately 20%-30% of the total global CPs between 2007-2013 (Jiang et al., 2017). Depending on raw materials, some of the technical mixtures made by Chinese manufacturers may have been mixtures of SCCPs, MCCPs, and LCCPs (Glüge et al., 2016, Yin, 2016). The estimated annual production increased from 600 000 t (metric tonnes) in 2007

(Fiedler, 2010) to 1000 000 t/year in 2009 (Chen et al. 2011). European production estimates for all chlorinated alkanes in 2010 was 45 000 t. The USA reported production volumes for 2007 at 45 000 t, including both SCCPs and MCCPs. The Chlorinated Paraffins Industry Association (CPIA) submitted Annex E (2010) information on the yearly production of CPs in North America from 2000 to 2009. Production was approximately 3700 t in 2000, peaked at approximately 4 000 t in 2001, and steadily declined to approximately 800 tonnes in 2009. (UNEP/POPS/POPRC.11/10/Add.2).

3. Use⁴

18. Parties to the Stockholm Convention shall prohibit and/or eliminate the use of SCCPs, unless they have notified the Secretariat of their intention to use SCCPs for a time-limited specific exemption listed in Annex A to the Convention. Parties for which the amendment did not enter into force automatically may continue to use SCCPs for any purpose until they have ratified the amendment through which the chemical was listed in Annex A. Information on use of the exemptions can be found in the register of specific exemptions of the Stockholm Convention on the Convention website (www.pops.int). Information on the status of ratification by the Parties of the amendment listing SCCPs in the Stockholm Convention can be found on the website of the Treaty Section of the United Nations (<https://treaties.un.org/>).

19. CPs are chemicals with different carbon lengths and degrees of chlorination, which give different properties and because of their versatility, they are used for a wide range of applications. Uses have varied between countries and over time, but main SCCP applications have been for polyvinylchloride (PVC), metal-working fluids, paints, coatings, sealants, rubber, and textiles, as a fire-retardant, plasticizer, or water-repellent. They have also been used in leather production. SCCPs have been used to replace PCBs, and many of the uses are similar. However, SCCPs have been reported to not be suitable for uses requiring high heat stability (e.g., capacitors, transformers) (Howard et al., 1975).

20. SCCPs are used as secondary plasticizers for PVC in applications such as electrical cables when the inherently low inflammability of PVC would be impaired by primary plasticizers (e.g., dioctyl phthalate) (IARC, 1990, ECB, 2000, USEPA, 2009). The majority of flexible PVC is believed to be used in flooring, wall covering, upholstery and insulation of wire and cables (ECB, 2008). In Western Europe, the main use (50 %) in the 1970's was in PVC and other plastics production (Schenker, 1979, as quoted in IPCS, 1996 (original source could not be located). SCCPs were still used in PVC in the EU in the 1990's (ECB, 2008). In the USA, the second largest use of SCCPs after metal-working was either as plasticizer or flame retardant in plastics (USEPA, 2009).

21. SCCPs are used as flame retardants in rubber products, also in conjunction with other flame retarding additives such as antimony trioxide and aluminum hydroxide (ECB, 2000). Rubber containing SCCPs has been used in conveyor belts for underground mining, sound-insulating materials in hoses as well as seals in the electrical installation and in vehicles. Among the different types of conveyor belts, use of SCCPs has been confirmed in mono-ply (solid woven) conveyor belts (the most modern type) (Danish Environmental Protection Agency, 2014). It is preferred to use SCCPs, because of their higher degree of chlorination per weight compared to MCCPs and therefore higher flame retardancy (German Federal Environment Agency, 2015). In 2007, 300 tonnes of SCCPs was used in Brazil for the purposes of flame retardant in rubber, car carpet and accessories (UNEP/POPS/POPRC.11/10/Add.2).

22. SCCPs have been used as extreme-pressure additives in metal-machining fluids (lubricants and coolants), engineering and metal working operations such as drilling, machining/cutting, drawing and stamping e.g. in the automobile industry, precision engineering industry and in machinery construction since around 1930 (IPCS, 1996, ECB, 2000). The short chain chlorinated paraffins (typically 49-69 % chlorine) are blended with other additives including corrosion inhibitors, emulsifiers, biocides and surface-active agents and can be used either in straight oil applications (in solution in a hydrocarbon) or in soluble oil emulsions dispersed in water (ECB, 2000). In the EU, 9380 tonnes (70% of all use) of SCCPs were used as metal working lubricants in 1994 (RPA, 2010), until the prohibition in 2003 (ECB, 2008). Similarly, nearly all use of SCCPs in Canada was related to metalworking (Environment Canada, 2008). IARC (1990) estimated that approximately 50% of the CPs consumed in the USA was used as extreme-pressure lubricant additives in the metal working industry. Also in the USA, the largest use of SCCPs was as a component of lubricants and coolants in metal cutting and metal forming operations (USEPA, 2012).

⁴ "Use" covers the use of SCCPs mixtures for the production of products and articles, as well as the use of those products and articles.

