UNITED
NATIONS

SC

UNEP/POPS/POPRC.2/16

Distr.: General
7 August 2006

Original: English

United Nations
Environment
Programme

Persistent Organic Pollutants Review Committee
Second meeting
Geneva, 6–10 November 2006
Item 6 (e) of the provisional agenda*

Consideration of chemicals newly proposed for inclusion in Annexes A, B or C of the Convention: Beta-hexachlorocyclohexane

Summary of beta-hexachlorocyclohexane proposal

Note by the Secretariat

1. The annex to the present note provides a summary prepared by the Secretariat of the proposal submitted by Mexico for listing beta-hexachlorocyclohexane in Annexes A, B or C of the Stockholm Convention on Persistent Organic Pollutants pursuant to paragraph 1 of Article 8 of the Convention. It has not been formally edited. The complete proposal is contained in document UNEP/POPS/POPRC.2/INF/8.

Possible action by the Committee

2. The Committee may wish:

(a) To consider the information provided in the present note and in document UNEP/POPS/POPRC.2/INF/8;

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

(c) To develop and agree on, if it decides that the proposal fulfils the requirements referred to in subparagraph (b) above, a workplan for preparing a draft risk profile pursuant to paragraph 6 of Article 8.

* UNEP/POPS/POPRC.2/1.

K0652410 110806

Annex

Proposal for listing beta-hexachlorocyclohexane in Annexes A, B or C of the Stockholm Convention on Persistent Organic Pollutants

Introduction

1. The 1998 Aarhus Protocol on Persistent Organic Pollutants (POPs) addresses technical hexachlorocyclohexane (HCH, a mixture of isomers) as a substance for restriction on use under Annex II. The Aarhus Protocol is one of the protocols under the United Nations Economic Commission for Europe (UNECE) convention on Long Range Transboundary Air Pollution (LRTAP). The objective of the UNECE regional Protocol is to control, reduce or eliminate discharges, emissions and losses of persistent organic pollutants.

2. The Rotterdam Convention on the Prior Informed Consent also includes technical HCH, indicating that several countries have banned or severely restricted import and use of this mixture of isomers. The objective of this convention is to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm.

3. Mexico proposed on June 29, 2005 that gamma-hexachlorocyclohexane (Lindane) be added to Annex A of the Stockholm Convention. The proposal presented data on the gamma isomer but mentioned as well that “other isomers of hexachlorocyclohexane should also be considered in this proposal”.

4. The POPs Review Committee (POPRC) evaluated Annex D information for Lindane at its first meeting, held in Geneva in November 2005, and decided that “the screening criteria have been fulfilled for Lindane”. The Committee agreed that the alpha and beta isomers could be included in the discussions, although any decision to propose inclusion of the chemical in the Convention would apply only to Lindane, the gamma isomer. As a consequence, Mexico is now proposing that beta-HCH (and alpha-HCH in another proposal) be added to Annexes A, B and/or C of the Convention to ensure that the global impacts of all three environmentally significant HCH isomers (alpha, beta and gamma) are addressed.

5. This dossier focuses solely on the information required under paragraphs 1 and 2 of Annex D of the Stockholm Convention and is mainly based on:

(a) CEC, 2000. North American Commission on Environmental Cooperation: North American Regional Action Plan (NARAP) on Lindane and other HCH isomers. http://www.cec.org;

(b) USEPA, 2006: Assessment of Lindane and Other Hexachlorocyclohexane Isomers. U.S. Environmental Protection Agency. http://www.epa.gov/fedrgstr/EPA-PEST/2006/February/Day-08/p1103.htm;

(c) ATSDR, 2005. Toxicological Profile for Hexachlorocyclohexanes, U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, August, 2005. http://www.atsdr.cdc.gov/toxprofiles/tp43.html.

6. These reviews and other references (as provided in UNEP/POPS/POPRC.2/INF/8) serve as a source of further information referred to in paragraph 3 of Annex D of the Stockholm Convention on this candidate POP chemical.

1 Identification of the chemical

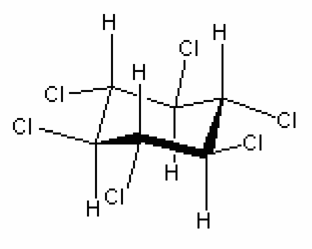
1.1 Names and registry numbers

Chemical name: beta-hexachlorocyclohexane (beta-HCH)

Synonym: 1-alpha, 2-beta, 3-alpha, 4-beta, 5-alpha, 6-beta-hexachlorocyclohexane

CAS[1] number: 319-85-7

1.2 Chemical Structure



Modified from Buser et al, 1995

Chemical formula: $C_6H_6Cl_6$

Molecular weight: 290.83

1.3 Chemical production

7. HCH isomers are produced as a result of the photochemical chlorination of benzene during the manufacture of technical HCH, which has been widely used as a commercial pesticide. Technical HCH is a mixture of five HCH isomers: alpha-HCH (53-70%), beta-HCH (3-14%), gamma-HCH (11-18%), delta-HCH (6-10%) and epsilon-HCH (3-5%).

8. As the gamma-HCH isomer, also known as Lindane, is the isomer with the highest pesticidal activity, technical-HCH is subject to subsequent treatment (fractional crystallization and concentration) to produce 99% Lindane. This process is extremely inefficient with only a 10-15% yield, producing 6-10 tons of other isomers for each ton of Lindane (IHPA, 2006). Alpha-HCH is the major by-product of the reaction (60-70%), followed by beta-HCH (7-10%) (WHO, 1991).

2 Persistence

9. In general, HCH isomers are resistant to abiotic processes like photolysis and hydrolysis (except at high pH), and microbial degradation is very slow (USEPA, 2006).

