Substance name: Hexabromocyclododecane
and all major diastereoisomers identified
EC number: 247-148-4 and 221-695-9
CAS number: 25637-99-4 and 3194-55-6
Names of the major diastereoisomers identified:
alpha-hexabromocyclododecane CAS No 134237-50-6
beta-hexabromocyclododecane CAS No 134237-51-7
gamma-hexabromocyclododecane CAS No 134237-52-8

PRIORITISATION AND ANNEX XIV BACKGROUND INFORMATION

14 January 2009

Disclaimer:

The present document has been developed by ECHA mainly based on the technical report "Data on Manufacture, Import, Export, Uses and Releases of HBCDD as well as Information on Potential Alternatives to its Use"; prepared by IOM Consulting, supported by BRE, PFA and Entec under framework contract ECHA/2008/2 (specific contract ECHA/2008/02/SR4/ECA.226). Secondary sources have been the "Proposal for identification of Hexabromocyclododecane as a SVHC (Annex XV report prepared by Sweden 2008) and the European Union Risk Assessment report (EC 2008).

Note that the information on alternatives is not intended to be an exhaustive analysis, but is only included in order to support the transitional arrangements and in particular the proposed application dates for substances proposed to be included in Annex XIV.

CONTENTS

PRIORITISATION AND ANNEX XIV BACKGROUND INFORMATION

1 Prioritisation

Given the PBT properties of the substance, the wide dispersive uses of end products containing HBCDD, the very high volumes and the releases over the full life-cycle of articles and preparations, **it is proposed to prioritise Hexabromocyclododecane (HBCDD) and all its major diastereoisomers for inclusion in Annex XIV**.

2 Identity of the substance

Substance Name	Hexabromocyclododecane (Hexabromocyclododecane and 1,2,5,6,9,10-hexabromocyclododecane) and all major diastereoisomers identified
EC Numbers	221-695-9, 247-148-4
CAS numbers	3194-55-6, 25637-99-4
IUPAC Name	Hexabromocyclododecane

Names of the major diastereoisomers identified:

alpha-hexabromocyclododecane	CAS No 134237-50-6
beta-hexabromocyclododecane	CAS No 134237-51-7
gamma-hexabromocyclododecane	CAS No 134237-52-8

3 Intrinsic properties

The substance has been identified as a PBT substance according to article 57(d) as reported in the support document on Hexabromocyclododecane and all major diastereoisomers identified and following the agreement of the MSC adopted on the 8th of October 2008.

4 Volumes

HBCDD is manufactured at only one site in the EU with a varying annual production volume which was assumed to be 6,000 tonnes/year in 2005 (IOM 2008). Between 2000 and 2004, about 1,000 tonnes/year of HBCDD were micronised in a grinding process, occurring at a very limited number of sites, mainly for use in the textile industry. It is likely that the production of micronised HBCDD has reduced and is estimated to be about 210 tonnes/year (IOM 2008).

The total volume of HBCDD used in the EU has been increasing in recent years and was estimated to be about 11,580 tonnes/year in 2006 (IOM 2008). It is believed that net imports of HBCDD increased from less than 4,000 tonnes per year to close to 6,000 tonnes/year between 2003 and 2007 (IOM 2008). The quantities of HBCDD

exported as such or in preparations, as well as import in preparations is unclear (IOM 2008). No reliable quantities of import/export of HBCDD in articles are available, however HBCDD is likely to be imported in considerable amounts, particularly in packaging materials, textiles and electrical/electronic equipments (IOM 2008). The volumes are summarised in Table 1.

Table 1 Summary of volumes of HBCDD (excludes imports in articles)

	Tonnes/year
Manufacture	≈ 6,000
Micronising[1]	1,000
Net import (substance and preparations)	≈ 6,000
Net import (in articles)	No data
Total use volume (2006)	≈ 12,000

In conclusion, the manufacturing volume of HBCDD is around 6,000 t/y and the total use in the EU in 2006 was ~ 12,000 tonnes with increasing tendency. The volume of HBCDD imported with articles is unknown, but believed to be considerable.

5 Characterisation of uses and releases

5.1 Uses

HBCDD is used solely as an additive flame retardant in the following main product types (data for 2007, IOM 2008):

- Expanded Polystyrene (EPS)
- Extruded Polystyrene (XPS)
- High Impact Polystyrene (HIPS)
- Polymer dispersion for textiles

In all products HBCDD is uniformly incorporated as an integral encapsulated component within the polymer matrix; however it is not bound to the matrix or transformed (IOM 2008).

