UNITED NATIONS

UNEP

SC

UNEP/POPS/POPRC.9/13/Add.2

Distr.: General
11 November 2013

Original: English

Stockholm Convention on Persistent Organic Pollutants

Persistent Organic Pollutants Review Committee
Ninth meeting
Rome, 14–18 October 2013

Report of the Persistent Organic Pollutants Review Committee on the work of its ninth meeting

Addendum

Risk management evaluation on hexachlorobutadiene

At its ninth meeting, by its decision POPRC-9/2, the Persistent Organic Pollutants Review Committee adopted a risk management evaluation for hexachlorobutadiene on the basis of the draft contained in document UNEP/POPS/POPRC.9/5. The text of the risk management evaluation, as amended, is set out in the annex to the present addendum. It has not been formally edited.

K1353962 031213

Annex

HEXACHLOROBUTADIENE

RISK MANAGEMENT EVALUATION

Prepared by the ad hoc working group on hexachlorobutadiene
Persistent Organic Pollutants Review Committee

18 October 2013

Table of Contents

Executive summary

1. The European Community and its Member States submitted a proposal to list hexachlorobutadiene (HCBD) in Annex A, B and/or C to the Stockholm Convention pursuant to paragraph 1 of Article 8 of the Convention. The risk profile of HCBD was adopted by the eighth meeting of the Persistent Organic Pollutants Review Committee in October 2012. The Committee decided (1) that HCBD is likely, as a result of its long range environmental transport, to lead to significant adverse human health and environmental effects such that global action is warranted; (2) to prepare a risk management evaluation that includes an analysis of possible control measures for HCBD and (3) to invite parties and observers to submit to the Secretariat the information specified in Annex F before 11 January 2013, as well as additional information relevant to Annex E, in particular data on sources of emissions such as the intentional production of HCBD and/or unintentional releases.

2. HCBD is a halogenated aliphatic compound which has been used in several technical and agricultural applications e.g. as intermediate in the chemical industry or as a product. In the past it was intentionally produced and applied e.g. as a solvent (for rubber and other polymers), as a "scrubber" to recover chlorine-containing gas or to remove volatile organic components from gas, as hydraulic, heat transfer or transformer fluid, in gyroscopes, in the production of aluminium and graphite rods and as a plant protection product. HCBD is not known to be currently intentionally produced or used. To limit the possible remaining uses and to prevent re-introduction of other uses, listing of HCBD in Annex A without any specific exemptions would be the most efficient control measure for intentional sources. As a consequence, HCBD would be submitted to the provisions of Article 3 of the Convention and the requirement to eliminate its production, use, import and export. All applications seem to have ceased, though specific information on intentional production and use is lacking for the current situation and for the past 30 years. This indicates that substitution has taken place and that alternatives are available. Additional costs for eliminating the intentional production and use of HCBD are not expected. Cost increases for consumers are not expected, since the alternatives are already in use. Health and the environment could be protected and benefited from the ban of HCBD, as the re-introduction of HCBD and related risks would be prevented and any currently unidentified intentional production and use around the world should end.

3. HCBD is unintentionally formed and released from industrial processes and other sources. Relevant sources are the production of chlorinated hydrocarbons, production of magnesium, and incineration processes. Releases can be minimized by alternative production processes, improved process control, emission control measures, or by substitution of the relevant chlorinated chemicals. Listing of HCBD in Annex C would subject this substance to the measures under Article 5 of the Convention, and establish the goal of continuing minimization and, where feasible, ultimate elimination of HCBD releases. This would include an obligation to promote best available techniques (BAT) and best environmental practices (BEP) for HCBD sources. Cost efficient BAT and BEP to reduce releases of unintentionally produced HCBD are available and described in relevant documents. Countries already have obligations to implement control measures for other unintentionally produced persistent organic pollutants (POPs) (hexachlorobenzene (HCB), pentachlorobenzene (PeCB), polychlorinated biphenyls (PCB), and polychlorinated dibenzo-*p*-dioxins and dibenzofurans PCDD/PCDF) under the Convention. These will be similar to those for HCBD. Emissive uses of perchloroethylene, trichloroethylene, and carbon tetrachloride have been phased out in several applications; for the remaining industrial uses, processes have been improved in a way that less product is consumed in the process and the production volumes of perchloroethylene and trichloroethylene are declining in numerous signature states to relevant Conventions[1]. Furthermore, when safer and technically feasible and cost-effective alternatives for specific uses of perchloroethylene and trichloroethylene, the unintentional generation of HCBD can be reduced by substituting chlorinated chemicals by alternatives. This demonstrates that measures to reduce unintentional releases of HCBD through listing in Annex C would positively impact human health and the environment. Additional costs for applying BAT and BEP and for control measures and emission inventories are considered low. Monitoring of HCBD will induce additional costs. Additional costs for implementation of measures to reduce releases of HCBD, enforcement and supervision are considered low as the control measures for other unintentional POPs such as PCDD/PCDF are already applied. Monitoring capacity for HCBD is needed in developing countries and countries with economies in transition.

4. Examples document the potential for HCBD releases from former waste disposal. There is no insight into the total amount of waste sites worldwide, nor into their releases. Listing of HCBD in Annex A and/or C would subject HCBD to the measures under Article 6 of the Convention and would establish the goal of identifying sites contaminated with HCBD and managing them in a manner protective of human health and the environment. BAT and BEP to minimise releases from waste disposal are available (BC, 1997). Countries have already introduced corresponding measures. The proposed measure would require the development of strategies to identify, to the extent practicable, existing waste stockpiles, and to manage them in an environmentally sound manner e.g. by appropriate treatment of relevant landfill leachate. Such measures would positively impact human health and the environment.

---

[1] CEH Marketing Research Report:" C2 Chlorinated Solvents" (2012); abstract available at http://www.ihs.com/products/chemical/planning/ceh/c2-chlorinated.aspx

Additional costs for identifying relevant landfills, establishing corresponding inventories and sound management of releases are considered low.

5. Having prepared a risk management evaluation and considered the management options, in accordance with paragraph 9 of Article 8 of the Convention, the Committee recommends that the Conference of the Parties to the Stockholm Convention should consider listing and specifying the related control measures for HCBD in Annexes A and C.

1. Introduction

1.1 Chemical identity of the proposed substance[2]

6. The European Union and its Member States submitted a proposal to list hexachlorobutadiene (HCBD) in Annex A, B and/or C to the Stockholm Convention on 10 May 2011 (UNEP/POPS/POPRC.7/3), together with a detailed dossier to support the proposal (UNEP/POPS/POPRC.7/INF/4).

7. HCBD is a halogenated aliphatic compound, mainly generated as a by-product in the manufacture of chlorinated aliphatic compounds (primarily tri- and tetrachloroethene and tetrachloromethane). It has also been used as a pesticidal fumigant.

Name and registry number

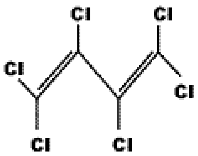
Common name:	Hexachlorobutadiene
IUPAC Name:	1,1,2,3,4,4-hexachlorobuta-1,3-diene
Synonym:	HCBD; perchloro-1, 3-butadine; perchlorobutadiene; 1,3-hexachlorobutadine; 1,3-butadiene, 1,1,2,3,4,4-hexachloro-; 1,3-butadiene, hexachloro-; hexachlorobuta-1,3-diene;[3,4,5]
CAS registry numbers:	87-68-3
Common trade names:	C-46, Dolen-pur, GP40-66:120, UN2279,[6]

Structures

Molecular formula3: C4Cl6, Cl2C=CClClC=CCl2

Molecular weight: 260.76 g/mol

Chemical structure :



Physical-chemical properties

8. HCBD has low water solubility and quite a high vapour pressure compared to other listed persistent organic pollutants (POPs) (UNEP/POPS/POPRC.2/14/Add.2). The substance is lipophilic based on a log Kow close to 5 (cf. Table 1). The substance can volatilize due to its Henry's law constant from moist soil and water (HSDB, 2012). According IPCS (1994) it has a turpentine-like odour. Selected physico-chemical properties (the majority of the values have been determined experimentally) are listed in Table 1 (quoted from UNEP/POPS/POPRC.8/3).

---

[2] UNEP/POPS/POPRC.8/16/Add.2.

[3] Mackay et al. (2006).

[4] UNEP/POPS/POPRC.7/INF/4.

[5] ACToR (2012).

[6] IPCS (1994).