10. Beta-HCH is the most persistent isomer, with half-lives of 184 and 100 days on cropped and uncropped plots. It comprised 80-100% of the total HCH residues found in soil and vegetation on land surrounding an industrial landfill in Germany 10 years after the final HCH input (ATSDR, 2005). Other laboratory studies have calculated half-lives values of 91 and 122 days for aerobic and anaerobic soil indicating that persistence is dependent on environmental factors such as the action of soil microorganisms, evaporation rates, soil oxygen and organic matter content (WHO, 1991).

11. Beta-HCH has a much lower vapor pressure and a much higher melting point than the alpha-HCH. These properties are dictated by the great physical and metabolic stability conferred by the isomer structure (Willet, 1998).

[1] Chemical Abstracts Service.

12. Although photolysis is not expected to be an important environmental fate process for HCH, it may be degraded in the atmosphere by reacting with photochemically produced hydroxyl radicals. A photodegradation half-life for a thin film of beta-HCH equal to 152 hours has been reported (ATSDR, 2005).

3 Bioaccumulation

13. Beta-HCH is the predominant isomer in soils and animal tissues because its configuration favors storage in biological media and affords it greater resistance to hydrolysis and enzymatic degradation (Walker, 1999).

14. The log octanol-water partition coefficient (log Kow) for beta-HCH is 3.78, indicating that it has the potential to bioaccumulate. A bioconcentration factor (BCF) equal to 1 460 was found for beta-HCH using zebra-fish under steady-state conditions compared to BCFs equal to 1 100 for alpha-HCH and 850 for gamma-HCH (ATSDR, 2005). BCFs from 250 – 1 500 on a dry weight basis or 500 000 times on a lipid basis within 3-10 days have also been reported (WHO, 1991).

15. Several studies suggest that the relative proportions of HCH isomers vary dramatically across species in the Arctic marine food web. A study carried out in 2000 indicated that upper trophic level mammals may be able to efficiently eliminate Lindane and to a smaller extent alpha-HCH, but not beta-HCH. As a result, beta-HCH tends to bio-accumulate to higher concentrations in upper trophic level fishes, birds and mammals (USEPA, 2006).

4 Potential for long range environmental transport

16. Air concentrations of beta-HCH have been measured regularly at the Alert and Tagish stations in Arctic Canada. The results indicate that concentrations of beta-HCH in the Arctic atmosphere are very low in comparison with the more volatile alpha- and gamma-HCH. However, the concentration of beta-HCH in Arctic surface water can be as high as 240 pg/L, approaching the concentration of gamma-HCH in the same media (Li et al, 2003).

17. Li et al (2002) reported that in contrast to alpha-HCH, beta-HCH appears to be less subject to direct atmospheric loading into the high Arctic as most of beta-HCH stays in the source region after application. This can be explained by differences in their Henry's law constant and air/water partition coefficient that leads to enhanced affinity for particles, greater resistance to degradation and reduced volatility of beta-HCH.

18. According to Li et al (2002), rain scavenging is much more efficient for beta- than for alpha-HCH. In addition, the amount and frequency of precipitation is considerably higher in the North Pacific compared to the Arctic. These two aspects, when combined, suggest that beta-HCH enters the Arctic probably by mechanisms involving wet deposition or partitioning into the North Pacific surface water and subsequently entering the Arctic in ocean currents passing through the Bering Strait (Li et al, 2003).

19. The Bering and Chukchi Seas are the most vulnerable locations for beta-HCH loadings coming primarily from Asia via the Pacific (Li et al, 2002).

5 Adverse effects

20. Beta-HCH has moderate toxicity for algae, invertebrates and fish. The acute LC50 values for these organisms are of the order of 1 mg/L (WHO, 1991).

21. Studies of short-, intermediate- and long-term exposure to beta-HCH in diet have reported liver and renal effects in animals. A significantly decreased body weight gain has been seen in rats treated orally with 250 mg/kg beta-HCH. Neurological effects have also been reported in rats exposed to beta-HCH. Oral exposure of rats and mice to beta-HCH has resulted in degeneration of male reproductive organs and sperm abnormalities. The limited genotoxicity data indicate that beta-HCH has some genotoxic potential but the evidence is not conclusive (USEPA, 2006).

22. Beta-HCH may be the most toxicologically significant HCH isomer due to the recent reports of its estrogenic effects in mammalian cells, laboratory mammals and fish (Willet, 1998).

23. There are limited studies to estimate cancer risk from exposure to beta-HCH. However, EPA's Integrated Risk Information System (IRIS) currently lists beta-HCH as a possible human carcinogen

based on the incidence of hepatic nodules and hepatocellular carcinomas observed in male mice administered beta-HCH at a single dose level in the diet (USEPA, 2006).

6 Statement of the reasons for concern

24. The proposal of Mexico contains the following Statement of Concern:

"Beta-HCH is the most persistent isomer of hexachlorcyclohexane. Due to its physicochemical properties it has the potential to bioaccumulate. Its listing as a possible human carcinogenic should also be of special concern.

Even though most countries have banned or restricted the use of technical HCH as a pesticide, replacing it in most cases by the use of Lindane (99% gamma-HCH), the production process to obtain a ton of pure gamma-HCH yields 6 – 10 metric tonnes of the other isomers that must be disposed of or otherwise managed. As Lindane is the only isomer in the mixture that has insecticidal properties, there is very limited to no commercial value for the other isomers obtained. Because of this waste isomer problem, the production of HCH/Lindane has been a worldwide problem for years.

Other HCH isomers, like beta-HCH, can be as toxic and persistent a contaminant as Lindane, or even more so. The continued use of Lindane in the world is causing this important pollution source. Global action is therefore needed to halt the pollution caused worldwide by Lindane production."