23. As a plasticizer or binder additive to paints, coatings and sealants, and to improve resistance to water and chemicals, SCCPs have been used as alternatives to PCBs (ECB, 2000, USEPA, 2009, UNEP/POPS/POPRC.11/10/Add.2, German Federal Environment Agency, 2015). The paints are used mainly in industrial/specialist applications such as marine primer paints and fire retardant paints (ECB, 2000, RPA, 2010). The SCCPs are mixed into the paint during the formulation step and becomes physically entrained in the coating once applied (ECB, 2008). Other applications include road marking paints, anti-corrosive coatings for metal surfaces, swimming pool coatings, decorative paints for internal and external surfaces, and primers for polysulfide expansion joint sealants, SCCPs may also be used in cross-linkable polyester systems with peroxides for the production of long-term road markings and it may be found in unsaturated polyester resin which is used in the production of fibre reinforced composites (RPA 2010, European Commission, 2011). Two main materials onto which SCCP-containing paints and varnishes were applied are metal and concrete. The sealant uses include rubber and chlorinated rubber coatings, polysulphide, polyurethane, acrylic and butyl sealants used in building and construction and in sealants for double and triple glazed windows. (IARC, 1990, WHO, 1996, ECB, 2008, Danish Environmental Protection Agency, 2014, German Federal Environment Agency, 2015).
24. SCCPs have been used in the production of flame-resistant, water repellent and rot-preventing textile finishes in sail cloths and industrial protective clothing and tarpaulins (ECB, 2000). The major historical use of chlorinated paraffins was in military tenting and other textile applications where fire risk must be controlled (Zitko & Arsenault, 1974). According to ECB (2008) SCCPs were mainly applied as a flame retardant for backcoating of textiles in the EU and less for waterproofing. Typical applications for back-coated textiles potentially included furniture upholstery, seating upholstery in transport applications, and interior textiles such as blinds and curtains as well as industrial protective clothing (RPA, 2010).
25. RPA (2010) suggested that use in the impregnation of commercial and military tents (to provide a flame retardant, waterproof and rot-proof finish – ‘dry proofing’ of heavy textiles) was still ongoing in the EU in 2010, and SCCPs were used in polyester-cotton, cotton or linen-flax. According to European Union (2011), tents were the only application of relevance to SCCPs in the EU.
26. SCCPs have been used in the leather industry as fat liquoring agents (European Commission, 2011). They show better adhesion to the animal skin than natural oils, with similar fattening and softening properties. They also impart better washability to the leather than natural oils. They are usually applied to the moist dressed leather in the form of a 10-30% emulsion or are added to sulphated or sulphonated oil or synthetic emulsifying agents. (ECB, 2000).
27. As SCCPs have been used in materials such as plastics, textiles, leather, rubbers, inks, paints, adhesives and surface coatings, that are used to produce apparel, footwear and accessories, they are commonly found in materials and consumer articles (German Federal Environment Agency, 2015, KEMI, 2016, Table 2). The articles containing SCCPs are mainly soft plastic items made of PVC (i.a. toys, beauty cases, exercise mats made of PVC plastic, stickers for wall decoration, dress costumes, etc.) (BTHA, 2016). In Europe SCCPs have not been used for PVC since 2008 (ECB, 2008), but there are plenty of examples of articles containing SCCPs at present in the EU market in the Rapex database (see Annex II). It has also been reported that hand blenders used for food preparation in Sweden were found to release chlorinated paraffins under normal use. It has also been demonstrated that the presence of CPs in household appliances can contaminate food during preparation and is an unexpected exposure pathway and should be addressed (Strid et al.2014).
28. SCCPs of different chain-lengths and degrees of chlorination have different properties, and have therefore been used for different applications. In metal machining fluids, pastes, emulsions and lubricants, chlorinated paraffin grades with good solubility in mineral oils (SCCPs as well as MCCPs (C10-17)) and chlorine contents of 40-60% are preferred. For flame-retardant applications, chlorinated paraffins with approximately 70% chlorine are used; the chain length depends on the substrate: SCCPs have been used for rubber and soft plastics (Zitko & Arsenault, 1974), but this is likely not the case anymore.
29. The use of CPs in general (including SCCPs) has only been reported in the USA between 1944-1977, although they may have been used in other countries during this period as well (Danish Environmental Protection Agency, 2014, Glüge et al. 2016). Since then the use of SCCPs in Europe and Japan increased significantly, until the use in Europe started to decrease in the early 2000’s (ECB, 2008, European Union, 2011, Glüge et al. 2016). Since 2000, China has been the largest consumer of CPs (share of SCCPs not specified), with approximately 500 000 t annually (Glüge et al. 2016). Use of SCCPs in metalworking and for fat liquoring of leather was prohibited in the EU in

2003. From 13 000 t per year in 1994 (EU-15), the use decreased to estimated 530 t per year in 2010 in EU-27 (RPA, 2010). In 2012 the use of SCCPs in the EU was further restricted to use as fire retardants in rubber used in conveyor belts in the mining industry, as fire retardants in dam sealants. The US prohibited use of SCCPs in 2013 (van Mourik et al., 2016). Japanese industry discontinued the use in metalworking voluntarily in 2007 (UNEP/POPS/POPRC.11/10/Add.2). In Canada, the production of chlorinated paraffins had stopped by 2008 (Environment Canada 2008), and the use of SCCPs were prohibited in 2013 (Government of Canada 2013).

30. CPs, including SCCPs, have been used for other purposes, which are apparently no longer relevant. These include use as a solvent in a nasal spray, component in clear lacquers for wood and hardboard, fire-proofing of wood, paper-sizing, antistatic agents on nylon, soot inhibitor for fuel oil, and coating for tableted calcium hypochlorite, used in the treatment of sewage and swimming pool waters. Chlorinated paraffin sulfonic acids were also used as emulsifiers for biocidal concentrates (as quoted in Zitko & Arsenault, 1974).

31. SCCPs have been under scrutiny for their health and environmental impacts, and restrictions have been implemented in Albania, Canada, EU, Norway and the United States (UNEP/POPS/POPRC.12/11/Add.3). Norway banned SCCPs in 2002 and Canada banned the manufacture, use, sale offer for sale or import in 2013 (Government of Canada, 2013). In the EU use of SCCPs was limited to use as flame-retardant in mining conveyor belts and dam sealants in 2012.

Table 2: Examples of concentrations of SCCPs in materials and articles.