Table 1: Physical-chemical properties of HCBD

Property	Value	Information source according to UNEP/POPS/POPRC.8/16/Add.2
Melting Point (°C)	-21	
Boiling Point (°C)	215	Horvath 1982, Lide 2003, all cited in Mackay et al. 2006
Density (g/cm3 at 20°C)	1.68	Horvath 1982 cited in Mackay et al. 2006
Water solubility (mg/L at 25°C):	3.2	Shake flask-HPLC, Banerjee et al. (1980) cited in SRC PhysProp Database (2012)
Vapour pressure (Pa at 20°C and 100°C)	20 and 2926	Person and McConell (1975) cited in Mackay et al. (2006) Environment Canada (1999)
Henry´s law constant (Pa m3 /mol)	1044 (experimental), 2604 (calculated)	Warner et al. (1987) cited in Mackay et al. (2006)
Log Kow	4.78, 4.9	Shake flask-HPLC Banerjee et al. (1980), Sangster (1993), Hansch et al. (1995), cited (and recommended value) in Mackay et al. (2006) Shake-flask-GC, both phases, Chiou (1985), cited in Mackay et al. (2006)
Log Koa at 10°C	6.5	Vulykh et al. (2005)
Log Koc	Reported range: 3.7 to 5.4	HSDB (2012)
Physical state	Liquid	

1.2 Conclusions of the POPs Review Committee regarding Annex E information

9. The POPs Review Committee has conducted and evaluated a risk profile in accordance with Annex E at its eighth meeting held in Geneva from 15 to 19 October 2012. The Committee, by its decision POPRC-8/2, adopted the risk profile for hexachlorobutadiene (UNEP/POPS/POPRC.8/16/Add.2) and:

(a) Decided, in accordance with paragraph 7 (a) of Article 8 of the Convention, that hexachlorobutadiene is likely, as a result of its long-range environmental transport, to lead to significant adverse human health and environmental effects such that global action is warranted;

(b) Also decided, in accordance with paragraph 7 (a) of Article 8 of the Convention and paragraph 29 of decision SC-1/7 of the Conference of the Parties, to establish an ad hoc working group to prepare a risk management evaluation that includes an analysis of possible control measures for hexachlorobutadiene in accordance with Annex F to the Convention;

(c) Invited, in accordance with paragraph 7 (a) of Article 8 of the Convention, parties and observers to submit to the Secretariat the information specified in Annex F before 11 January 2013, as well as additional information relevant to Annex E in particular data on sources of emissions such as the production of hexachlorobutadiene and/or unintentional releases.

1.3 Data sources

10. The risk management evaluation is primarily based on:

(a) information that has been provided by parties and observers. Responses regarding the information specified in Annex F of the Stockholm Convention (risk management) have been provided by the following parties and observers :[7]

(i) Parties: Canada, Croatia, Estonia, Mexico, Nigeria, Romania, Slovakia, Sri Lanka

(ii) Observers: no information submitted

(b) decision POPRC-8/2 (UNEP/POPS/POPRC.8/16);

(c) the risk profile for hexachlorobutadiene (UNEP/POPS/POPRC.8/16/Add.2);

(d) the exploration of management options for HCBD (UNECE 2007).

In addition to the above-mentioned sources, information has been gathered from other open information sources and literature. Such information sources are listed in the Reference section.

1.4 Status of the chemical under international conventions

11. HCBD is subject to a number of international treaties and regulations:

(a) In December 2009, HCBD has been proposed to amend Annex I (prohibition of production and use) of the Aarhus Protocol on Persistent Organic Pollutants (POPs) under the United Nations Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution (CLRTAP), according to Decision 2009/1. The amendment will come into force when two thirds of the Parties have adopted the amendment.

(b) The UNECE has included HCBD in Annex II of the Protocol on Pollutant Release and Transfer Registers (PRTRs) to the Aarhus Convention on access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters.

(c) HCBD is currently under a review process by the Chemical Review Committee (CRC) for inclusion under the Rotterdam Convention. The review process was initiated by notifications of final regulatory action to ban or severely restrict HCBD by Canada and Japan (http://www.pic.int) (Thailand, 2011).

(d) HCBD is on the List of Substances of Possible Concern, Section B under the OSPAR Commission for the Protection of the Marine Environment of the Northeast Atlantic. Section B lists substances which are of concern for OSPAR but which are adequately addressed by European Commission initiatives or other international forums.

Additional information on the status of the chemical under international conventions has not been provided by parties or observers who submitted Annex F information.

1.5 Any national or regional control actions taken

12. HCBD is considered in several regional and national control actions:

(a) In the European Union, Decision No 2455/2001/EC on a first list of priority substances of the adopted EU Water Framework Directive 2000/60/EC listed HCBD in its Annex. In addition, HCBD is regarded as a priority hazardous substance and thus it is subject to a step-wise cessation or phasing out of discharges, emissions and losses. Quality standards for surface and marine water have been set in the European Directive 2008/105/EC and will presumably be renewed through a European Directive 2013/xx/EC. HCBD was incorporated in the EU Directive 88/347/EEC, which regulated the discharges of certain dangerous substances by means of limit values and quality objectives;

(b) In the European Union, the production, placing on the market and use of HCBD is prohibited since the substance has been incorporated in the EU POPs Regulation in 2012 (Regulation (EC) No 850/2004);

(c) In the European Union, HCBD is incorporated in the Pollutant Release and Transfer Registers by means of Decision 2006/61/EC. Remarkably, reporting is obligatory for water and land above limit values of 1 kg/year, but it is not required for emissions to air;

(d) HCBD is included in the second Priority Substances List of the Canadian Environmental Protection Act, 1999 (CEPA1999). In July 2003, HCBD was added to Schedule 1 (List of Toxic Substances) to CEPA 1999. Later, in 2006, HCBD was added to the Virtual Elimination List (UNECE 2007);

[7] Annex F information provided by parties and observers is available at the SC website (see http://chm.pops.int/Convention/POPsReviewCommittee/LatestMeeting/POPRC8/POPRC8Followup/SubmissiononHCBD/tabid/3069/Default.aspx); status of the website evaluated for the present document: 14.02.2013.

(e) The manufacture, use, sale, offer for sale and import of HCBD in Canada is prohibited under the Prohibition of Certain Toxic Substances Regulations, 2012 which came into force on March 14, 2013 (http://www.ec.gc.ca/lcpe-cepa/eng/regulations/detailReg.cfm?intReg=207);

(f) HCBD is on the Domestic Substances List. HCBD is not included and will not be considered for addition to the National Pollutant Release Inventory;

(g) In Canada, HCBD is being monitored in air under the Northern Contaminants Program (NCP) at Alert (Nunavut) (Annex F, Canada 2013);

(h) In Canada, HCBD has been monitored in wildlife and water/sediments (Annex F, Canada 2013);

(i) Ontario's Water Resources Act has a "provincial water quality objective" of 0.009 µg/L for HCBD in discharge as well as in ambient water. In addition, this province has a "leachate quality criteria" for HCBD set at 0.5 ppm. Waste that produces a leachate with concentrations equal or greater than 0.5 ppm HCBD when performing the Toxicity Characteristic Leaching Procedure is defined as a "leachate toxic waste" in the Revised Regulations of Ontario Regulation 347 (UNECE 2007);

(j) In the U.S, national emission standards that require the use of best available control technologies have been developed for sources categories emitting HCBD, including rubber tire production, chlorine production, and miscellaneous organic chemical processes (1990 Clean Air Act 112B) (UNECE 2007);

(k) In the US, HCBD is among the chemicals for which emissions/releases must be reported as part of the U.S. Toxics Release Inventory (TRI) program (see above). HCBD is also listed in the following Acts as (UNECE 2007):

(i) A hazardous air pollutant (HAP) under the U.S. Clean Air Act;

(ii) A hazardous constituent under the Resource Conservation and Recovery Act (RCRA);

(iii) A hazardous substance under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as Superfund); and

(iv) A candidate for the Drinking Water Contaminant List under the Safe Drinking Water Act.

(l) In California, HCBD is listed on the current (February 8, 2013) Proposition 65 list of Chemicals Known to the State of California to Cause Cancer or Reproductive Toxicity. HCBD was added to the list on May 3, 2011 for its carcinogenic properties.[8] HCBD in water discharges is regulated under the California Toxics Rule; the limit is 0.44 µg/l (UNECE 2007).

(m) HCBD is on the Massachusetts Toxics Use Reduction Act (TURA) Chemicals List.[9] The TURA requires Massachusetts companies that use large quantities of specific toxic chemicals to evaluate and plan for pollution prevention opportunities, implement them if practical, and measure and report their results on an annual basis.

(n) In Mexico, the use of HCBD as a plant protection product is not registered. Production and import for this use is prohibited (Annex F, Mexico 2013).

(o) In Mexico, HCBD has a maximum allowable limit of 0.5 mg/L in leachate (above this limit, residues are considered toxic to the environment) (NOM-052-SEMARNAT-2005). HCBD is included in GRENA (North American emergency response guide). The Guide has been jointly elaborated by Transport Canada (Transport Canada), the US Department of transportation (DOT) and the Secretariat of communications and transportation of Mexico. A water quality value for HCBD for the protection of the aquatic life is set to 0.0009 mg/L for freshwater and 0.03 mg/L for marine water (See Annex F, Mexico, 2013).

(p) European Union initiatives call for sediment and organisms to be uncontaminated with HCBD, and specify a water quality objective of 0.1 µg/l (UNECE 2007).

(q) Several regulations are in place in Germany relating to: the Ordinance on Hazardous Substances, Maximum Workplace Concentrations, Technical Guidelines for Clean Air (‘self-classification’ of HCBD according to the TA-Luft leads to maximum allowed emissions of 20 mg/m^3 for a mass flow of 0.1 kg/h), Catalogue of Chemicals with a High Water Contaminating Potential, Wastewater Disposal (emissions of 1 g/ton HCBD are permissible) and Transport Regulations (UNECE 2007).

[8] See State of California’s Environmental Protection Agency Office of Environmental Health Hazard Assessment List of Chemicals Known to the State to Cause Cancer of Reproductive Toxicity (February 8, 2013) (accessed March 13, 2013). http://oehha.ca.gov/prop65/prop65_list/newlist.html.

[9] See http://www.mass.gov/dep/toxics/tura/reportsum.htm#chemicals

(r) HCBD is on the Master List[10] of the German Federal Environment Agency (UBA). The list is part of the publication “Substances classified as carcinogenic, mutagenic and toxic for reproduction (CMR) and other substances of concern in consumer products”, which deals with chemical substances in consumer-relevant articles that may be of concern for health or the environment.

