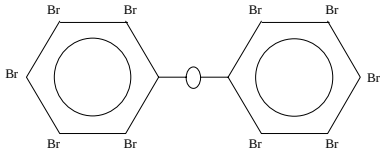
SIDS INITIAL ASSESSMENT PROFILE

CAS No.	1163-19-5
Chemical Name	Bis(pentabromophenyl) ether (Decabromodiphenyl ether)
Structural Formula	

SUMMARY CONCLUSIONS OF THE SIAR

Human Health

Decabromodiphenyl ether (DBDPE) can be absorbed through the gastro-intestinal tract (approximately 6-9.5%) and is distributed to the blood, the liver and the adipose tissue. Given the low rate of oral absorption in rats, a low bioaccumulation potential might be anticipated. Some DBDPE is absorbed intact from the intestine and excreted intact or in the form of metabolites (e.g. debrominated hydroxylated diphenyl oxides). Only trace amount of bromine compounds was found in tissues and the brain of neonatal mice exposed on postnatal day 3, 10 or 19. However the toxicological significance of this last finding is unclear. A maximal dermal absorption of 1% may be assumed. Although pulmonary exposure may occur due to the small particle size (<5 µm), the limited available data do not allow determination of pulmonary absorption.

DBDPE has a low oral, dermal and inhalation acute toxicity in animals. Acute oral toxicity data indicate a rat LD50 greater than 5,000 mg/kg for DBDPE in corn oil. No clinical signs of toxicity were observed up to 2,000 mg/kg and no deaths were seen up to 5,000 mg/kg. A dermal LD50 greater than 2,000 mg/kg has been demonstrated in rabbits using DBDPE applied neat under occlusive wraps. No deaths were observed up to 2,000 mg/kg. Local and general signs of toxicity were not reported and necropsies were not performed in this dermal toxicity study. Following acute rat inhalation administration of DBDPE at 2 and 48.2 mg/l during one hour, no deaths were seen, only minor ocular signs and dyspnea were observed from 2 mg/l concentration. The reliability of this data is limited by the absence of information on particle size distribution.

DBDPE is not a dermal or an ocular irritant and does not exhibit a chloroacnegenic activity. There is no indication of skin sensitisation.

The lowest NOAEL of 1,120 mg/kg/day for systemic toxicity (including non neoplastic lesions exclusively) is derived from a chronic dietary study in rats. At the highest dose tested (2,240 mg/kg/day) in males, non neoplastic lesions in the liver (increased incidence of thrombosis and degeneration), spleen fibrosis and lymphoid hyperplasia of the mandibular lymph nodes were observed. In the same study, a LOAEL of 1,120 mg/kg/day is determined for local effects based on the slight increase of the forestomach acanthosis observed from 1,120 mg/kg/day. No effects on thyroid homeostasis were found in either sex of two species after 13 weeks treatment with DBDPE up to approximately 7,000 and 11,000 mg/kg/day in mice and 2,800 and 3,800 mg/kg/day in rats and only mild effects (follicular cell hyperplasia and marginally increased incidence of thyroid follicular cell adenomas or carcinomas) were found in one species after a life time exposure from 3,200 mg/kg/day in male mice.

With regard to mutagenesis, DBDPE is considered as a non *in-vitro/in-vivo* genotoxic.

With regard to carcinogenesis, a LOAEL for carcinogenicity of 1,120 mg/kg/day is stated based on the increased incidence of liver neoplastic nodules from the lowest tested dose (1,120 mg/kg/day) in a dietary study in rats. On thyroid, marginal increase in incidence of thyroid tumours in mice but not in rats, supported by an increased incidence of follicular cell hyperplasia is observed. It is recognized that there are marked species differences in thyroid gland biochemistry and physiology and that the rodent thyroid gland is markedly more active and operates at a considerably higher level with respect to thyroid hormone turnover as compared to primate. Finally, it should be reminded that DBDPE presents a non-genotoxic profile as well as other polybrominated congeners such as OBDPE and PeBDPE and is devoid of alert-structure for genotoxicity.

