Hexabromobiphenyl (HBB)

Draft Risk Management Evaluation May 2007
http://www.pops.int/documents/meetings/poprc/drprofile/drme/DraftRME_HBB.pdf
Risk Profile UNEP/POPS/POPRC.2/17/Add3
http://www.pops.int/documents/meetings/poprc_2/meeting_docs/report/POPRC-2%20rep%20add3.pdf

Composition	Hexabromobiphenyl belongs to a wider group of polybrominated biphenyls (PBBs). The term "polybrominated biphenyls" or "polybromobiphenyls" refers to a group of brominated hydrocarbons formed by substituting hydrogen with bromine in biphenyl. The hexabromo congeners exist as 42 possible isomeric forms. Trade names include FireMaster BP-6 and FireMaster FF-1. The commercial production of PBBs began in 1970. Approximately 6 million kg of PBBs were produced in the United States from 1970 to 1976. Production and use of hexabromobiphenyl has ceased in most, if not all, countries. However, it is possible that hexabromobiphenyl is still being produced in some developing countries or in countries with economies in transition.
Uses	Hexabromobiphenyl has been used as a fire retardant in acrylonitrile-butadiene-styrene (ABS) thermoplastics for constructing business, machine housings and in industrial and electrical products and in polyurethane foam for auto upholstery. A considerable part of the substance produced will probably reach the environment sooner or later because of the high stability of these compounds.
Releases	Data for loss into the environment during normal production are published only for the United States. In 1973, an accidental release of PBBs occurred in Michigan (referred to as the "Michigan disaster" in EHC 152), when two products manufactured by the Michigan Chemical Company were inadvertently confused and 250-500 kg (Di Carlo *et. al*., 1978) of FireMaster(R), instead of NutriMaster(R), a magnesium oxide-based cattle feed supplement, were added to animal feed and distributed to farms within the state. This accidental mix up resulted in widespread contamination by PBBs. Approximately 5350 tonnes of hexabromobiphenyl were used in commercial and consumer products in the United States, most in the production of plastic products with an estimated use life of 5–10 years. Since the cessation of production, all of these products, such as TV cabinet and business machine housings, are expected to have been disposed of by land filling or incineration.
Fate	According to available data, hexabromobiphenyl can be considered to be highly persistent in the environment. There is evidence of low or no degradation in water, soil and sediment, in the laboratory as well as in the field. Hexabromobiphenyl is less volatile than many of the currently listed POP substances. However, extensive data on monitoring shows

	that it is found throughout the Arctic wildlife, demonstrating that it does have a high potential for long range environmental transport. With measured weight-based BCF values in the range 4,700-18,100 and biomagnification factors in the aquatic food chain exceeding 100, hexabromobiphenyl is considered to be highly bioaccumulative and to have a high potential for biomagnification. These properties are demonstrated by several authors to be comparable to those of hexachlorobiphenyl (a PCB compound), for which the bioaccumulative properties are well documented.
Effects	Hexabromobiphenyl is readily absorbed into the body and accumulates following prolonged exposure. Although the acute toxicity of hexabromobiphenyl is low, a number of chronic toxic effects including hepatotoxicity have been observed in experimental animals at doses around 1 mg/kg bw/day following long-term exposure, and effects are seen in the rat thyroid at doses as low as 0.05 mg/kg bw/day. The International Agency for Research on Cancer has classified hexabromobiphenyl as a possible human carcinogen (IARC group 2B). The PBBs are endocrine disrupting chemicals, and effects are seen on reproductive capacity in rats, mink and monkeys. There is epidemiological evidence of hypothyroidism in workers exposed to polybrominated biphenyls and of increased incidence of breast cancer in exposed women. Data on toxicity to other species than laboratory mammals is scarce but suggests the environmental toxicity of hexabromobiphenyl is comparable to that of hexachlorobiphenyl.
Exposure	Recent monitoring data in soil, water and sediments for PBBs are limited. Historical monitoring data from the United States indicate that environmental PBB concentrations are confined to areas near former manufacturing facilities and regions of Michigan affected by the farm accident of the early 1970's. The only available data for environmental concentrations of PBBs in areas outside the vicinity of former production sites are those from sediment samples from Greenland, where PBBs (including PBB 153) were not detected in any sample (the limits of detection/quantification are, however, not well defined in the paper). The US ATSDR (2004), considers the current human exposure to PBBs to be very low, because PBBs are no longer produced or used. Thus, the general population exposure to PBBs will only be from historical releases. For people residing in the lower peninsula of Michigan, especially in the immediate vicinity of the PBB contaminated areas of this region, exposure to PBBs may still be occurring today. However, environmental levels have decreased since the 1970s and current exposure, if any, will be at low levels. For other regions of the United States, the levels of exposure will either be very low or none. In Arctic and North Atlantic regions, where the traditional diet includes top predators (e. g. seal in Greenland and pilot whale in the Faroe