Material	SCCP content (mg/kg)	Source
As secondary plasticizer in PVC	Up to 100 000	BTHA, 2016 KEMI, 2016
EVA foam	Up to 70 000 (found in yoga mats)	BTHA, 2016, Annex II
Metal working, cutting fluids	70 000-90 000 50 000-100 000 in oil-based cutting fluids <10 000 in emulsion-based cutting fluids 20 000-100 000, up to 800 000	Koh et al, 2002 European Commission, 2011 -“- ECB, 2000
Rubber	10 000-40 000, can be up to 150 000 100 000-170 000 in conveyor belts 100 000 in conveyor belts, 100 000-170 000 for other rubber products The concentration of SCCPs depends on the rubber type used	ECB, 2008 -“- RPA, 2010 European Commission, 2011
Coatings	25000-100 000 in intumescent coatings 100 000-150 000 in anti-corrosive and protective coatings	RPA, 2010
Textiles	Potential flame retardant in cellulosic textiles 40 000-150 000 in backcoating of textiles	BTHA, 2016 RPA, 2010
Leather	Maximum of 10 000 in leather 20 000 mean 200 000 in fat-liquoring mix	ECB, 2000 RPA, 2010 European Commission, 2011
Paints	50 000-200 000 (after drying) 20 000 (road markings) 10 000-100 000 in road markings	ECB, 2008 European Commission, 2011 RPA, 2010
Adhesives and sealants	50 000-140 000 200 000-300 0000	ECB, 2008 Danish Environmental Protection Agency, 2014
Paper	130 mg/A4 sheet	German Federal Environment Agency, 2015

4. Wastes

32. 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 SCCPs from waste management activities. In that context, the following should be recognized:

- (a) Compared to most other POPs, historical production and use of SCCPs are much

higher. Therefore, also the amount of waste can be expected to be high. However, as the use started already in the 1930s and hazardous waste management capacity and practices were not developed until 1970s, it can be assumed that a large amount of wastes containing SCCPs have already been disposed of;

(b) Many applications of SCCPs have long service-lives (for example conveyor belts, cooling oils, sealants, paints, adhesives and floorings used in construction sector). European Commission (2011) cites service-life of a conveyor belt at 2-30 years. Therefore, waste originating from currently prohibited uses can still be found. On the other hand, metal and leather processing fluids and also the treated leather products have relatively short product life cycles. It can therefore be assumed that the used processing fluids, as well as the treated leather products will soon be disposed of after prohibition (German Federal Environment Agency, 2015);

(c) SCCPs have been used worldwide as a fire retardant or plasticiser in materials, such as plastics (PVC and EVA), rubbers, fabrics, inks, paints, adhesives and surface coatings and leather, that are used to produce e.g. equipment, pipes, apparel, clothing, footwear, and accessories. SCCPs have been found in construction waste and consumer articles in levels of up to 7 000 mg/kg;

(d) SCCPs may be released from products and articles during the service life as well as after their disposal, unless properly managed. European Commission (2011) assumes that about 8 % of the SCCPs in sealants is emitted during lifetime. Also landfill leachates and sludges from waste water treatment contain SCCPs (Danish Environmental Protection Agency, 2014);

(e) There is recent evidence on consumer products (toys, sports accessories, electric cables of kitchen equipment) containing several thousands of mg/kg SCCPs which are commonly found on the EU market (KEMI, 2016, BTHA, 2016, see Annex II). It is not possible to identify the SCCP-containing consumer products without laboratory analysis and there are considerable uncertainties related to analyses;

(f) Second major use is as an additive in metal-working and machining lubricants and coolants. In regions where this use has ended due to prohibitions, and there is likely not much waste containing SCCPs being generated, except where longer chain chlorinated paraffins contain SCCPs;

(g) Many materials containing SCCPs have been recycled or reused (e.g. plastics, rubber and textiles, building joint sealants). Elevated SCCP concentrations have been found in biota near an e-waste recycling site in China (Luo et al., 2017, Yuan et al., 2017). Conveyor belts have been recycled by reduction to powder and subsequent manufacture of new belts, curtains, mats and building materials (European Commission, 2011);

(h) Use of MCCPs may lead to high concentrations of SCCPs in the products and articles (the EU limit for unintentional trace contamination was set at 1 500 mg/kg in articles to allow for continued use of MCCPs). MCCPs containing up to 1% by weight SCCPs,⁵ are commonly used as alternatives to SCCPs. Also, possible recycling of metal-working oils may have led to SCCPs being present in unintended applications.

33. Wastes may contain variable concentrations of SCCPs, depending on the quantities in which they were originally present in specific products and the quantities released during product use and waste management. Waste consisting of, containing or contaminated with SCCPs (hereinafter referred to as “SCCP wastes”) may be found as:

- (a) SCCP chemicals:
 - (i) Pure SCCPs;
 - (ii) Technical CPs mixtures containing varying levels of SCCPs depending on the starting material;
 - (iii) Obsolete SCCPs which can no longer be used;
- (b) Packaging materials of SCCP formulations;
- (c) Preparations and articles which have been produced using SCCPs:
 - (i) Metal working lubricants and coolants, swarf from metal cutting operations;

⁵ According to the European chlor-alkali industry association Eurochlor, the short carbon chain constituents in MCCPs are not likely SCCPs as defined in REACH Regulation and the detection of chains below C14 in an MCCP product does not mean that the product contains SCCPs ([http://www.eurochlor.org/chlorinated-alkanes-\(casg\)/education-spotlight.aspx](http://www.eurochlor.org/chlorinated-alkanes-(casg)/education-spotlight.aspx), accessed 3 December, 2017).

