UNITED NATIONS

SC

UNEP/POPS/POPRC.1/5

Distr.: General
24 August 2005

Original: English

United Nations Environment Programme

Stockholm Convention on Persistent Organic Pollutants
Persistent Organic Pollutants Review Committee
First meeting
Geneva, 7–11 November 2005
Item 5 (a) of the provisional agenda*

Consideration of chemicals proposed for inclusion in Annexes A, B and C of the Convention: Pentabromodiphenyl ether

Pentabromodiphenyl ether proposal**

Note by the Secretariat

1. The annex to the present note provides a summary prepared by the Secretariat, as requested by the Chair of the Committee, Mr. Reiner Arndt (Germany), of the proposal submitted by the Government of Norway for listing pentabromodiphenyl ether in Annex A of the Stockholm Convention on Persistent Organic Pollutants pursuant to paragraph 1 of Article 8 of the Convention. The complete submission is given in document UNEP/POPS/POPRC.1/INF/5.

Possible action by the Committee

2. The Committee may wish to:

(a) Consider the information provided in the present document and in document UNEP/POPS/POPRC.1/INF/5;

(b) Decide whether it is satisfied that the proposal fulfils the requirements of Article 8 and Annex D of the Convention;

(c) Develop and agree on, if it decides that the proposal fulfils the requirements referred to in subparagraph (b) above, a work plan to prepare a draft risk profile pursuant to paragraph 6 of Article 8. In developing such a work plan, the Committee may wish to take into consideration the information presented in document UNEP/POPS/POPRC.1/INF/11.

* UNEP/POPS/POPRC.1/1.
** Stockholm Convention, Article 8.

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Annex

Proposal for listing pentabromodiphenyl ether in Annex A of the Stockholm Convention on Persistent Organic Pollutants

Introduction

1. Commercial pentabromodiphenyl ether is a highly viscous liquid mixture of tri-, tetra- and pentabromodiphenyl ethers, hexabromodiphenyl ethers and heptabromodiphenyl ethers. The major components of pentabromodiphenyl ether products are 2,2',4,4'–tetrabromodiphenyl ether (BDE-47) and 2,2',4,4',5–pentabromodiphenyl ether (BDE-99). Commercial pentabromodiphenyl ether is used mainly in rigid and flexible polyurethane foams and polyurethane elastomers. Most of this polyurethane is used in turn in upholstery and furnishing. Global market demand for pentabromodiphenyl ether has more than doubled in the last decade to the present 8.5×10^6 kg per year. Simultaneously, use in Europe has decreased to approximately 2.1×10^5 kg per year.

2. All Nordic countries have committed themselves to stop using this flame retardant. The European Commission has already made a proposal for banning the use and placing on the market of pentabromodiphenyl ether or products and articles treated with it. Alternative chemicals and techniques for avoiding the use of pentabromodiphenyl ether are available for most of its uses.

3. The present dossier focuses solely on the information required under paragraphs 1 and 2 of Annex D of the Stockholm Convention and it is mainly based on information from the following review reports:

- Environmental Health Criteria (EHC) 162: Brominated Diphenyl Ethers. IPCS International Programme on Chemical Safety. United Nations Environment Programme. International Labour Organization. World Health Organization. Geneva 1994 (available at http://www.inchem.org/documents/ehc/ehc/ehc162.htm).

- Risk Assessment Report for Diphenyl Ether, Pentabromo Derivative (Pentabromodiphenyl ether), Final Report of August 2000. European Commission. 2000.

- Brominated Flame Retardants. Report 5065 (author, C.A. de Wit), Swedish Environmental Protection Agency, Stockholm. 2000. ISBN 91-620-5065-6.

4. Those extensive reviews and a 50-page document of additional information provided by the proponent (with over 100 references) also serve as sources of the additional information referred to in paragraph 3 of Annex D of the Stockholm Convention on this candidate POP chemical.

1. Identification of the chemical

1.1 Names and registry numbers

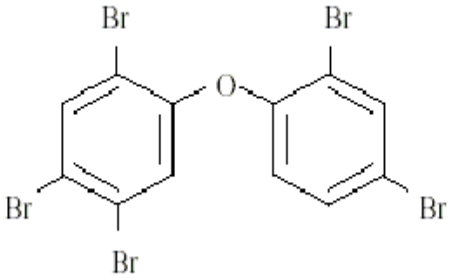
CAS chemical name: Commercial product is a mixture. Major components are BDE-99 (2,2',4,4',5–pentabromodiphenyl ether) and BDE-47 (2,2',4,4'–tetrabromodiphenyl ether)

Synonyms/abbreviations: Pentabromodiphenyl ether (PeBDPE and PentaBDPE),
Benzene, 1,1'-oxybis-, pentabromo derivative,
Pentabromophenoxybenzene,
Pentabromobi(s)phenyl ether; biphenyl ether, pentabromo derivative = PeBBE,
Pentabromobi(s)phenyl oxide = PeBBO,
Pentabromodiphenyl oxide = PeBDPO = PentaBDPO

Trade names: Bromkal 70, Bromkal 70 DE, Bromkal 70 5DE, Bromkal G1, Great Lakes DE 71, Great Lakes DE-60 F (85% PeBDE), FR 1205/1215, Pentabromprop, Saytex 115, Tardex 50.