(s) HCBD is on a list of phase out substances (KEMI: PRIO Database), a web-based tool elaborated by the Swedish Chemicals Agency (KEMI) intended to be used to preventively reduce risks to human health and the environment from chemicals.[11]

(t) In Japan, HCBD is designated as Class I Specified Chemical Substances under the Chemical Substances Control Law (CSCL). A person who intends to operate a business of manufacturing, import or use of a Class I Specified Chemical Substance shall obtain permission (the manufacture, import or use of these chemical substances is prohibited in principle).[12]

(u) The World Health Organization recommends a guideline value for drinking water of 0.6 µg/litre (WHO, 2004).

13. Additional information on national or regional control actions has not been provided by parties or observers who submitted Annex F information.

2. Summary information relevant to the risk management evaluation

2.1 Additional relevant information on sources, releases and measures

Production

14. HCBD is not known to be currently intentionally produced or used. HCBD is usually a by-product of the production of chlorinated chemicals. BUA (1991) states that HCBD is not a target product of the chemical industry in Germany. It arises as a by-product from certain processes, particularly during low-pressure chlorolysis for the production of perchloroethylene and trichloroethylene but also during other processes. However, HCBD as a by-product has been partly sold for commercial uses. This could be considered “commercial production”. In the following, the term “intentional production” means “commercial production”. Unintentional formation means the generation as an unwanted waste by-product in the production of chlorinated chemicals, but also other possible sources of unintentional formation of HCBD such as the manufacture of magnesium and incineration processes. As a consequence, there is a certain overlap between measures targeting intentional production and unintentional generation. Control measures targeting intentional production and unintentional generation as an unwanted waste by-product in the production of chlorinated chemicals, can be identical.

15. The following processes are relevant in this respect according to BUA (1991):

Process	**HCBD concentration in the raw product**	**Remarks**
Low pressure chlorolysis for the manufacturing of perchloroethylene and carbon tetrachloride	5%	HCBD is recycled in the process together with other high-boiling by-products
Optimised low pressure chlorolysis for the manufacturing of perchloroethylene and carbon tetrachloride	0.2 to 0.5%	The HCBD containing residue is treated by distillation and result in a residue containing 7 to 10% HCBD. The latter residue is incinerated.
Manufacturing of hexachlorocyclopentadiene	0.2 to 1.11 %	
Manufacturing of tetrachloride and trichloroethylene from acetylene and chlorine and subsequent decomposition to carbon tetrachloride and trichloroethylene	0.4%	

16. BUA (1991) also describes three possible processes for the direct production of HCBD. In Germany such processes were not applied at that time. Whether these were ever used for industrial manufacturing of HCBD is not clear. (1) Intentional production, (2) unintentional generation and (3) stockpiles are possible anthropogenic sources of

[10] Downloadable at http://www.uba.de/uba-info-medien-e/4092.html

[11] See http://www2.kemi.se/templates/PRIOEngframes____4144.aspx

[12] Comment from Japan, 2013.

HCBD. There are no natural sources of HCBD in the environment (BUA 1991, Environment Canada 2000); (for details see UNEP/POPS/POPRC.8/16/Add2, section 2.1 on sources).

(1) Intentional production:

17. It seems that HCBD is no longer intentionally produced in the UNECE region including in the US and Canada (see UNEP/POPS/POPRC.8/16/Add.2). Data about intentional production outside of the UNECE region are not available. However, monitoring data from China (Li et al., 2008; Juang et al., 2010) suggest that intentional production and/or unintentional generation and release have continued at least until recently.

18. Data on quantities of HCBD produced as by-product in the manufacture of chlorinated hydrocarbons are difficult to quantify. Therefore the information is summarised as follows :

19. According to UNEP/POPS/POPRC.8/16/Add.2, the intentional production of HCBD in Europe ended in the late 1970s (Van Der Honing 2007). HCBD was never generated as a commercial product in the US or Canada (Lecloux, 2004), at least not in commercial quantities (ATSDR, 1994). Data about intentional production outside of the UNECE region are not available (Lecloux, 2004).

20. HCBD was produced in high volumes between 1970 and 1980. Worldwide production of HCBD was estimated at 10,000 tons in 1982. Cesars database (2001)[13] report refers to US EPA (1980), which estimates the annual American production to be between 7.3 and 14.5 million pounds per year (3,300 to 6,600 tonnes/year). According to TOXNET,[14] in 1975, the total US production of HCBD was reported to be 8.0 million pounds (3,600 tonnes/year). Cesars database also reported the import of 0.2 to 0.5 million pounds (0.1 to 0.2 tonnes/year) from Germany between 1970 and 1974.

21. The unintentional HCBD waste by-product, generated during the production of chlorinated chemicals, was higher than the intentional production by 14,000 tons in1982 in the US alone (IPCS, 1994 as cited in Lecloux, 2004). This is more or less in line with information from US EPA (2003): the annual HCBD waste generation was of 8 million pounds (3,600 tonnes) in 1975, and had increased to 28 million pounds (12,000 tonnes) in 1982.

22. In 1979, about 4,500 tonnes of HCBD were generated in Germany, of which 1021 tonnes was exported, 3,400 tonnes incinerated and 100 tonnes landfilled. In 1991, the figures have decreased to a quantity between 550 to 1,400 tonnes of which about 300 tonnes were exported as a product, and 250 to 1,100 tonnes were recycled in the process (BUA 1991).

23. In 1980, about 10,000 tonnes of HCBD were generated, in the former European Union of which 1,000 tonnes was exported, 5,580 to 6,120 tonnes incinerated and 1,600 to 2,440 tonnes was landfilled. In 1990, in Western Europe, a HCBD quantity of 2,000 to 49,900 tonnes was estimated (BUA 1991).

24. Some sources indicated that there has been production in Austria.[15] In a 2001 report from the Austrian Umweltbundesamt (UBA AT, 2001), emission standards for HCBD have been provided, which suggest HCBD has been produced in Austria, however, actual data on production could not be retrieved.

25. HCBD has never been produced in Canada but was mainly released as a by-product from the production of tetrachloroethylene. It was also a by-product from the manufacture of trichloroethylene, carbon tetrachloride, vinyl chloride, allyl chloride, and epichlorohydrin. It could be found in the fly ash during refuse combustion. It is no longer imported, and the two Canadian tetrachloroethylene producers ceased the production in 1985 and 1992 (CCME 1999).

26. On the one hand, there is some information indicating that intentional production and/or use may still be relevant at least until recently:

(a) According to a UNEP press release in 2001, HCBD has been classified as a high-volume production chemical by the Organization for Economic Cooperation and Development (OECD), with one country reporting that its factories were producing more than 10,000 tonnes annually;

(b) The European Directive 88/347/EEC and Decision 92/446/EEC mentioned “industrial plants using HCBD for technical purposes” as a possible source for HCBD releases.

27. On the other hand, there is some information indicating that current or recent intentional production and/or use is at least not in significant quantities or relevant :

(a) A 1998 report from New Zealand report indicates that HCBD is prioritised by OECD for the collection of a Screening Information Data Set to permit a more comprehensive risk assessment. There are no data that indicate

---

[13] Cesars database, Canadian Centre for Occupational Health & Safety (2001). http://www.ccohs.ca/products/databases/samples/cesars.html

[14] See http://toxnet.nlm.nih.gov/cgi-bin/sis/search/a?dbs+hsdb:@term+@DOCNO+2870

[15] See e.g. http://monographs.iarc.fr/ENG/Monographs/vol73/mono73-14.pdf

that it is produced or imported by a member state in quantities more than 1,000 tonnes in 1997. The classification of HCBD as High Production Volume (HPV) could not be confirmed in the OECD database;[16]

(b) HCBD has not been reported by the EU Industry as an HPVC[17] or LPVC[18] within ESIS;[19]

(c) HCBD has not been reported as an HPV[20] within the US HPV database.[21]

28. The trade with HCBD is not regulated under the Rotterdam Convention. Canada provided a Notification of Final Regulatory Action to the Secretariat of the Rotterdam Convention in 2008 for its regulatory action controlling the use of this substance under the *Prohibition of Certain Toxic Substances Regulations, 2005.* Japan had previously submitted a Notification of Final Regulatory Action for HCBD in 2005. Although these notifications were considered in 2009 by the Chemicals Review Committee (the technical expert' body under the Rotterdam Convention), the notification from Japan did not meet all criteria and HCBD has not been recommended for listing under the Rotterdam Convention to date. Some additional data were submitted by Thailand and Hungary in 2009. HCBD has not been included in the European regulation 689/2009 on the export and import of dangerous chemicals. Thus, no data on international trade of HCBD could be retrieved from the European database EDEXIM.[22]

29. Specific data on quantities of intentional production and use of HCBD during the past 30 years are not available. In conclusion, there is no specific information on the current production and use, however, possibly remaining intentional production and use (particularly in quantities below the limits for HPVCs/HPVs) cannot be excluded.

30. Canada, Mexico, Nigeria, Slovakia and Sri Lanka reported that HCBD is not produced in these countries (Annex F, Canada, Mexico, Nigeria, Slovakia and Sri Lanka, 2013). Additional information on the production of the chemical has not been provided by parties or observers who submitted Annex F information.

(2) Unintentional production:

31. HCBD can be unintentionally produced during the manufacture of chlorinated chemicals. For example HCBD is still unintentionally generated during the production of chlorinated hydrocarbons, particularly of perchloroethylene and trichloroethylene, but also during other processes (for information on the quantities generated see above).