- (ii) Lubricants, in particular for automobile engines, electric generators, wind power facilities;
 - (iii) Lubricants in oil production and refining: oil drilling and gas exploration, petroleum refining to produce diesel oil;
 - (iv) Dried sludges from user process such as paper coating;
 - (v) Flexible polyvinylchloride (PVC) and ethylene-vinyl acetate (EVA);
 - (vi) Paints, adhesives, floorings and coatings;
 - (vii) Sealants, such as fire retardant dam sealants, building sealants, window sealants;
 - (viii) Fire-retardant rubber, such as in transmission and conveyor belts;
 - (ix) Fire-retardant back-coated textiles, such as upholstery, tents;
 - (x) Leather that has been fat-liquored with SCCPs;
 - (xi) Other articles made of rubber or soft plastics, i.a. toys, sports accessories and kitchen equipment;
- (d) Contaminated soils;
- (e) Municipal and industrial sludge (e.g. leather industry) and landfill leachate.
34. The most important SCCP waste streams in terms of potential volume are expected to be:
- (a) PVC and EVA plastics in flooring, wall covering, wire and cable insulation;
 - (b) Construction waste contaminated with SCCPs in paints, sealants, adhesives and flooring;
 - (c) Metal working lubricants and coolants;
 - (d) Lubricants and coolants in oil and gas exploration and drilling;
 - (e) Back-coated textiles, including upholstery;
 - (f) Transmission belts and conveyor belts.
35. The most important SCCP waste streams in terms of potential releases or concentration of SCCPs are expected to be:
- (a) SCCP formulations;
 - (b) PVC and other plastics with SCCPs as plasticizer;
 - (c) Rubber containing SCCPs;
 - (d) Lubricants and coolants in oil and gas exploration and drilling;
 - (e) Oily waste from metal working;
 - (f) Paints, adhesives and coatings;
 - (g) Plasticiser condensates;
 - (h) Water based mixtures and emulsions;
 - (i) Consumer articles made of plastics and rubber containing SCCPs;
 - (j) Leather and textiles.
36. SCCP 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 SCCP. In Europe and North America some of the applications are believed to have ceased decades ago but may be such materials could still be in use or disposed of.

Table 3: Overview of the production and application of SCCPs and their release media into the environment (based on UNEP/POPS/POPRC.11/10/Add.2, ECB, 2000, ECB, 2008, KEMI, 2016).

Group	Source materials /Substance used	Applications /Processes	End product	Release media
SCCPs PRODUCTION				
Chemical production	Chlorinated alkanes C10-C13, chlorine	Chemical synthesis	SCCPs	<ul style="list-style-type: none"> • Solid waste (including filtration sludge) • Landfill leachate • Waste water • Sludge • Air
	Chlorinated alkanes C14-C17, chlorine	Chemical synthesis	MCCPs, with up to 1% SCCPs as impurity	
PRODUCTION OF FORMULATIONS AND ARTICLES USING SCCP				
(The boxes below include articles that have become wastes. Such wastes may also be generated at production sites, such as leftovers, cutting waste, etc.)				
Polyvinylchloride (PVC) production	SCCPs, MCCPs	Production of flexible PVC products	Flooring, wall covering, upholstery and insulation of wire and cables, consumer articles (such as toys, yoga mats, game controllers, water heaters), cable, footwear, hosing, conveyor belting, coated fabric and profiles	<ul style="list-style-type: none"> • Solid waste • Construction waste • WEEE • Landfill leachate • Liquid industrial and household cleaning waste • Wastewater • Sludge • Air
Rubber production	SCCPs	Rubber production	Conveyor belts, shoe soles, industrial sheeting	<ul style="list-style-type: none"> • Solid waste • Construction waste • Liquid industrial waste • Landfill leachate • Wastewater • Sludge • Air
Metal-working fluids	SCCPs	Metal-working fluid production and use	Lubricants and coolants in machining, e.g. automobile industry, precision engineering industry and in machinery construction	<ul style="list-style-type: none"> • Solid waste (swarf from metal-working) • Landfill leachate • Liquid industrial waste • Wastewater • Sludge • Air
Leather	SCCPs	Fat-liquoring of leather	Leather	<ul style="list-style-type: none"> • Solid waste • Landfill leachate • Liquid industrial and household cleaning waste • Wastewater • Sludge • Air

Textiles and fabric	SCCPs, polyester-cotton, cotton or linen-flax	Production of waterproof and fire-retardant textiles and fabric	Tents, camouflage nets, professional clothing	<ul style="list-style-type: none"> • Solid waste • Landfill leachate • Liquid industrial and household cleaning waste • Wastewater • Sludge • Air
Adhesives and sealants	SCCPs	Adhesive production, building and construction sealant production	Polysulphide, polyurethane, acrylic and butyl sealants used in building and construction and in sealants for double and triple glazed windows	<ul style="list-style-type: none"> • Solid waste • Construction waste • Liquid industrial and household waste • Landfill leachate • Wastewater • Sludge • Air
Paints	SCCPs	Paint production	Road marking paint	<ul style="list-style-type: none"> • Solid waste • Liquid industrial and household waste • Landfill leachate • Wastewater • Sludge • Air
Paper coating	SCCPs	Paper production	Carbonless copy paper	<ul style="list-style-type: none"> • dried sludges from paper coating • Solid waste • Liquid industrial and household waste • Landfill leachate • Wastewater • Sludge • Air

II. Relevant provisions of the Basel and Stockholm Conventions

A. Basel Convention

37. 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”).

38. Annex I and II lists some of the wastes which may consist of, contain or be contaminated with SCCPs:

- (a) Y6: Wastes from the production, formulation and use of organic solvents;
- (b) Y9: Waste oils/water, hydrocarbons/water mixtures, emulsions;
- (c) Y12: Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish;
- (d) Y13: Wastes from production, formulation and use of resins, latex, plasticizers, glues/adhesives;

- (e) Y18: Residues arising from industrial waste disposal operations;
- (f) Y45: Organohalogen compounds other than substances referred to in this Annex I (e.g., Y39, Y41, Y42, Y43, Y44);
- (g) Y46: Wastes collected from households.