The main uses for EPS are insulation panels/boards in the construction sector and automobile cushions for children. Minor uses are packaging material and props for exhibitions, films or similar (IOM 2008). The use of EPS has increased from 3,452 tonnes/year (2002) till 5,301 tonnes per year in 2006 (IOM 2008).

[1] The tonnage of HBCDD used in micronising is already included in the tonnage of the substance manufactured

XPS is mainly used in cold bridge insulation, sandwich panels and different other uses in construction materials (cavity insulation, floors, walls, roofs, etc.). As with EPS, XPS use has also been increasing in the last few years (3,954 tones/year to 5,859 tonnes /year, from 2002 to 2006 respectively, IOM 2008).

Even though use of EPS and XPS may reduce slightly in the immediate future because of the downturn in house-building currently affecting much of Europe, in the long term, industry predict an increased use of insulation products as a response to increasing cost of energy and awareness of climate change (IOM 2008).

The use of HBCDD into HIPS is mainly for video and stereo equipment, distribution boxes for electrical lines in the construction sector and refrigerator lining (IOM 2008). Different sources estimate the HBCDD content of flame-retarded HIPS between 1-7 % (w/w) and the EU Risk Assessment Report (cited in IOM 2008) assumed as a realistic worst case, that HIPS contains 7 % HBCDD. The use volume has not changed in the last few years in Europe and is estimated as 210 tonnes/year (IOM 2008).

Micronised HBCDD is used in textile applications to comply with British and German DIN flame retardant standards (IOM 2008), mainly for upholstered furniture and seating in transportation, draperies, bed mattress ticking, interior and automobile textiles. A likely HBCDD concentration in the final product is estimated to be 10-15 % (IOM 2008). After a substantial reduction of this use during the last few years it is estimated that only about 210 tonnes/year are currently used in textile coating (IOM 2008).

Table 2 provides an overview of the different uses of HBCDD. The overall volume used (years 2006/2007), estimated on the statements of IOM (2008) was 11,580 tonnes/year.

Table 2 Summary table of the different uses of HBCDD

	Tonnes/year	Number of sites of use
Expanded Polystyrene	5,301	21
Extruded Polystyrene	5,859	28
High Impact Polystyrene	210	3
Textile coating	210	16
Total	**11,580**	**47**

5.2 Releases

5.2.1 Releases from manufacture and unintentional formation

As production, transportation to storage silos and packaging are done in a closed system, releases from manufacture are low (IOM 2008). Workers are mainly exposed

to HBCDD during packing and compaction of powders. Measured HBCDD concentrations in dust were 0.18 mg/m^3 and 1.23 mg/m^3, respirable and inhalable respectively (mean, IOM 2008). From the EASE occupational exposure model, a dermal exposure of 170 mg/day or 17 mg/day for handling powder or granulates respectively was estimated (IOM 2008).

Taking into account currently increasing manufacture volumes and improving emissions control, a worst-case estimate of manufacture releases to the environment corresponds to 0.73 kg/year and 2 kg/year to wastewater and air respectively (IOM 2008).

During micronising, measured exposure concentrations of HBCDD in dust averaged 1.43 mg/m^3 and 22.7 mg/m^3 for respirable and inhalable, respectively. Dermal exposure (840 mg/day) was also much higher than during manufacture (IOM 2008). The release to the environment from the largest micronising operation was determined to be 0.3 kg/year to air, with no releases to waste or surface water (IOM 2008).

The amount of unintentional formation of HBCDD is believed to be negligible (IOM 2008).

5.2.2 Releases from uses

The exposure of workers to respirable mean concentrations of HBCDD for most uses (EPS, HIPS, production of textile coating) was estimated between 0.12 mg/m^3 and 0.33 mg/m^3, while the inhalable mean concentrations were estimated between 1.18 mg/m^3 and 1.89 mg/m^3 (IOM 2008). Measured releases into working environment during XPS formulation were much lower with mean exposure concentrations of 0.01 mg/m^3 and 0.03 mg/m^3 for the respirable and inhalable fractions respectively (IOM 2008).

The maximum dermal exposure during industrial HBCDD use for XPS, EPS and HIPS was estimated at 17 mg/day (IOM 2008). However, much higher exposures were estimated for sewing of the textiles: inhalation exposure concentration of 0.5 mg/m^3 and total dermal exposure of 840 mg/day (IOM 2008).