32. HCBD can generally be destroyed or recycled in the plant. However, total elimination of industrial HCBD emissions is currently not feasible, as the production of the relevant chlorinated hydrocarbons results in the generation of HCBD as an unintentional by-product. Releases can be minimised by technical abatement measures to very low levels, but are not eliminated with the current industrial practices. In Germany HCBD could not be identified in off-gases from an incineration of production residues from a tetrachloroethene/tetrachloromethane plant (Dow 1992b quoted from BUA 1991/2006). According to Dow Germany the releases to the atmosphere from the incineration of production residues from tetrachloroethene/tetrachloromethane production in Germany in 1998 were estimated at 60 g (Dow 2005 quoted from BUA 1991/2006). Other techniques, such as the use of closed loop systems and the substitution of chlorinated hydrocarbons by alternatives that are not leading to unintentional formation of HCBD, and that prove to be technically and economically feasible and also advantageous from a life cycle management point of view, will be necessary to further minimise and ultimately eliminate HCBD releases.

33. Other sources of unintentional formation of HCBD are the manufacture of magnesium and incineration processes (e.g. motor vehicle emissions, incineration processes of acetylene, incineration of chlorine residues). Deutscher and Cathro (2001) observed HCBD generation during the electrolytic production of magnesium in a laboratory-scale electrolytic cell. Lenoir et al. (2001) observed the by-product formation of organochlorine compounds including HCBD from incineration processes of acetylene, which was indicated as being present in flames of all incineration processes. Releases from incinerators have been reported in WWF (2005) and INERIS (2005). In 2003, according to the Association of Plastic Producers (Syndicat des Producteurs de Matières Plastiques, SPMP) in France, HCBD has been detected in the effluents of an incinerator eliminating chlorine residues (INERIS 2005). It was also reported that HCBD releases can take place during waste incineration, and that combustion sources of HCBD are similar to those of dioxins, furans and hexachlorobenzene (Environment Canada 2000). Also, emissions from motor vehicles have been indicated as source for HCBD (WWF 2005).

[16] Comment from the Netherlands, 2013.

[17] High Production Volume Chemicals; Substances with a production or import volume in excess of 1000 tonnes/year.

[18] Low Production Volume Chemicals; Substances with a production or import volume between 10 and 1000 tonnes/year.

[19] ESIS = Existing Substance Information System of the European Commission: http://esis.jrc.ec.europa.eu/index.php?PGM=hpv

[20] Chemicals produced or imported into the United States in quantities of 1 million pounds or more per year.

[21] http://www.epa.gov/hpvis/

[22] Comment from the Netherlands, 2013.

34. Waste-water treatment plants are a possible secondary source of HCBD. HCBD entering such plants can be released to water and soil via sewage sludge (ESWI 2011).

(3) Stockpiles:

35. Examples document the potential of HCBD releases from former waste disposal such as hazardous waste disposal sites or industrial facility waste disposal sites. One example of HCBD stockpiles in waste dumps is the Devil's swamp area in Louisiana (US). At the Orica dump in Australia, large quantity of HCB contaminated with HCBD and other organochlorines are stored in drums (approximately 20,000 tonnes) (Rae, 2012). The examples document the potential of HCBD releases from former waste disposal. At Weston Quarries (UK), properties built on quarry spoil next to the waste dump had to be demolished for excessive indoor HCBD concentrations (Nicole, 2004; Barnes et al., 2002; Crump et al., 2004). There is no insight into the total amount of waste sites worldwide, nor on their releases (Crump et al., 2004).

Use

36. HCBD was used in several technical and agricultural applications and as an intermediate in the chemical industry or as a product. It was applied as a solvent (for rubber and other polymers); as a "scrubber" to recover chlorine-containing gas or to remove volatile organic components from gas; as hydraulic, heat transfer or transformer fluid; in gyroscopes; or in the production of aluminium and graphite rods. The former use of HCBD as a plant protection product has stopped in the EU. It is unclear whether the use as a fumigant for treating grapes has also stopped outside the EU (UNEP/POPS/POPRC.8/16/Add2, section 2.1.2). The European Chemicals Agency (ECHA) classification and labelling inventory indicates that there are 65 notifiers for HCBD.[23] HCBD is furthermore listed in the ECHA inventory of pre-registered substances with an envisaged registration deadline in 2010. Nevertheless, so far, no registration for HCBD has been submitted to ECHA. This suggests that there are no EU companies which produce or import HCBD in high volumes (i.e. > 1,000 tpa). The number of entries in the classification and labelling (C&L) inventory[24] and the fact that pre-registrations have been submitted to ECHA at least indicate that HCBD is of certain interest for EU companies, although pre-registrations could also have been submitted due to strategic reasons instead of real registration obligations.

37. Mexico reported that the use of HCBD as a fungicide is not registered in the country. Therefore, its use, production and import for this use are prohibited (Annex F, Mexico, 2013). Additional relevant information on uses has not been provided by parties or observers who submitted Annex F information.

38. It has been indicated by several sources that HCBD has been used as laboratory reagent (Haskoning 2002, ATSDR 1994, WWF 2005, INERIS 2005). However, it is unknown if HCBD is still being used for this purpose (Haskoning 2002 quoted from ESWI 2011). According to Article 3 paragraph 5, the use for laboratory-scale research or as a reference standard is excluded from the Stockholm Convention.

Releases

39. Most of the specific information on HCBD releases is scarce and obsolete (UNEP/POPS/POPRC.8/16/Add2, section 2.1.3).

40. Comparatively recent release estimates are available for Europe and the US. Recently estimated releases to air and surface water are in the same order of magnitude (up to several hundred kilograms per year) in Europe for the period from 2007 to 2009 and in the US for the period from 2007 to 2010. Release estimates from unintentional sources in Canada in 2004 are comparatively low (below 100 g for some sources, including products or mixtures containing HCBD as a contaminant, chemical industry, vinyl chloride monomer manufacture). Also, HCBD was not detected in municipal solid waste and hazardous waste incinerators. There were no data available for other sources, including hazardous landfill leachate and long range transport (EC 2004).[25] Former releases in the UNECE region were significantly higher (e.g. 454 tons released to the environment in 1975 in the US; about 2 tons in 2000 in the US; and 2.59 tons in 2000 in UNECE Europe).

41. In 2011, the most recent reporting year for the U.S. Environmental Protection Agency's Toxics Release Inventory (US TRI), the on- and off-site disposal or other releases of HCBD totalled 1,187 pounds (538 kg) with 9 US facilities reporting. The majority of these HCBD releases were fugitive air emissions (794 pounds or 360 kg) and point source air emissions (270 pounds or 122 kg).[26] In 2010, the most recent reporting year for the European Pollutant Release and Transfer Register (E-PRTR), releases of HCBD from industrial activities totalled 88.9 kg with 11 facilities reporting. These HCBD releases were releases to water from waste and wastewater management (9

---

[23] http://clp-inventory.echa.europa.eu/ SummaryOfClassAndLabelling.aspx?SubstanceID=80395&HarmOnly=no?fc=true&lang=en

[24] EU database containing classification and labelling (C&L) information on notified and registered substances received from manufacturers and importers (http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database).

[25] http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=81EBD5A7-0C9C-4CB0-86FD-849869B75715

[26] Source: U.S. Toxics Release Inventory at http://iaspub.epa.gov/triexplorer/tri_release.chemical.

facilities; 69.5 kg), production and processing of metals (1 facility; 17.0 kg) and chemical industry (1 facility; 2.35 kg).[27] Release data from the E-PRTR and the US TRI are not directly comparable, as for the E-PRTR it is only necessary to report releases of HCBD to water above an emission limit of >1 kg per year. Reporting of releases to air is not obligatory, and corresponding releases are thus not reported.

42. Currently, the most important known source of HCBD in the 27 EU Member States (EU 27) is due to the manufacture of chlorinated chemicals (particularly tri- and tetrachloroethene and tetrachloroethylene) through chlorolysis. The estimated amount of HCBD released during this process varies between ~0.7 kg/year up to possible ~500 kg/year (EC 2012). Urban waste-water treatment plants are the second main sources of HCBD. HCBD in wastewater treatment stations accumulate in the sewage sludge. A total amount of HCBD which ends up in the sewage sludge in EU 27 is estimated to be approximately 6 kg/year. It must be noted that this estimation is based on the sewage sludge contamination data from China, since no data from European facilities were identified (EC 2012).[28]

43. For the non-UNECE regions, information is scarce. There is still a potential for unintentional release of HCBD from production of chlorinated chemicals in most parts of the world. Reports from South India suggest substantial ongoing HCBD emissions from industry despite the lack of corresponding data for, e.g. Asia. Data of Juang et al. (2010) indicate that there are still considerable sources in South-East Asia.

44. HCBD is on the list of chemicals subject to reporting on emissions registration and transfer of pollutants from Mexico (Annex F, Mexico 2013). The main emission/discharge sources of HCBD are (a) unintentional release during the production of chlorinated hydrocarbons, (b) emission from disposed waste of chlorinated hydrocarbons, (c) emissions from other commercial uses and (d) emission from magnesium production (Annex F, Nigeria, 2013). Additional information on releases has not been provided by parties or observers who submitted Annex F information.

45. To conclude, while in the UNECE region releases of HCBD generated as an unintentional by-product have decreased by orders of magnitude over the last decades, though still continue, , there is a crucial lack of information about intentional production or unintentional formation in non-UNECE countries. Reductions in the UNECE-region can be expected to be largely due to technical investments (minimization, recycling or destruction of the by-product on site and waste management). No estimates of the costs associated with such technical investments are available in the literature or from submissions by parties for Annex F information on HCBD.