39. Annex I wastes are presumed to exhibit one or more Annex III hazard characteristics, which may include 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 hazardous characteristic in Annex III of the Convention until such time as the hazardous characteristic is fully defined. Guidance documents 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 meetings.

40. 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 SCCP, including:

- (a) A1090: Ashes from the incineration of insulated copper wire;
- (b) A1100: Dusts and residues from gas cleaning systems of copper smelters;
- (c) A1190: Waste metal cables coated or insulated with plastics containing or contaminated with coal tar, PCB, lead, cadmium, other organohalogen compounds or other Annex I constituents to an extent that they exhibit Annex III characteristics;
- (d) A3040: Waste thermal (heat transfer) fluids;
- (e) 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);
- (f) A3110: Fellingmongery wastes containing hexavalent chromium compounds or biocides or infectious substances (note the related entry on list B B3110);
- (g) A3120: Fluff-light fraction from shredding;
- (h) A4060: Waste oils/water, hydrocarbons/water mixtures, emulsions;
- (i) 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);
- (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).

41. 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 SCCP, including:

- (a) B1110 Electrical and electronic assemblies;⁶
- (b) B3010: Solid plastic waste;⁷
- (c) B3020: Paper, paperboard and paper product wastes;⁸

⁶ Refer to Annex IX of the Basel Convention for a full description of this entry.

⁷ Ibid 6.

⁸ Ibid 6.

- (d) B3030: Textile waste;⁹
- (e) B3035: Waste textile floor coverings, carpets;
- (f) B3080: Waste parings and scrap of rubber;
- (g) B3090: Paring and other wastes of leather or of composition leather not suitable for the manufacture of leather articles, excluding leather sludges, not containing hexavalent chromium compounds and biocides (note the related entry on list A A3100);
- (h) B3100: Leather dust, ash, sludges or flours not containing hexavalent chromium compounds or biocides (note the related entry on list A A3090);
- (i) B3110: Fellmongery wastes not containing hexavalent chromium compounds or biocides or infectious substances (note the related entry on list A A3110);
- (j) B4010: Wastes consisting mainly of water-based/latex paints, inks and hardened varnishes not containing organic solvents, heavy metals or biocides to an extent to render them hazardous (note the related entry on list A A4070);
- (k) B4020: Wastes from production, formulation and use of resins, latex, plasticizers, glues/adhesives.¹⁰

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

B. Stockholm Convention

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

44. Annex A defines SCCPs as follows:

“Short-chain chlorinated paraffins (Alkanes, C₁₀₋₁₃, chloro) ⁺: straight-chain chlorinated hydrocarbons with chain lengths ranging from C₁₀ to C₁₃ and a content of chlorine greater than 48 per cent by weight”.

45. In addition, examples have been added in Annex A as follows:

“For example, the substances with the following CAS numbers may contain short-chain chlorinated paraffins:

CAS No. 85535-84-8;
 CAS No. 68920-70-7;
 CAS No. 71011-12-6;
 CAS No. 85536-22-7;
 CAS No. 85681-73-8;
 CAS No. 108171-26-2”

46. Production of SCCPs is allowed for Parties who have notified the Secretariat of their intention to produce them for the time-limited specific exemptions listed in Annex A to the Convention for which Parties may continue using SCCPs:

- (a) Additives in the production of transmission belts in the natural and synthetic rubber industry;
- (b) Spare parts for rubber conveyor belts in the mining and forestry industries;
- (c) Leather industry, in particular fat liquoring in leather;
- (d) Lubricant additives, in particular for automobile engines, electric generators, wind power facilities, drilling in oil and gas exploration and petroleum refining to produce diesel oil;
- (e) Tubes for outdoor decoration bulbs;
- (f) Waterproofing and fire-retardant paints;
- (g) Adhesives;
- (h) Metal processing;

⁹ Ibid 6.

¹⁰ Ibid 6.

(i) Secondary plasticizers in flexible polyvinyl chloride, except in toys and children's products.

47. Furthermore, Annex A specifies in Note (vii) that quantities of SCCPs that occur in mixtures at concentrations greater than or equal to 1 per cent by weight, cannot be considered unintentional trace contaminants, as outlined for other chemicals in Note (i). This is flagged by a plus sign (“+”) in the definition (see paragraph 44 above).

48. Further information on the register of specific exemptions for SCCPs is available from: www.pops.int.

49. 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

50. The provisional definition of low POP content for SCCPs is [10 000] mg/kg.¹¹

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

52. Wastes with a content of SCCPs above [10 000] 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.

53. Wastes with a content of SCCPs at or below [10 000] 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).

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

B. Levels of destruction and irreversible transformation

55. 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

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

IV. Guidance on environmentally sound management (ESM)

A. General considerations

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

B. Legislative and regulatory framework

58. 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 SCCP wastes.

59. Elements of a regulatory framework applicable to SCCPs 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 SCCPs, except in the case of Parties that have notified the Secretariat of their intention to use or produce SCCPs in accordance with the time-limited specific exemption listed in Annex A to the Stockholm

¹¹ Determined according to national or international methods and standards.

Convention;

(c) A requirement that best available technologies (BAT) and best environmental practices (BEP) be employed in the production and use of SCCPs, in cases where Parties have notified the Secretariat of their intention to use or produce SCCPs in accordance with the time-limited exemption listed in Annex A to the Stockholm Convention;

(d) Measures to ensure that SCCP 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 SCCPs from materials that can be recycled (e.g., plastics, oils, rubber, construction materials);

(f) Transportation requirements for hazardous materials and waste;

(g) Specifications for containers, equipment, bulk containers and storage sites for obsolete unused SCCP;

(h) Specification of acceptable analytical and sampling methods for SCCPs;

(i) Requirements for waste management and disposal facilities;

(j) Definitions of hazardous waste and conditions and criteria for the identification and classification of SCCP wastes as hazardous wastes;

(k) 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;

(l) Requirements for identification, assessment and remediation of contaminated sites;

(m) Requirements concerning the health and safety of workers;

(n) Legislative measures on, e.g., waste prevention and minimization, inventory development and emergency response.