Professional and private use of insulation boards in buildings result in emissions of HBCDD through minor polystyrene particles (dust) during e.g. sawing, facilitating the HBCDD release to air in relative short time, due to large area per mass unit of the particles (EC 2008). These releases were estimated by the EC (2008) as 5.0 g XPS-particles per tonne and 100 g EPS-particles per tonne, resulting in a total yearly release of 560 kg HBCDD (30 kg from 5,859 t HBCDD used in XPS and 530 kg from 5,301 t HBCDD used in EPS) .

Releases of HBCDD during service life of EPS and XPS products (mainly from insulation panels and similar) were estimated as 70 kg/year based on measurements (IOM 2008). Based on the calculation of releases subject to wear and washing of HIPS textiles from the EC (2008), they were estimated in 26.8 kg/year and 2.1 kg/year for wear and washing respectively. Brominated fire retardants released from textiles have been found in house dust, but the estimated resulting human exposure levels were considered insignificant by the RAR (IOM 2008).

The highest exposure to HBCDD during disposal of EPS/XPS articles was estimated for building demolition (0.1 mg/m^3) (IOM 2008). An undetermined but increasing proportion of waste generated from HIPS and textile articles is recycled (IOM 2008). The rest goes to landfill or incineration. Neither method is likely to give rise to substantial emissions as HBCDD is unlikely to be leached from landfills and very low levels of brominated dioxins are expected from correctly operated incineration (IOM 2008). As the service life duration of most of the uses of HBCDD is several decades, no reliable data for releases from disposal are available.

Based on the information in the risk assessment report (EC 2008), the increasing amounts of HBCDD used and assuming that emissions would increase pro rata (IOM 2008), the total environmental releases from the manufacture and different uses/end uses of HBCDD to air, wastewater and surface water were estimated and these are presented in Table 3.

Table 3 Total emission to environment from manufacture and different uses of HBCDD (IOM 2008)

	Total HBCDD emissions from	**Sources**		**Air (kg/year)**	**Waste-water (kg/year)**	**Surface water (kg/year)**	**All compartments (kg/year)**
		diffuse	point				
Manufacturing processes	Manufacture of HBCDD		X	2	0.73	0	2.73
	Micronising of HBCDD		X	0.28	0	0	0.28
Use of HBCDD in formulations	EPS and HIPS formulation		X	30.4	75	330	435.4
	XPS formulation		X	13.5	84	10	107.5
	Formulation of textiles		X	1.4	44	11	56.4
Industrial uses	Industrial use of EPS		X	159	128	31	318
	Installation of insulation boards	X		236	0	236	472
	Industrial use of XPS		X	146	63	16	225
	Industrial use of HIPS	X		6.3	5	1.3	12.6
	Industrial use of back-coating		X	0.12	1130	283	1413
Releases during service life	Use as building insulation	X		70	0	0	70
	Textiles during service life	X		0	21.4	5.4	26.8
	From washing of textiles	X		0	2.1	0	2.1
	Total	**584**	**2559**	**665**	**1553**	**925**	**3142**

From Table 3 it can be seen that in 2007 a total of approximately 3 tonnes/year of HBCDD are released into the environment of EU 27, from which 50% were to waste water, 21 % to air and 29 % to surface water.

It should be noted that monitoring data show ubiquitous presence of HBCDD in the European environment and in biota, reaching even arctic regions (EC 2008).

5.3 Geographical distribution

The only production site left in Europe is located in the Netherlands (IOM 2008).

From a total of 21 EPS manufacturing sites 15 are located in central Europe, 5 in southern Europe and only one in the north (IOM 2008). The 28 XPS manufacturing sites are more equally distributed (12 in central Europe, 13 in the south and 3 in the north, IOM 2008). A total of 47 formulation sites are distributed throughout Europe (IOM 2008).

Hundreds of EPS industrial users and 35 XPS industrial users are distributed across Europe (IOM 2008).

Due to specific regulations, furniture containing treated textile is believed to be mainly used in UK and Ireland (IOM 2008).

5.4 Conclusions on wide dispersiveness of uses

HBCDD is used as flame retardant in polystyrene products (mainly insulation panels, packaging material and electronic/electric devices) and textile coatings, where the substance is uniformly incorporated into the polymer matrix.
There are one manufacturing and about 50 main formulation sites in Europe; however there are thousands of professional users of articles containing HBCDD and nearly all end uses are widespread throughout Europe.
Most uses (e.g. application of insulation boards, as well as service life of insulation boards or HBCDD containing clothing) are associated with a not insignificant release of HBCDD to the environment. Although release rates are relatively low, monitoring data show ubiquitous presence of HBCDD in environment and biota, even in arctic regions. A substantial proportion of articles containing HBCDD will have very long service life duration (30+ years for typical building insulation) and environmental releases will continue for a long time into the future. Hence, all uses of HBCDD can be considered as wide dispersive.