[27] Release data accessible at http://prtr.ec.europa.eu/PollutantReleases.aspx

[28] The estimation was made by using average contamination data for China derived from Cai et al. (2007) and the quantity of sewage sludge generated in EU 27 to calculate the estimated quantity of HCBD released with sewage sludge in EU 27.

Possible measures

46. Possible measures can be directed at the relevant anthropogenic sources of HCBD: (1) intentional production, (2) unintentional formation and (3) stockpiles. Figure 1 illustrates relevant sources and possible control measures for HCBD.

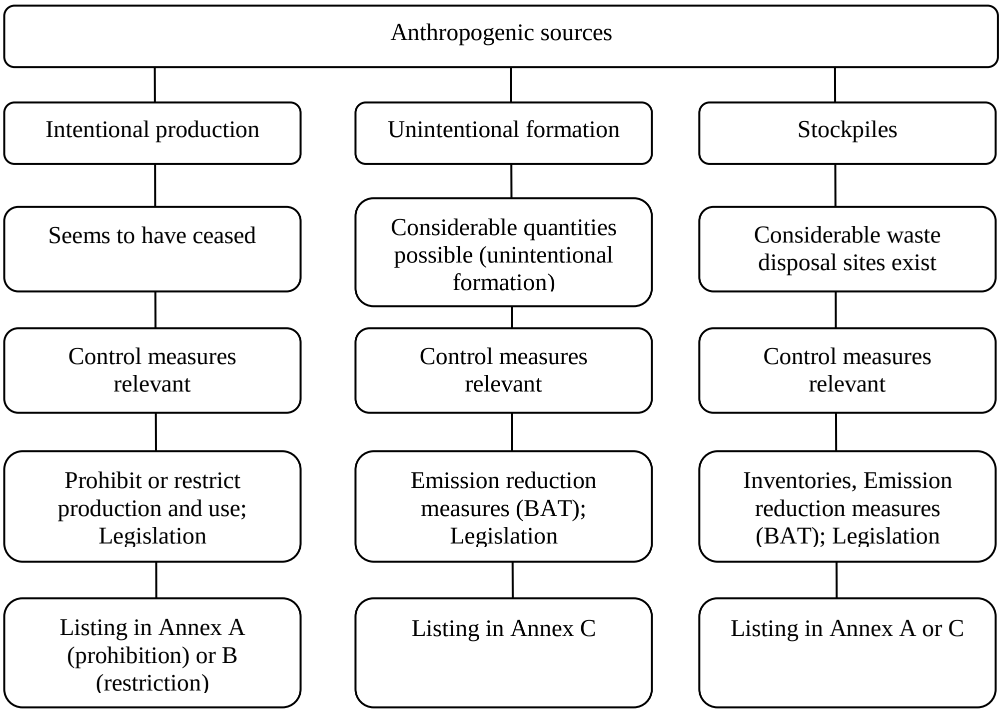


Figure 1: Relevant sources and possible control measures for HCBD
(Note: use for laboratory-scale research or as a reference standard is not considered; such use is excluded from the Convention according to Article 3(5); natural sources are out of the scope of the Convention: according to article 5, measures are related to anthropogenic sources)

2.2 Identification of possible control measures

Control measures for releases from intentional production

47. HCBD has been intentionally produced in the past. Intentional production and use seem to have ceased, though specific information on current intentional production and use and for the past 30 years is lacking The most efficient control measure would be the prohibition of the production and use of HCBD and HCBD containing articles and products. Although information on substitutes for commercial use of HCBD has not been submitted to the Committee, the significantly decreased use indicates that substitution has taken place and thus, technically feasible, economically viable alternatives are available.

48. Data on possible current production and use are completely lacking and there is no insight in international trade. Only a limited amount of countries have regulated production and use. To limit possibly remaining uses at the global scale and to prevent re-introduction of other uses, listing of HCBD in Annex A, without any specific exemptions, could be the primary control measure for intentional production and use under the Convention. As a consequence, HCBD would be subject to the provisions of Article 3 of the Convention, with the requirement to eliminate its production, use, import and export.

Control measures for releases from unintentional generation

49. HCBD is unintentionally generated and released from industrial processes. Unintentional releases of HCBD can be minimised by abatement techniques and legislation. Possible measures to minimise releases from unintentional formation as by-product are e.g. to modify processes and process control or destruction and/or in-process recycling of HCBD according to BAT and BEP, or to apply alternative processes, such as closed loop systems or the substitution of the associated chlorinated hydrocarbons in various uses to avoid HCBD by-product formation. Listing of HCBD in Annex C would subject the chemical to the measures under Article 5 of the Convention, and establish the goal of continuing minimization and, where feasible, ultimate elimination of HCBD releases. This would include an obligation to promote best available techniques (BAT) and best environmental practices (BEP) for HCBD sources.

(1) Manufacture of chlorinated chemicals:

50. HCBD can be unintentionally generated during the manufacture of chlorinated chemicals. For example HCBD is still unintentionally generated during the production of chlorinated hydrocarbons. Emissions of HCBD due to by-product formation can be minimized by improved process control or alternative production processes, by emission control measures or by substitution. In case significant amounts of HCBD are being formed, there should be strict control to minimize and, where feasible, eliminate such releases. Emission control shall be based on applying BAT (UNECE 2007).

51. Currently, high temperature incineration is usually operated in developed countries as an emission control technique for residues from the production of chlorinated chemicals. In France, stripping is also applied as a control technique for HCBD removal in one chlorinated solvent producing plant. In the US, most of the disposed waste from chlorinated hydrocarbon manufacturing processes is incinerated. In Europe, HCBD emissions to air from chlor-alkali production sites have decreased to almost zero (UNECE 2007). Although incineration may be utilized in developed countries, it may not be the most cost-effective option in all countries. For example, in some countries (e.g. small island countries) appropriate waste treatment facilities may not be available and additional costs may be incurred to store and then ship wastes to out-of-country treatment facilities.

52. Production processes for the simultaneous manufacturing of tetrachloroethene and tetrachloromethane are either the high-pressure or the low-pressure chlorolysis process. For the production of tetrachloroethene, other processes are applied. In principle, all production processes for tetrachloroethene may produce traces of HCBD. The low-pressure chlorolysis process tends to produce more HCBD than the high-pressure process. However, the HCBD formed in the low-pressure chlorolysis process can be drastically reduced in a subsequent distillation step, followed by incineration of the HCBD containing off-gas (UNECE 2007).

53. Relevant BAT is specified in the BREF Document on production of Large Volume Organic Chemicals (EC BREF LVOC, 2003). The document specifies BAT for pollution prevention and minimisation for the sector and for the control of pollutants and residues (EC BREF LVOC, 2003, section 6). Primary and secondary measures aiming to reduce/minimise emissions of polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/PCDF) and/or chlorinated hydrocarbons from chemical production are also described in Section VI.F Part III Chapter 4 of the UNEP BAT and BEP guidelines (UNEP 2007). This section focuses on processes for the manufacture of industrial chemicals that could theoretically give rise to persistent organic pollutants (particularly those chemicals listed in Annex C of the Stockholm Convention). Most of the processes described share common steps, including chlorination of organic or inorganic raw materials, purification of the products, separation of product streams (usually by distillation), destruction of high-molecular-weight side products and recycle or sale of hydrogen chloride. Efficient separation and destruction of chlorinated organic side products, which may include persistent organic pollutants, is key to best available techniques applicable to these processes, as is the associated guidance for any incorporated incineration processes (UNEP 2007). Related to chlorinated chemicals, it is outlined that the process to generate trichloroethylene and perchloroethylene involves chlorination, oxychlorination and pyrolysis, by-product will include chemicals listed in Annex C. These materials can be separated from final product by distillation and isolated in a fraction known as heavy ends. Many years ago, heavy ends material was commonly landfilled; however, since the 1970s, hazardous waste incineration, or thermal destruction with recovery and reuse of HCl, is by far the more common treatment (UNEP 2007). It can be concluded that specific BAT is already common practice in the manufacturing of the chlorinated chemicals. Measures already taken for other POPs will also be effective for HCBD. Monitoring of HCBD will induce additional costs. Additional costs for implementation of measures to reduce releases of HCBD, enforcement and supervision are considered low as the control measures for other unintentional POPs such as PCDD/PCDF are already applied. Monitoring capacity for HCBD is needed in developing countries and countries with economies in transition.

54. As the manufacturing of some chlorinated chemicals (e.g, perchloroethylene, trichloroethylene,) is identified as a potential source of HCBD emission, reducing and ultimately eliminating their production when safer technically feasible and cost-effective alternatives are available could be an effective way to prevent the unintentional formation of HCBD and other POPs. This is particularly relevant when the manufacturing process does not use techniques aiming at reducing the by-production of HCBD. Information is available on some substitutes for relevant chlorinated chemicals (TURI, 2006; 2008; 2012).