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

C. Waste prevention and minimization

61. Both the Basel and Stockholm conventions advocate waste prevention and minimization. The production and use of SCCPs is to be eliminated under the Stockholm Convention, unless they fall under the exemptions listed in part I of Annex A to the Convention.

62. Quantities of waste containing SCCPs 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.

63. The mixing and blending of wastes with SCCPs content above [10 000] mg/kg with other materials solely for the purpose of generating a mixture with an SCCPs content at or below [10 000] 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.

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

D. Identification of wastes

65. 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 SCCPs is the starting point for their effective ESM.

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

1. Identification

67. SCCP wastes can be found:

(a) In residues from SCCPs production and at sites where such chemicals were produced, formulated and stored;

- (b) In storage facilities and at sites where SCCPs were used or applied, e.g., at PVC, EVA and rubber production facilities, construction material production, construction sites, metal-working, paint, fabric, textile and leather production;
- (c) In contaminated materials, including protective clothing, application equipment and accessories, empty packaging materials, containers, floors, walls and windows;
- (d) In facilities for the collection, recycling and waste management of PVC and other plastics, textiles, rubber, construction materials, metal-working oils, etc;
- (e) In soils, sediments and sewage sludges and in water that has been contaminated by, for example, spills;
- (f) In retail of products containing SCCPs, such as products and articles made of flexible PVC (cable, footwear, hoses, conveyor belts, coated fabric and profiles), paints, sealants and adhesives, construction materials;
- (g) At dumpsites and in landfills.

68. 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 SCCPs.

2. Inventories

69. When developing inventories on SCCP 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.

70. The main uses of SCCPs differ from region to region as well as their timing. In several countries, many historical applications of SCCP have ceased already due to national restrictions or introduction of alternatives. Therefore, a thorough consideration of potential uses is important to focus the inventory activities correctly, noting that it may be difficult to estimate whether SCCPs is present in imported commercial products.

71. Although estimating SCCP waste volumes is difficult due to variety of uses, long service lives and long history, a few good approaches have been made in the European Union, for example in Denmark and Germany (European Commission, 2011, Danish Environmental Protection Agency, 2014, German Federal Environment Agency, 2015).

E. Sampling, analysis and monitoring

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

73. Sampling, analysis and monitoring procedures, should be established for articles that may contain SCCPs.

1. Sampling

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

75. 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.

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

- (a) Liquids:
 - (i) SCCP formulations;
 - (ii) Oil- and water-based liquids: metal-working fluids, cooking oil;
 - (iii) Leachates from landfills, water;
 - (iii) Biological fluids (blood, maternal milk);
- (b) Solids:
 - (i) Production wastes;

- (ii) Biological tissue samples;
- (iii) Soils, sediments and municipal and industrial sludges;
- (iv) Materials where SCCPs have been used: e.g. PVC, plastic products, rubber, construction products, paints, textiles, leather, conveyor belts;
- (v) Indoor dust.

2. Analysis

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

78. 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.

79. Analysis of SCCPs is extremely difficult because of the poor description of the reference materials and their complex compositions with thousands of isomers and homologues (Koh et al, 2002, Bayen et al., 2006, Gao et al., 2016).

80. No fully validated routine analytical method is available yet and only semi-quantitative analysis is possible (van Mourik et al. 2015). The results from all the methods used are dependent to some extent on the substance(s) used as reference (ECB, 2000, Bayen et al., 2006). CP manufacturers (Eurochlor, 2017) list several difficulties related to quantification of CPs, thus including SCCPs:

- (a) It is not currently possible to accurately quantify individual CA components;
- (b) State-of-the-art CA analysis techniques can qualitatively identify groups of CA isomers by carbon chain length and chlorination level, although this remains difficult;
- (c) Instrument detector response is affected by both chlorine content and distribution of chlorine atoms on the carbon chain;
- (d) Reference substances matching commercial products are currently unavailable. These are necessary for more accurate individual congener quantification;

81. In the absence of more complete characterizations of the mixtures and suitable individual standards, quantification is usually based on a technical product, introducing major uncertainties if compositions of the sample and the standard do not match (Bayen et al. 2006, UNEP/POPS/POPRC.11/10/Add.2, Vorkamp & Riget 2014).

82. Detection limits for SCCPs are higher than for most other POPs. The European Commission (2011) concluded that a detection limit of 10 mg/kg would be realistically achievable in relevant waste matrices. German Federal Environment Agency (2015) reported detection limit of 1 mg/kg in the waste materials studied. The German Federal Environment Agency (2015) also reported price for analysis at 190-370 EUR/sample.

83. Three International Standards Organization (ISO) methods address the standardized analyses of SCCPs in water, sediment, sewage sludge, suspended matter and leather. A new standard for analysis of SCCPs in textiles is under development. The methods are:

ISO 12010:2012

Determination of the sum of SCCPs in unfiltered surface water, ground water, drinking water and wastewater using gas chromatography-mass spectrometry with electron capture negative ionization (GC-ECNI-MS)

ISO 18635:2016

Water quality -- Determination of short-chain polychlorinated alkanes (SCCPs) in sediment, sewage sludge and suspended (particulate) matter -- Method using gas chromatography-mass spectrometry (GC-MS) and electron capture negative ionization (ECNI)

ISO 18219:2015

Chromatographic method to determine the amount of SCCPs in processed and un-processed leathers.