With regard to reproductive toxicity, no effects on fertility were seen in a 1-generation reproduction oral study in rats up to 100 mg/kg/day administered in the diet, though the absence of parental toxicity indicates higher dose levels could have been tested. However, no histological changes were seen in the reproductive organs in rats and mice treated for 2 years in a dietary study with up to 50,000 ppm DBDPE (equivalent to approximately 2,240-2,550 and 6,650-7,780 mg/kg/day respectively).

For developmental effects, no adverse treatment related effect was observed such as external or internal malformations or variations, foetal weight, sex ratio, total resorption and late resorption up to 1,000 mg/kg/day.

With regard to breast feeding, following pregnancy, HxBDPE and other PBDPEs such as TeBDPE and PeBDPEs have been identified in breast milk but such measurements were not carried out on DBDPE neither on OBDPE. However, considering the toxicokinetic profile of DBDPE, a rather low excretion in breast milk might be anticipated.

With regard to neurotoxicity, DBDPE caused behavioural disturbances on post-natal day 3 in neonatal mice exposed to DBDPE in a single dose of 2.22 to 20.1mg/kg/bw. This effect was not seen in mice exposed on post-natal day 10 or 19. The authors indicate that PCBs have been shown to induce this type of behavioural profile when administered on post-natal day 3, but this response is always accompanied by a response in animals exposed to the toxic compound on post-natal day 10. The study has certain limitations compared with regulatory guidelines and thus uncertainty as regards interpretation of the results remains. Moreover only an abstract of this study and a personal communication from the authors are available with limited details. Therefore**,** no firm conclusion can be drawn from this end-point.

Environment

The environmental effects database does not formally meet the requirements of the SIDS data package as there is no information on the toxicity to invertebrates. Based on the available data for fish and algae, the substance appears to have a very low toxicity in short-term tests, with no effects being seen up to the water solubility of the substance. Similarly, no effects would be expected with *Daphnia* based on the lack of effects seen with the closely related octabromodiphenyl ether. Due to the lack of effects seen in the aquatic toxicity tests, it is not possible to derive a PNEC for this compartment.

For microorganisms, no effects were seen in a 3 hour activated sludge respiration inhibition test at a concentration of 15 mg/l. A $PNEC_{microorganisms}$ for waste water treatment plants of $\geq$ 1.5 mg/l was derived from this value using an assessment factor of 10.

Toxicity data are available for the sediment and the terrestrial compartment. For sediment, no effects were seen with the worm *Lumbriculus variegatus* in a prolonged toxicity test (28 days) using two different sediment types. The lowest NOEC from these studies was $\geq$ 3,841 mg/kg dry weight and a PNEC for sediment of $\geq$ 384 mg/kg dry weight basis (or $\geq$ 148 mg/kg on a wet weight basis) was derived from the data using an assessment factor of 10 (a factor of 10 is used as this species was the most sensitive species found for another related substance, pentabromodiphenyl ether).

For the terrestrial compartment, studies on the toxicity to plants and earthworms (*Eisenia fetida*) have been carried out. No effects were seen on germination and growth six species of plant (*Zea mays*, *Allium cepa*, *Lolium perenne*, *Cucumis sativa*, *Glycine max* and *Lycopersicon esculentum*) at concentrations up to 5,349 mg/kg dry weight. For *Eisenia fetida* no effects were seen at concentrations up to 4,910 mg/kg dry weight in a 56 day reproduction test. Based on a NOEC of $\geq$ 4,910 mg/kg dry weight, a PNEC for this end point of $\geq$ 98 mg/kg dry weight (or $\geq$ 87 mg/kg

on a wet weight basis) can be derived using an assessment factor of 50.

No data are available to allow a PNEC to be derived for the atmospheric compartment. However, the atmospheric concentrations of decabromodiphenyl ether are very low and so adverse effects are unlikely.