(2) Production of magnesium:

55. There may be substantial amounts of by-product formation from non-chemical facilities producing magnesium (UNECE 2007, Denier van der Gon et al. 2007). The available information particularly indicates possible releases from production of magnesium by electrolysis (Deutscher and Cathro 2001). The main global production of magnesium is currently carried out by the reduction of the oxide at high temperatures with silicon. Nevertheless, industrial magnesium production by electrolysis is still relevant. However, no publications on measured HCBD air emissions from industrial magnesium production have been found. Possible emissions of HCBD from the production of magnesium can potentially be controlled by using measures based on the use of BAT, consisting of scrubbing and incineration of off-gases. The off-gases are treated in a series of wet scrubbers and wet electrostatic precipitators,

before finally being subject to incineration. Water from the off-gas treatment is transferred to a wastewater treatment plant. Since wastewater treatment plants are usually not specifically designed to remove HCBD and other POPs, this may result in discharges of HCBD and other POPs directly into water. These measures aim to reduce or minimise the emissions of hydrocarbons (including HCBD) and PCDD/PCDF and are described in chapter 10.4.1.3 (emissions to air) and 10.4.2 (emissions to water) of the draft BREF document for the production of non ferrous metals (EC BREF NFM 2009). They are also consistent with the approach of Annex V of the Aarhus Protocol on Persistent Organic Pollutants (BAT to control emissions of POPs from major stationary sources) (UNECE 2007). Primary and secondary measures aiming to reduce or minimise emissions of PCDD/PCDF and/or chlorinated hydrocarbons from magnesium production are also described in Section VI.B Part III Chapter 4 (see table 11 and Table 12) of the UNEP BAT and BEP guidelines (UNEP 2007).

(3) Other potential sources for unintentional formation of HCBD:

56. Other sources of unintentional formation of HCBD concern incineration processes (e.g. motor vehicle emissions, incineration processes of acetylene, incineration of chlorine residues). Lahaniatis et al. 1977 identified HCBD in fly ash samples from waste incineration in the Netherlands. Further specific information on these sources is lacking. For HCBD formed as a by-product in incineration processes, there is a relation to PCDD/PCDF and other unintentional POPs releases formed by combustion. Most measures taken to reduce such POPs releases will lead to a significant reduction of releases of HCBD. BAT and BEP relevant to unintentionally produced POPs for various types of incinerators and other thermal sources are described in the UNEP BAT and BEP guidelines, in Section V, and in several EU BAT reference documents. BAT includes providing for appropriate incineration conditions. BAT and BEP relevant to unintentionally produced POPs from motor vehicles are described in the UNEP BAT and BEP guidelines, in section VI.H. BAT includes banning of halogenated scavengers, and fitting motor vehicles with an oxidation catalyst or particulate filter.

Control measures for releases from stockpiles

57. Examples document the potential of HCBD releases from former waste disposal locations such as hazardous waste disposal sites or industrial facility waste disposal sites. There is no insight into the total amount of waste sites worldwide, nor on their releases. There is a need to determine ways to ensure better data collection and reporting of HCBD wastes and releases in order to track progress in reducing and eliminating these sources of contamination. Leachate monitoring and control plays a central role in the management of landfills. Possible measures to control releases from stockpiles are e.g. to establish an inventory of the relevant landfills and the control and sound management of releases (particularly leachate) from relevant waste disposal sites or restoration/decontamination of waste disposal sites.

58. As a result of environmental and health problems experienced with historic and abandoned landfill sites and due to the high costs associated with remediation of contaminated sites, many countries have introduced the specially engineered landfill concept. Engineering standards for landfills, including management of leachate, and further information on sustainable waste management are described in the technical guidelines of the Basel Convention on specially engineered landfill (BC 1997).

59. Listing of HCBD in Annex A and/or C would subject HCBD to the measures under Article 6 of the Convention, and establish the goal of identifying stockpiles consisting of or containing chemicals listed in Annex A or C and managing them in a safe, efficient and environmentally sound manner.

2.3 Efficacy and efficiency of possible control measures in meeting risk reduction goals

Intentional production

60. Although information on substitutes for commercial use of HCBD is not readily available, all applications seem to have ceased, though specific information on intentional production and use is lacking and the significantly decreased use indicates that substitution has taken place. Critical uses have not been identified. The elimination of the intentional production is therefore considered technically feasible.

61. In the UNECE region additional costs for eliminating the intentional production and use of HCBD are not expected, since industry has already substituted this use (UNECE 2007). Specific cost implications outside of the UNECE region cannot be assessed in detail, but it is expected that there are no additional costs as there is no specific information on intentional production of HCBD.

62. Cost increases for consumers are not expected, since the substitutes are already in use and the measures to address unintentional releases have to be taken to reduce other releases (UNECE 2007).

Unintentional generation

63. BAT and BEP to minimise unintentional generation of HCBD are described in relevant documents (see above) and are technically feasible. The technical measures required to minimise releases of unintentionally produced HCBD are already required according to existing BAT and BEP in the industrial manufacturing of chemicals and magnesium and for other possible sources (motor vehicle emissions and incineration processes). BAT and BEP as described in the

relevant documents are being applied for other unintentionally produced substances such as hexachlorobenzene (HCB), pentachlorobenzene (PeCB), polychlorinated biphenyls (PCB) and PCDD/PCDF and will be effective for HCBD as well. Monitoring of HCBD will induce additional costs. Additional costs for implementation of measures to reduce releases of HCBD, enforcement and supervision are considered low as the control measures for other unintentional POPs such as PCDD/PCDF are already applied. Monitoring capacity for HCBD is needed in developing countries and countries with economies in transition.

64. The most relevant known sources for HCBD releases as a by-product during the production of certain chlorinated chemicals can be minimized by improved process control, alternative production processes, emission control measures or by substitution (UNECE 2007). For the production of chlorinated hydrocarbons, incinerations at high temperatures and stripping have proved to be cost-effective measures to reduce emissions. However, incineration may not be the most cost-effective option in all countries, and there are concerns regarding the possible unintentional formation of POPs, as noted in Part II of Annex C to the Convention. HCBD emissions in the US and Europe have significantly decreased due to decreased unintentional formation and deployment of emission control measures. In many cases, current control measures and application of BAT and BEP to address other unintentionally produced POPs are likely to also reduce emissions of HCBD. There are no extra costs involved for industry if these existing BAT and BEP measures are already implemented. If measures are taken to reduce PCDD/PCDF, there are no extra costs to industry for the reduction of HCBD emissions from magnesium production (UNECE 2007). According to Nigeria, control measures, when effectively applied, would eliminate emission of HCBD; however, the risks of application of control measures need be further studied. Some of the measures, like substitution of production processes, maintenance, substitution of raw materials, green chemistry have been documented. However, for nations needing capacity building, technical and funding assistance may be necessary (Annex F, Nigeria, 2013).

65. In addition, the substitution of the relevant chlorinated chemicals in their specific applications can contribute to reducing the production of these substances and can thus contribute to reducing corresponding HCBD releases. Technically feasible and cost-effective alternatives to perchloroethylene and trichloroethylene are available for certain applications and could be employed as part of BAT to reduce HCBD emissions

66. There will be additional costs for monitoring, namely for chemical analysis, even if monitoring programmes for other POPs (e.g. PCDD/PCDF, HCB and PCB) are already established. Within the UNECE region, control costs are expected to be very low and could consist of extra costs for measuring of HCBD content in products or from unintentional emissions, and for conducting emission inventories (UNECE 2007). According to Mexico, costs should be considered for monitoring environmental levels in order to demonstrate that levels decrease as a consequence of the control measures taken.

Stockpiles

67. As a consequence of listing HCBD in Annex A and or C, parties to the Convention would have to identify existing stockpiles and waste and to manage them in a safe, efficient and environmentally sound manner. Costs for identifying relevant landfills and establishing corresponding inventories are considered low. Costs for managing existing technically engineered landfills in an environmentally sound manner already arise for such landfills and will not significantly change. The Convention does not oblige parties to undertake remediation measures for contaminated sites. If such measures would be undertaken, they shall be performed in an environmentally sound manner and very significant costs would arise.

68. Examples of contaminated sites due to former waste disposal operations show that remediation costs and the cost for the protection of the environment and health can be significant. For example, in the case of the Orica dump in Australia (see section 2.1), the recovery and destruction of approximately 20,000 tonnes HCB contaminated with HCBD and other organochlorines would require significant financial efforts. At Weston Quarries in the UK (see section 2.1), significant costs arose due to demolition of properties for health protection reasons.. Corresponding costs do not necessarily arise due to the listing of HCBD in the Stockholm Convention, but for the protection of the environment and health.

69. HCBD often arises in combination with other organochlorine pollutants (e.g. with HCB as in the case of the Orica dump) which are already regulated, among others, through the Stockholm Convention. The measures taken for one substance are therefore often effective for the other substance as well. In such cases there are no additional costs.

2.4 Information on alternatives (products and processes) where relevant

70. It seems that HCBD is no longer intentionally produced and used in the UNECE region including in the US and Canada; specific information on current intentional production and use and for the past 30 years is lacking. This indicates that substitution has taken place and alternatives are available, though specific information on these was not provided to the Committee. Neither the requests have been received nor any particular needs identified for specific exemptions on HCBD.

71. Emissive uses of chlorinated hydrocarbons have been phased out or are stringently regulated in various signature states, since a range of alternatives exists and are in practice for many of those applications.

2.5 Summary of information on impacts on society of implementing possible control measures

Intentional production

72. The intentional production of HCBD appears to have stopped worldwide. Benefits for health, the environment and the society from a prohibition of the production and use of HCBD could be maintained, as the re-introduction of HCBD and related risks would be prevented. A beneficial effect could be expected with the elimination of any currently unidentified intentional production and use around the world. Relevant negative impacts are not expected.