	Islands), exposure has not ceased. Especially the level of PBBs in pilot whale blubber of up to 17 µg/kg lipid indicate the presence of hexabromobiphenyl in food. Pilot whale blubber is consumed as a delicacy in the Faroe Islands.
Status	Hexabromobiphenyl is listed in Annex A of the Protocol to the Convention on Long-range Transboundary Air Pollution (CLRTAP) on Persistent Organic Pollutants. The provisions of the Protocol oblige Parties (currently 25) to phase out all production and uses of hexabromobiphenyl. Hexabromobiphenyl, together with other PBBs, is also included in the UNEP/FAO Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. Under the Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area (HELCOM1) hexabromobiphenyl is listed as a selected substance for immediate priority action (Recommendation 19/5, Attachment, Appendix 3) and is scheduled for elimination (Annex I, part 2). HELCOM aims to move towards the target of the cessation of discharges, emissions and losses of hazardous substances by the year 2020. Under the Basel Convention, PBBs are classified as hazardous in Annex VIII without further specification. SAICM does not specifically address Hexabromobiphenyl but includes POPs as a class of chemicals that might be prioritized for assessment and related studies.
Alternatives	The hexabromobiphenyl risk profile describes three principal commercial products that contained hexabromobiphenyl in the USA and Canada: 1) acrylonitrile-butadiene-styrene (ABS) thermoplastics used for business machine housings and electrical products such as radio and TV; 2) fire retardant in cable coatings and lacquers, and 3) fire retardant in polyurethane foam for auto upholstery. A number of reports on risk assessment of alternative substances and processes are available. The OSPAR priority substances Series provides summary information on alternatives for brominated flame retardants. The Danish Environmental Protection Agency has described alternative halogen-free flame retardants for a variety of uses including epoxy, phenolic resins, rigid and soft polyurethane foam, textiles, and a variety of plastics including ABS. Both drop-in chemical substitutes and alternative materials are listed. US EPA has described process alternatives and chemical substitutes for polyurethane foam. The German Federal Ministry of Environment has reported on alternatives for flame retardants used in electronics, upholstery, and other sectors. As brominated flame retardants only account for about 15% of the global flame retardant consumption, principally a large number of

[1] Helsinki Commission - Baltic Marine Environment Protection Commission http://www.helcom.fi/environment2/hazsubs/action/en_GB/list governing body of the Convention

	compounds may be considered as alternatives. Substitution can take place at three levels: 1) brominated flame retardants can in some applications be replaced by another flame retardant without changing the base polymer; (major group of substitutes); 2) the plastic material, i.e. the base polymer containing flame retardants and other additives, can be replaced by another plastic material; (e.g. polysulfone, polyaryletherketone and polyethersulfone) 3) a different product can replace the product, e.g. the plastic material is replaced by another material (e.g. wool), or the function can be fulfilled by the use of a totally different solution.