For secondary poisoning, based on the available standard mammalian toxicity tests, a PNEC of 2,500 mg/kg food can be derived. However, although decabromodiphenyl ether has generally shown a low level of toxicity in standard tests, there is some evidence from non-standard behavioural tests on mice that these standard tests may not detect more subtle effects that might be occurring with this substance at lower doses with sensitive life stages or over prolonged exposure.

Based on the available laboratory data, decabromodiphenyl ether appears to have a low bioaccumulation potential. However, the substance has recently been found at low but measurable concentrations in fish, marine mammals and predatory birds' eggs (Peregrine Falcons and Common Terns), which indicates that the substance is able to cross biological membranes and possibly that it is being accumulated in the food chain. The mere presence of a chemical in biota is not necessarily a cause for concern, and there is no evidence at this point in time of biomagnification taking place or actual environmental harm arising from this substance. However, these findings, when coupled with the uncertainties over the effects of this substance, mean that further work should be considered. In addition, the possibility that the substance may photodegrade in the environment to give more toxic and accumulative products should be investigated further.

Exposure

The world-wide demand for decabromodiphenyl ether was reported to be 54,800 tonnes in 1999. The substance is imported into the EU and the 1999 EU consumption was 7,500 tonnes. The substance is used in the plastics and textile industries as a flame retardant. In the plastics industry, it is used as an additive flame retardant in a wide range of plastic types. In the textile industry, the substance is generally backcoated onto the textile in a latex binder. The commercially supplied decabromodiphenyl ether is a mixture of congeners, consisting of mainly decabromodiphenyl ether (≥97%), with small amounts of other brominated diphenyl ethers such as nonabromodiphenyl ether.

The substance is a white solid with a melting point in the range 300^{o}C to 310^{o}C and a vapour pressure of 4.63×10^{-6} Pa at 21^{o}C. The substance does not have a distinct boiling point as it decomposes at >320^{o}C. It has a very low solubility in water (<0.1 µg/l at 25^{o}C), and shows limited solubility in common organic solvents. The n-octanol water partition coefficient (log Kow) has been measured as 6.27.

Emissions to the environment can occur both to the atmosphere (as vapour and as dust) and waste water. Sources of release include production sites, polymer processing sites and textile processing sites. In addition emissions to the environment could also occur from finished articles (e.g. plastic components, treated textiles) during their use and at disposal.

The substance does not appear to biodegrade under either aerobic or anaerobic conditions but can be degraded photolytically. The products formed from this direct photolysis reaction, and also the rate and extent of the reaction, in the environment are uncertain but may include small amounts of toxic and accumulative brominated diphenyl ethers that contain lower numbers of bromine. It is also expected to degrade in the atmosphere by reaction with hydroxyl radicals and a rate constant for this reaction of around 1.7×10^{-13} cm^{3} molecule^{-1} s^{-1} has been estimated.

The low vapour pressure, water solubility and high log Kow value indicate that the substance has a high potential for adsorption onto soil, sediment or suspended sediment.

RECOMMENDATION

The chemical is a candidate for further work.

RATIONALE FOR THE RECOMMENDATION AND NATURE OF FURTHER WORK RECOMMENDED

The SIDS requirements are met. Further work is needed to address the concerns over the possible accumulation in, and effects on, top predators and also the possible formation of more accumulative and toxic congeners from photolytic processes in the environment. These areas are difficult to address with standard tests. In this respect, industry has volunteered to carry out, as part of the EU risk assessment:

a) a more widespread monitoring project to determine whether the finding in predatory birds (including birds' eggs) is a widespread or localised phenomenon and to identify any possible trends,

b) a more detailed investigation of the rate of formation of photodegradation products under environmentally relevant conditions, and

In addition, consideration is being given to carrying out a further developmental neurotoxicological test (OECD 426 or similar).

No further work is required for the human health assessment, however, as stated above, a neurotoxicity study may voluntarily be carried out for the environmental part and the results from this study could be useful to better assess the neurotoxicity properties of this substance.