Unintentional generation

73. Cost efficient BAT and BEP to reduce releases of unintentionally produced HCBD are available and described in relevant documents (UNEP 2007, EC BREF LVOC 2003, EC BREF NFM 2009). Countries already have obligations to implement control measures for other unintentionally produced POPs (HCB, PeCB, PCB, PCDD/PCDF) under the Convention. These may be similar to those for HCBD. Emissive uses for chlorinated hydrocarbons have been phased out or are stringently regulated in various signature states, since a range of alternatives exist and are in practice for many of those applications. Measures to reduce unintentional releases of HCBD through listing in Annex C would positively impact human health and the environment. Additional costs for applying BAT and BEP and for control measures and emission inventories are considered low. According to Canada, the costs of inventories are relative and would differ in each country. For Canada, there are no known intentional sources, but considering all of the various unintentional by-product sources listed in the paper, considerable effort would be needed to research all of the potential sources and establish which sources may be emitting. This would need to be flagged as soon as possible to ensure that sufficient resources were devoted to the research and development of the inventories. The 4th statement in the conclusion is about unintentional by-product formation and states that measures to reduce other POPs will also reduce HCBD releases. This is very difficult to characterize in an emissions inventory and requires detailed information from facilities on past releases.

Stockpiles

74. HCBD is unintentionally released from existing waste disposal sites. BAT and BEP to minimise releases from waste disposal sites are available and described (BC 1997). Countries have already introduced corresponding measures (e.g. specially engineered landfill concept). Listing of HCBD in Annex A and/or C would require developing strategies to identify existing stockpiles, and to manage them in an environmentally sound manner. Such measures would positively impact human health and the environment. Costs for identifying relevant landfills, establishing corresponding inventories and sound management of releases are difficult to estimate because they are country-dependent and site dependent. The costs of remediation of contaminated sites are significant.

2.6 Other considerations

75. Specific relevant facts on information and public education have not been provided by parties or observers who submitted Annex F information.

76. Canada reports that HCBD is monitored in (1) air (HCBD is being monitored under the Northern Contaminants Program (NCP) at Alert (Nunavut)), (2) wildlife (a screening study on organochlorine contaminants in plasma and eggs of Svaldard glaucous gulls conducted in 2005 by Verreault et. al., HCBD was one of the substances looked at, however HCBD was not detected in eggs or plasma.) and (3) water/sediments (the St. Clair River Remedial Action Plan includes regular monitoring. HCBD is one of the organic compounds being monitored in water and suspended sediments. A report was created in conjunction with the Ontario Ministry of the Environment on Concentrations and Trends of Nutrients, Major Ions, Trace Metals and Organic Contaminants in the St. Clair River from 1987-1999) (Annex F, Canada, 2013). HCBD is not among the chemicals currently monitored in air, water and food in Slovakia (Annex F, Slovakia, 2013).

3. Synthesis of information

Risks and need for action

77. According to the risk profile, HCBD meets all screening criteria, i.e. long-range environmental transport, bioaccumulation, persistence and toxicity. The POPs Review Committee decided that HCBD is likely, as a result of its long-range environmental transport, to lead to significant adverse human health and environmental effects such that global action is warranted.

Sources

78. HCBD is not known to be currently intentionally produced or used. HCBD was used in several technical and agricultural applications. HCBD was used as an intermediate in the chemical industry or as a product. It seems that HCBD is no longer intentionally produced and used in the UNECE region including in the US and Canada. Data about intentional production and use outside of the UNECE region are not available. There is no specific information that the intentional production or use of HCBD still takes place. It seems that the intentional production and relevant use have ceased, though specific information on intentional production and use is lacking for the current situation and

for the past 30 years. Monitoring data from China suggest that intentional production and/or unintentional formation has continued at least until recently.

79. HCBD is still unintentionally generated during the production of chlorinated hydrocarbons, particularly of perchloroethylene and trichloroethylene but also during other processes. It can generally be destroyed or recycled in the plant. However, a total cessation of industrial HCBD emissions is currently not achieved with existing technology. Reduction and elimination of industrial emissions of HCBD may be achieved through modified processes and BAT and BEP methods which lead to the reduction and elimination of emissions of HCBD from chlorinated solvent production. Substitution of the relevant chlorinated chemicals in specific applications can also contribute to a limited extent to reduce the production quantities of these substances and can thus also slightly contribute to reducing the corresponding HCBD releases. Other sources of unintentionally produced HCBD concern the manufacture of magnesium and incineration processes.

80. Examples document the potential for HCBD releases from former waste disposal sites. This indicates that there may be significant quantities of HCBD present in existing waste stocks. However, there is no insight into the total amount of HCBD in waste sites worldwide, nor into their releases.

Existing control

81. HCBD is subject to a number of international treaties and regulations such as the UNECE Aarhus Protocol on POPs and the UNECE PRTRs pursuant to the Aarhus Convention on access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters. HCBD is currently under a review process for inclusion under the Rotterdam Convention, and it is included in several relevant lists of substances of concern (e.g. in the EU Water Framework Directive, OSPAR, European PBT working group). Moreover, HCBD is considered in numerous regional and national control actions.

Releases and control measures and their efficacy and efficiency

82. In the present document, an overview of the sources of releases of HCBD from current activities and related possible control measures is given. Possible release sources are (1) intentional production (which seems to have ceased), (2) unintentional formation (as a by-product from the chemical industry, magnesium industry, incineration processes) and (3) release from former waste disposal.

(1) Intentional production:

83. Intentional production and use seem to have ceased though specific information on intentional production and use is lacking for the current situation and for the past 30 years. To limit the possibly remaining uses and to prevent the re-introduction of other uses, listing of HCBD in Annex A without any specific exemptions could be the primary control measure for intentional sources under the Convention. As a consequence, HCBD would be submitted to the provisions of Article 3 of the Convention and to the requirement to eliminate its production, use, import and export.

84. All applications seem to have ceased. This indicates that substitution has taken place and that alternatives are available. Additional costs for eliminating the intentional production and use of HCBD are not expected. Cost increases for consumers are not expected since the substitutes are already in use. Health and the environment could benefit from a ban of HCBD, as the re-introduction of HCBD and related risks would be prevented and any currently unidentified intentional production and use around the world would end.

(2) Unintentional formation:

85. HCBD is unintentionally produced and released from industrial processes. Relevant sources are the production of chlorinated hydrocarbons, production of magnesium and other potential sources (incineration processes). Unintentional releases from the production of chlorinated hydrocarbons, due to by-product formation, can be minimized by improved process control, alternative production processes, or by emission control measures. Emissive uses for chlorinated hydrocarbons have been phased out or are stringently regulated in various signature states, since a range of alternatives to the use of chlorinated chemicals exist and are in practice for many of those applications. Releases from the production of magnesium can be controlled by emission control measures consisting of scrubbing and incineration of off-gases. Releases from incineration and other thermal processes are related to the releases of PCDD/PCDF and other unintentionally produced POPs formed by combustion. Most measures taken to reduce such POP releases will also lead to a significant reduction of HCBD releases. Listing of HCBD in Annex C would subject this substance to the measures under Article 5 of the Convention, and establish the goal of continuing minimization and, where feasible, ultimate elimination of HCBD releases. This would include an obligation to promote BAT and BEP for HCBD sources.

86. Cost efficient BAT and BEP to reduce releases of unintentionally produced HCBD are available and described in relevant documents. Countries already have obligations to implement control measures for other unintentionally produced POPs (HCB, PeCB, PCB, PCDD/PCDF) under the Convention. These may be similar to those for HCBD. Furthermore, technically feasible and cost-effective alternatives for specific uses of perchloroethylene, trichloroethylene, and tetrachloromethane are available. Measures to reduce unintentional releases of HCBD through

listing in Annex C would positively impact human health and the environment. Additional costs for applying BAT and BEP, for control measures and for emission inventories are considered low. Monitoring of HCBD will induce additional costs. Additional costs for implementation of measures to reduce releases of HCBD, enforcement and supervision are considered low as the control measures for other unintentional POPs such as PCDD/PCDF are already applied. Monitoring capacity for HCBD is needed in developing countries and countries with economies in transition.

(3) Release from former waste disposal:

87. Examples document the potential for HCBD releases from former waste disposal. There is no insight into the total amount of waste sites worldwide, nor into their releases. Listing of HCBD in Annex A and/or C would subject HCBD to the measures under Article 6 of the Convention, and would establish the goal of identifying sites contaminated with HCBD and managing them in a manner protective of human health and the environment.

88. BAT and BEP to minimise releases from waste disposal sites are available. Countries have already introduced corresponding measures (e.g. specially engineered landfill concept). The proposed measure would require to develop strategies to identify existing waste stockpiles, and to manage them in an environmentally sound manner e.g. by the appropriate treatment of relevant landfill leachate. Such measures would positively impact human health and the environment. Additional costs for identifying relevant landfills, establishing corresponding inventories and sound management of releases are difficult to estimate because they are country-dependent and site dependent. The cost of remediation of contaminated sites is significant.

4. Concluding statement

89. Having evaluated the risk profile for HCBD, the Committee concluded that this chemical is likely, as a result of long-range environmental transport, to lead to significant adverse effects on human health and/or the environment, such that global action is warranted.

90. The Committee prepared this risk management evaluation and concluded that although HCBD is not known to be currently intentionally produced or used, it is important to prevent its re-introduction and manage the risks associated with its unintentional release.

91. HCBD is generated as an unintentional by-product from industrial processes (particularly the production of chlorinated hydrocarbons, production of magnesium). Measures to minimise releases from these sources, and technically feasible, cost-effective substitutes to key chlorinated hydrocarbons are known and already applied in countries that are parties to the Stockholm Convention.

92. Like other unintentionally produced POPs listed in the Convention (HCB, PeCB, PCB and PCDD/PCDF), HCBD is unintentionally generated during combustion and other thermal processes and industrial processes. Most measures to reduce unintentional releases of POPs from such processes will lead to significant reduction of HCBD releases. Monitoring of HCBD will induce additional costs. Monitoring capacity for HCBD is needed in developing countries and countries with economies in transition.