ISO/NP 22818 (under development)

Textiles- Determination of SCCP and MCCP in textile products out of different matrices by use of GC-ECNI-MS

84. The most advanced technique in CPs, which includes SCCPs, detection is 2-dimensional gas chromatography combined with electron capture detection. The method is able to qualitatively identify groups of CP isomers by carbon chain length and chlorination level. Currently, the most commonly used method of detection and quantification used in the literature is gas chromatography followed by either high or low resolution electron capture negative ion mass spectrometry (GC/ECNI-MS) (UNEP/POPS/POPRC.11/10/Add.2, Wang et al, 2013).

85. While GC/ECNI-MS remains the most commonly applied technique, novel and promising use of high resolution time of flight Mass Spectrometry (TOF-MS) has also been reported (van Mourik et al. 2015). In addition, improved cleanup procedures have been found to remove interfering compounds, and new instrumental techniques, which distinguish between MCCPs and SCCPs, have been developed. The study also states that new CP quantification methods have emerged, including the use of mathematical algorithms, multiple linear regression and principal component analysis. Gao et al. (2016) developed a novel analytical method, deuterodechlorination combined with high resolution gas chromatography – high resolution mass spectrometry (HRGC-HRMS), to determine the congener compositions of SCCPs in commercial chlorinated paraffins and environmental and biota samples. Internal standard quantification of individual SCCP congeners was achieved, and the relative standard deviations for quantification of total SCCPs were within 10% (Gao et al. 2016).

86. For more information on analytical methods, see Bayen et al, 2016.

3. Monitoring

87. 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.

88. Monitoring programmes should be implemented in facilities producing and using SCCP as well as wastes containing SCCP.

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

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

90. In cases where SCCP 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.

91. In cases where waste containing SCCPs was a constituent of a product or article (e.g., textiles, leather, PVC plastic item), 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

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

93. When conducting repairs in or renovation or demolition of buildings, renovators and contractors should pay attention to the possibility of SCCPs being contained in sealants, paints, coatings, flooring, double-glazed windows, upholstery and textiles. Should these materials contain SCCPs, they should be carefully removed and isolated to prevent dust from spreading to surrounding areas. SCCPs may also be present in electronic and electric appliances, such as in WEEE recycling. 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.

94. Organizations handling waste containing SCCPs should have in place a set of procedures for handling such wastes and workers should be trained in such procedures.

2. Collection

95. Collection arrangements that include depots for SCCP wastes should provide for the separation of SCCP wastes from other wastes. In case the country has existing arrangement for separate collection of PVC plastics, these may also receive SCCP wastes. Some of SCCP wastes, however, may be difficult to identify as containing SCCPs.

96. Collections depots should not become long-term storage facilities for SCCP wastes.

3. Packaging

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

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

4. Labelling

99. In cases where SCCP 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.

5. Transportation

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

6. Storage

101. SCCP wastes should be stored in designated sites and appropriate measures should be taken to prevent the scattering, release and underground seepage of SCCPs, and to control the spread of odors.

102. Appropriate measures, such as the installation of partitions, should be taken to avoid contamination of other materials and wastes with SCCPs.

103. Storage areas for SCCP wastes should have adequate access roads for vehicles.

104. SCCP wastes in storage should be protected from fire.

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

105. SCCPs are poorly water soluble, and water-based liquid mixtures or emulsions containing liquid SCCPs principally from metal forming/deforming but also including used leather textile treatment liquors, should be processed to remove oil and SCCP before being discharged. Eurochlor (2016) lists three techniques: chemical splitting, aqueous evaporation and ultrafiltration. Recovery treatments are strongly recommended by the manufacturers (European Commission, 2008).

106. Liquid SCCPs can also be adsorbed onto solids for further treatment (Eurochlor, 2016).

107. Metal swarf with SCCPs can be degreased and separated from solvent prior instead of incineration/re-smelting (Eurochlor, 2016).

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

2. Destruction and irreversible transformation methods

109. 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

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

4. Other disposal methods when the POP content is low

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

H. Remediation of contaminated sites

112. Soil contamination can take place over a long period of operation by accumulation and also from spills events. Application of sewage sludge to soil or irrigation by wastewater may be a source of SCCP loadings to soil (Zeng et al. 2011, 2012, UNEP/POPS/POPRC.11/10/Add.2).

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

I. Health and safety

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

1. Higher-risk situations

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

116. Higher-risk situations occur at sites where high concentrations or high volumes of SCCP wastes are found and a high potential for exposure of workers or the general population exists.¹² Direct dermal exposure to and inhalation of fine dust or particles containing SCCP in the workplace or home are of particular concern. Exposure to vapour is generally considered insignificant due to the low vapour pressures involved. However, there is a potential for significant inhalation exposure to SCCPs during the formulation of hot melt adhesives and in the use of metal working fluids. Local exhaust ventilation can be used to control inhalation exposure in the hot melt adhesive manufacturing sector. In the metal working sector, inhalation exposure to mists/aerosols of metal working fluids can be controlled by using anti-mist additives in the formulation and by enclosing the workpiece using splash guards (ECB, 2000)

117. While articles containing SCCPs 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.

118. Higher-risk situations specific to SCCPs may occur:

(a) At sites where SCCPs are produced or used due to spills, facility wash-down and storm water runoff (Environment Canada, 2008);

(b) At sites where recycling of plastics containing SCCPs takes place. Polymer-incorporated CPs could be released during recycling of plastics, which may involve processes such as chopping, grinding and washing (Environment Canada, 2008);

(c) At sites where metal-working/cutting fluids containing SCCPs are used. They may also be released into aquatic environments from drum disposal, carry-off and spent bath use (ECB, 2000, European Commission, 2011, Environment Canada, 2008);

(d) At facilities using SCCPs for fat-liquoring of leather;

(e) When consumer products containing SCCPs are used.

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 SCCPs 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.