CAS registry number: Commercial product is a mixture and does not have a CAS number. Individual components have CAS numbers, e.g., BDE-99, 32534-81-9; BDE-47, 40088-47-9. Some commercial mixtures use the CAS number for BDE-99.

1.2 Structure



2,2',4,4',5–pentabromodiphenyl ether (BDE-99)

Molecular formula: $C_{12}H_5Br_5O$

Molecular weight: 564.7

2. Persistence

5. According to a standard Organisation for Economic Cooperation and Development test with aerobic activated sludge, pentabromodiphenyl ether is not readily biodegradable. No experimental studies have been reported on its abiotic degradation. Some photolysis resulting in reductive debromination may occur and be a possible pathway for abiotic degradation. Abiotic and biotic degradation of pentabromodiphenyl ether in sediment, water and soil have not been reported in experimental studies but the half-lives for BDE-99 and BDE-47 have been estimated at 600 days (aerobic sediment) and 150 days (water and soil) for both congeners.

3. Bioaccumulation

6. Commercial pentabromodiphenyl ether and all its components have logKow values greater than 5. All the components of commercial pentabromodiphenyl ether bioconcentrated in carp (*Cyprinus carpio*). The bioconcentration factor for commercial pentabromodiphenyl ether in carp was estimated to be ca. 27,400. BDE-99 and BDE-47 are taken up efficiently in pike (*Esox lucius*) and to similar or higher levels than many PCBs. The bioaccumulation potentials of BDE-47 and BDE-99 in blue mussels (*Mytilus edulis*) have been shown to be one order of magnitude higher than the bioconcentration potentials for several PCBs. BDE-47, BDE-99 and commercial pentabromodiphenyl ether are taken up efficiently and excreted slowly by rats and mice.

7. Concentrations of the major pentabromodiphenyl ether congeners increase in successive trophic levels. Tetrabrominated and pentabrominated diphenyl ethers show the highest biomagnification potential of all polybrominated diphenyl ethers studied. Increasing levels of pentabromodiphenyl ether congeners have been reported in high trophic level biota from around the world.

4. Potential for long-range environmental transport

8. Commercial pentabromodiphenyl ether components have very low volatility (vapour pressures between 9.6×10^{-8}–4.7×10^{-5} Pa) and water solubility (between 2 and 13 µg/l). The estimated Henry's Law constants suggest that the less brominated components can be volatilized in significant amounts from aqueous solutions. Vapour pressure and water solubility decrease with increasing bromination. According to the atmospheric half-life estimates from structure-activity relationship (SAR) modelling, pentabromodiphenyl ether has long-range transport potential in the atmosphere (10–20 days for BDE-99; 11 days for BDE-47). Both BDE-47 and BDE-99 have been found in the Arctic air in Canada and Sweden.

9. Data from remote areas are still scarce but indicate clearly increasing contamination by pentabromodiphenyl ether. Concentrations of the two major congeners in whales have been reported in the range of ca. 66 to 864 ng/g lipid (BDE-47) and 24 to 169 ng/g lipid (BDE-99).

5. Adverse effects

10. Rat studies indicate that the liver is the main target organ affected by pentabromodiphenyl ether. Other in vivo studies have found developmental neurotoxicity and behavioural effects in young mice. Immunotoxic effects have been reported in mice but not in rats. Several pentabromodiphenyl ether congeners appear to be anti-oestrogenic.

11. BDE-47 was shown to be acutely toxic for the copepod *Acartia tonsa* in a standard 48-hour test and caused disturbances in larval development at much lower levels. The EC_{50} in a five-day study was 13 µg/l.

6. Statement of the reasons for concern

12. The proposal of the Government of Norway contains the following statement of concern:

> "According to the available data, pentabromodiphenyl ether resists abiotic and biotic degradation and thus persists in the environment for long times. It has a great potential for bioaccumulation and in addition there is monitoring evidence of its biomagnification. Due to its physical and chemical properties and considerably long atmospheric half-life it can be assumed that pentabromodiphenyl ether can be transported long distances in air. There is a solid data base on the toxic and ecotoxic properties of pentabromodiphenyl ether showing that it or its metabolites cause, inter alia, adverse developmental effects in offspring, liver effects, growth disturbance, dioxin-like effects and endocrine disruption depending on the target organism studied.
>
> These data on the harmful properties of pentabromodiphenyl ether are supported by data from the environment. The available data from remote areas show clearly contamination of biota and air by pentabromodiphenyl ether. A few observations of temporally increasing contamination are also available from remote areas. It must be underscored that biological effects in remote area marine mammals cannot be excluded. An upward trend has been observed also in the general human population in blood and milk.
>
> Pentabromodiphenyl ether is widely used as a flame retardant in various articles throughout the world, for the most part in connection with polyurethane applications. The releases of pentabromodiphenyl ether are coming mainly from diffuse sources. The ability of pentabromodiphenyl ether to move in the atmosphere far from its sources further widens the area contaminated by it. No single country, nor group of countries, alone can abate the pollution caused by the production, use and releases of pentabromodiphenyl ether. Therefore regional and global actions are needed to eliminate this pollution."