93. HCBD is released to an unknown extent from former waste disposal sites. Control measures to minimise such releases are available. There is no insight into the total amount of waste sites worldwide and it would be useful to establish information on the existence of relevant sites and manage them appropriately.

94. The Stockholm Convention aims at protecting human health and the environment from POPs, while being mindful of the Precautionary Approach as set forth in Principle 15 of the Rio Declaration on Environment and Development. It seeks to adopt measures to eliminate releases from intentional POP production and use, to reduce or eliminate releases of unintentionally produced POPs, and to reduce or eliminate POP releases from stockpiles and wastes, in support of the goal agreed at the 2002 Johannesburg World Summit on Sustainable Development of ensuring that by the year 2020, chemicals are produced and used in ways that minimize significant adverse impacts on the environment and human health.

95. Having prepared a risk management evaluation and considered the management options, in accordance with paragraph 9 of Article 8 of the Convention, the Committee recommends the Conference of the Parties to the Stockholm Convention to consider listing and specifying the related control measures for HCBD in Annexes A and C.

References

Annex F submissions on HCBD by January 2013, available at http://chm.pops.int/Convention/POPsReviewCommittee/LatestMeeting/POPRC8/POPRC8Followup/SubmissiononHCBD/tabid/3069/Default.aspx

ATSDR 1994: U.S. Department of Health and Human Services, Public Health Service Agency for Toxic Substances and Diseases Registry, Toxicological Profile for Hexachlorobutadiene, May 1994.

Barnes et al., 2002: Barnes G, Baxter J, Litva A, Staples B. 2002: The social and psychological impact of the chemical contamination incident in Weston Village, UK: a qualitative analysis. Soc Sci Med. 55 (12):2227-41.

BC 1997: Basel Convention, Technical Guidelines on Specially Engineered Landfill (D5), Basel Convention series/SBC No. 02/03, First Published in 1997 and reprinted in November 2002.

BUA 1991/2006: Gesellschaft Deutscher Chemiker, Hexachlorbutadien. BUA-Stoffbericht 263 (BUA Ergänzungsberichte XII; BUA Stoffbericht 62 (August 1991) Ergänzungsbericht (Februar 2006)). Weinheim, VCH.

Cai et al., 2007: Q.-Y. Cai, C.-H. Mo, Q.-T. Wu, Q.-Y. Zeng, A. Katsoyiannis, Occurrence of organic contaminants in sewage sludges from eleven wastewater treatment plants, China, Science Direct, Chemosphere 68 (2007) 1751-1762.

CCME 1999: Canadian Council of Ministers of the Environment, Hexachlorobutadiene - Canadian Water Quality Guidelines for the Protection of Aquatic Life, 1999.

CEH 2012: Abstract of the CEH Marketing Research Report:" C2 Chlorinated Solvents" (2012); available at http://www.ihs.com/products/chemical/planning/ceh/c2-chlorinated.aspx

Crump et al., 2004: Crump D, Brown V, Rowley J, Squire R (2004) Reducing Ingress of Organic Vapours into Homes Situated on Contaminated Land. Env. Technol. 4(25): 443-450.

Denier van der Gon et al. 2007: Hugo Denier van der Gon, Maarten van het Bolscher, Antoon Visschedijk, Peter Zandveld. Emissions of persistent organic pollutants and eight candidate POPs from UNECE–Europe in 2000, 2010 and 2020 and the emission reduction resulting from the implementation of the UNECE POP protocol, Atmospherinc Environment 41 (2007) 9245-9261.

Deutscher et Cathro 2001: R.L. Deutscher, K.J. Cathro. Organochlorine formation in magnesium electrowinning cells. Chemosphere 43 (2001) 147 -155.

EC BREF LVOC 2003: EUROPEAN COMMISSION, Integrated Pollution Prevention and Control (IPPC), Reference Document on Best Available Techniques in the Large Volume Organic Chemical Industry, February 2003.

EC BREF NFM 2009: EUROPEAN COMMISSION, Integrated Pollution Prevention and Control (IPPC), Draft Reference Document on Best Available Techniques for the Non-Ferrous Metals Industries, Working draft in progress, July 2009.

EC 2012: European Commission, Draft Commission staff working Document. The Document presents a draft of the second European Union Implementation Plan on Persistent Organic Pollutants. Brussels, (2012).

Environment Canada 2000: Priority Substance List Assessment Report, Hexachlorobutadiene, ISBN 0-662-29297-9. http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/psl2-lsp2/hexachlorobutadiene/index-eng.php, November 2000.

ESWI 2011: BiPRO, Study on waste related issues of newly listed POPs and candidate POPs, BiPRO as part of the Consortium ESWI on behalf of the European Commission, DG Environment, Final Report, 13 April 2011.

Haskoning 2002: E. van de Plassche and A. Schwegler, Royal Haskoning, The Netherlands, Hecachlorbutadien, 2002.

HSDB, 2012: Hazardous Substances Data Bank; Hexachlorobutadiene. Division of Specialized Information Services, National Library of Medicine (http://toxnet.nlm.nih.gov/, last revised 10/12/2011).

INERIS 2005: J.-M. Brignon, Hexachlorobutadiene, HCBD, INERIS –DRC- MECO, Version No. 1, Mai 05.

IPCS 1994: International Programme on Chemical Safety, Environmental Health Criteria 156, Hexachlorobutadiene, World Health Organization.

Juan et al., 2010: Juang D-F, Lee C-H, Chen W-C, Yuan C-S 2010: Do the VOCs that evaporate from a heavily polluted river threaten the health of riparian residents? Sci. Tot. Env. 408(20): 4524–4531.

Lahaniatis et al. 1997: E.S. Lahaniatis, H. Parlar, F. Korte. Über das Vorkommen chlorierter Kohlenwasserstoffe in Flugaschen von Müllverbrennungsanlagen. Chemosphere No. 1, pp 11 – 16, 1977.

Lecloux, 2004: Lecloux A.: Hexachlorbutadiene – Sources, environmental fate and risk characterization, Science Dossier, Euro Chlor representing the chlor-alkali industry, 2004; www.eurochlor.org, 43p.

Lenoir et al 2001: D. Lenoir, A. Wehrmeier, S.S. Sidhu, P.H. Taylor. Formation and inhibition of chloroaromatic micropollutants formed in incineration processes, Chemosphere 43 (2001) 107-114.

Li et al., 2012: Li, MT, Hao LL, Sheng LX, Xu JB 2008: Identification and degradation characterization of hexachlorobutadiene degrading strain Serratia marcescens HL1. Bioresource Technology 99(15): 6878–6884.

Nicole, 2004: NICOLE (Network for Contaminated Land in Europe), Report of the Nicole workshop, 2004, Nicole Projects Reporting Day, February 2004, Runcorn, UK.

Ian Rae, comment on the first draft risk profile, April 2012.

Thailand 2011: Submission of information specified in Annex E to the Stockholm Convention pursuant to Article 8 of the Convention.

TURI 2006: Five chemicals alternatives assessment study. http://www.turi.org/About/Library/TURI_Publications/2006_Five_Chemicals_Alternatives_Assessment_Study

TURI 2008: Trichloroethylene factsheet. http://www.turi.org/About/Library/TURI_Publications/Massachusetts_Chemical_Fact_Sheets/Trichloroethylene_TCE_Fact_Sheet/Printable_Trichloroethylene_TCE_Fact_Sheet

TURI 2012: Assessment of alternatives to perchloroethylene for the dry cleaning industry. http://www.turi.org/content/download/7399/134622/file/Perc%20Alternatives%20Assessment%20for%20Dry%20Cleaning%20Industry.pdf

UBA AT 2001: Umweltbundesamt Austria. BAT for Large Volume Organic Chemicals and Production in Austria, Vienna, 2001.

UNECE 2007: Exploration of management options for Hexachlorobutadiene (HCBD), Paper for the 6th meeting of the UNECE CLRTAP Task Force on Persistent Organic Pollutants, Vienna, 4-6 June 2007. 20 June 2007.

UNEP 2007: GUIDELINES ON BEST AVAILABLE TECHNIQUES AND PROVISIONAL GUIDANCE ON BEST ENVIRONMENTAL PRACTICES relevant to Article 5 and Annex C of the Stockholm Convention on Persistent Organic Pollutants, May 2007, Geneva, Switzerland.

UNEP/POPS/POPRC.8/16: Report of the Persistent Organic Pollutants Review Committee on the work of its eighth meeting. Geneva, November 2012.

UNEP/POPS/POPRC.8/16/Add.2: Risk profile on hexachlorobutadiene. Geneva, 1 November 2012.

US EPA 2003: U.S. Environmental Protection Agency, Office of Water Health Effects. Support Document for Hexachlorobutadiene. EPA 822-R-03-002, February 2003.

US EPA 2012b: Great Lakes Binatinoal Toxics Strategy, Appendix 1, Persistent toxic substances focused on by the Canada-United States strategy for the virtual elimination of persistent toxic substances in the Great Lakes

Verreault et al., 2005: Verreault J. and R. Letcher, D.C.G. Muir, S. Chu, W.A. Gebbink, G.W. Gabrielsen. 2005. New Organochlorine Contaminats and Metabolites in Plasma and Eggs of Glaucous Gulls (Larus Hyperboreus) from the Norwegian Arctic.

WWF 2005: WWF, Stockholm Convention “New POPs”, Screening Additional POP Candidates, April 2005.