¹² For example, health impacts were identified for workers of organochlorine production facility in Brazil (ACPO, 2004).

Annex I to the technical guidelines

Synonyms and trade names of commercial formulations that contain or may contained SCCPs addressed by Stockholm Convention on POPs

Synonyms for SCCPs:

Alkanes, chlorinated; alkanes (C₁₀₋₁₃), chloro (60%); alkanes (C₁₀₋₁₃), chloro (50-70%); chlorinated alkanes; chlorinated alkanes, chlorinated paraffins; chloroalkanes; chlorocarbons; paraffin, chlorinated; paraffins, chloro; paraffins, chlorinated; polychlorinated alkanes; polychloroalkanes

The synonyms are general in nature, and may encompass much more than the substance represented by either the CAS number given or C10-13 chlorinated alkanes in general.

Tradenames for CPs, potentially SCCPs

The following generic trade names are usually accompanied by a suffix indicating a specific product (IARC, 1990): A 70; A 70 (wax); Adekacizer E; Arubren; Cereclor; Chlorinated paraffins (CPs); Chlorcosane; Chlorez; Chlorofin; Chloroflo; Chlorparaffin; Chlorowax, Chlorowax 500AO; Chlorowax 45AO, Chlorowax 52AO; Cloparin; Cloparol; Clorafin; CP F; CW; Diablo; Derminolfett; Derminolöl; EDC-tar; Electrofine; Enpara; FL X; Hordaflam; Hordaflex; Hordalub; Hulz; KhP; Meflex; Monocizer; Paroil; Poliks; Tenekil; Toyoparax; Unichlor., ,

Annex II to the technical guidelines

Consumer products containing SCCPs on the EU market 2013-2017

Year	Product	SCCP content mg/kg	
2017	Sports equipment: Boxing gloves	4400	
	Sports equipment: Gym ball	8500	
	Toy pistol (plastic cord)	7000	
	Bathub pillow	17 000	
	Electric shaver (cable)	9800	
	Hobby/sports equipment: Hot pack	4000	
	Hobby/sports equipment: Exercise tube	90 000 (handles)	
	Speaker (cord)	10 000	
	Radio controlled car (tyres)	17 000	
	Claw hammer (Handle)	7000	
	In-ear headphones (USB cord)	3000	
	LED candle (cord)	13 000	
	Power cord	26 000	
	Table cloth	6 000	
	Selfie stick (cord)	45 700	
	USB cable	16 000	
	Bath toy	13 400	
	Game controller	43 000	
	Plastic doll	8 600	
	Babies' sleeping bag/footmuff (packaging)	40 000	
	Babies' sleeping bag (anti-slip knobs)	18 000	
	Handle (cycle parts)	3 500	
	Breastfeeding pillow (packaging)	60 000	
	Hammer (handle)	2 800	
	Sports equipment: Yoga mat	8 000	
	Erotic article	4 400	
	2016	Lighting chain (cord)	7 000
		Sports equipment: Yoga mat	2 300
		Sports equipment: Abs trainer	4000
		Steering wheel cover	4 600
Long sleeved sweater (print)		2 300	
Steering wheel cover		3 000	
Motor vehicle sidelight (cable)		2 600	
USB-cord		2 570	
Selfie Stick		1 600	
Digital thermometer (cable)		1 100	
Stickers (toys)		9 000	
Stickers (toys)		14 000	
Mobile phone case		4 400	
Sports equipment: Baseball glove		13 600	
All-purpose mat		3 600	
Sports equipment: Yoga mat		6 400	
Sports equipment: Yoga mat		5 400	
Sports equipment: Yoga mat		32 000	
Sports equipment: Yoga mat		69 000	
Sports equipment: Yoga mat		3 500	
Sports equipment: Fitness gloves		1 800	
Rain cover for pushchair		7 300	
Extension lead		47 000	
Extension lead		17 000	
2015		Kettle (cable)	36 400
		Game Controller (cable)	19 000

Year	Product	SCCP content mg/kg
	Rubber knife	2 600
	Mobile phone cover	2 600
	Cloche cover (garden equipment)	4 000
	Toilet seat for children	710
	Plastic doll	3 170
	Toy doctor set (stethoscope)	49 100
	Electric kettle (cord)	5 000
	Beach ball	3 100
	Bouncy toy	5 000
	Bathmat	5 200
	Shower curtain	4 900
	Stickers (toys)	15 000
	Stickers (toys)	2 000
	Bathmat	5 300
	Shower hose	47 000
	Earphones	2 800
2014	Wallet (artificial leather)	1 300
	Handbag (artificial leather)	14 000
	Mobile phone bag (artificial leather)	1 100
	Brush case black (artificial leather)	3 500
	Toiletry bag	11 700
	Handbag (artificial leather)	3 800
	Handbag (artificial leather)	3 200
	Bag (artificial leather)	2 700
	Small bag / purse (artificial leather)	1 700
	Wallet case for smartphones (artificial leather)	1 800
	Purse (artificial leather)	2 000
	Pencil case (artificial leather)	5 000
	Handbag (artificial leather)	10 000
	Toiletry bag (artificial leather)	1 300
	Toy car (tyres)	8 300
	Sports equipment: Exercise mat	16 000
	Sports equipment: Exercise mat	49 000
	Sports equipment: Jump rope	22 000
	Plastic cooking set (plastic bag)	8 800
2013	Beauty case	12 000
	Squeeze toy (chicken)	100 000
	Plastic bath toy	71 000
	Pirate slap-on bracelet	31 000
	Doll with accessories	15 000
	Police costume (transparent plastic pocket)	57 000
	Replaceable wall decorative stickers	18 000
	Pirate costume for children	2 800 (belt) and 1900 (vest)
	Plastic toy figures	83 000

Annex III to the technical guidelines

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