6 Complexity of the supply chain

The actors directly associated with the HBCDD supply chain and affected by the possible authorisation requirement include at least:

- one EU manufacturer,
- A small number of sites where micronising takes place,
- 47 Formulators for HBCDD in EPS, XPS, HIPS and textile coatings,
- 24 producers of textile coatings,
- 28 producers of EPS articles,
- An unknown number of producers of articles containing HIPS,
- 21 producers of XPS articles,
- 1000s of end users installing insulation boards in construction (EPS and XPS),
- An unknown number of recyclers of HIPS parts from electronic equipment.

HBCDD is imported in relatively high quantities (around 5,500 t in 2006) to the EU, but no data about the sources is given (IOM 2008).

The supply chain of HBCDD used in EPS and XPS is relatively complex: After manufacture/import, most HBCDD is transformed into the different EPS/XPS formulations (EPS, XPS), which are transformed into articles used mainly in construction but also in variety of other professional and consumer uses (IOM 2008). For HIPS, the supply chains may also be complex as HIPS products are mainly used in electrical and electronic appliances (IOM 2008) with specific needs.

Even though the amount of HBCDD used in textile coating is rather low (about 210 t/year), up to 20 other ingredients are necessary for this use (IOM 2008). These are applied to the textile to create fire retarded fabrics that are largely used in furniture fabric (IOM 2008), resulting in an overall relatively complex supply chain.

7 Alternatives

Any alternative of HBCDD should have equal or better flame retardance and should not negatively influence the physical properties of the product (IOM 2008).

Due to available information (IOM 2008), at present, no suitable flame retardant is available to replace HBCDD in most uses of XPS or EPS, as much higher levels of non-halogen flame retardant (EPS and XPS contain 0.7 % and 2.5 % HBCDD respectively) would be necessary, and these would change the polymer quality significantly (IOM 2008). However alternative forms of insulation could be used in many, but not necessarily all applications (IOM 2008). Examples are phenolic foam/resins, polyurethane, mineral wools or similar (see Table 4). Mineral wools are already used in 30 % in the European building insulation market. Even though phenolic foam is a very efficient insulation product with moisture resistance and low density, it is not widely used, due to its high costs (IOM 2008). There are also several alternative techniques mentioned: thermal barriers, loose-fill or blanket insulation, as well as intumescent systems (IOM 2008). These however, are not directly comparable to the use of EPS/XPS flame retarded with HBCDD.

Halogenated flame retardants, such as Decabromodiphenylehter (decaBDE), decabromodiphenylethane (decaBDEthane) or Thylenebis(tetrabromo phtalimide) (EBTBP) in conjunction with antimony trioxide (ATO), were used as alternatives to HBCDD in HIPS (IOM 2008). These and further alternatives are summarized in Table 4.

Table 4 Summary of toxicity, ecotoxicity and costs of viable alternatives for HBCDD for different uses. (IOM 2008)

Use	Alternative*	Toxicity						Ecotoxicity						Cost	Technically viable
		Low	neuro tox.	chronic	Sensi-tizer	CMR	Fertility	Low	Not readily biodegr.	Persis-tent	Bioaccumulation			aqua toxic	
											low	mod.	high		
Fire retardants in HIPS	ATO (synergist)					X			X		X	X			-	X
	decaBDE/ATO		X						X		X	X			(↓)	X
	decaBDEthane/ ATO	X							X	(X)					↔	X
	EBTBP/ATO	X							X	X					↔	X
	TPP			X										X	↑	X
	RBBPP			X						(X)			(X)		↑	X
	BPA-BDPP	X							X						↑	
	DPCP			X			X								↑	X
Alternative to HIPS	Polyethylene with Magnesium Hydroxide	X												(X)	↓	X
Textiles	decaBDE		X						X		X	X			(↓)	(X)
	Chlorinated paraffins			X		X				P or vP					↓	X
	Ammonium polyphosphates	X						X							↑	X
EPS/XPS	Phenolic Foam	X (use)		X (man.)		X (man.)									↑↑	XX
	PU and PIC	X (use)			X (man.)										↓	X
	Mineral wools	X						X							↓	X
	Cellulose fibre					X		X								

* ATO = Antimony trioxide; decaBDE = Decabromodiphenylether; decaBDEthane = Decabromodiphenylethane; EBTBP = Ethylenebis(tetrabromophthalimide); TPP = Triphenyl phosphate; RBBPP = Resorcinol bis (biphenyl phosphate); BPA-BDPP = Bis phenol A bis (biphenyl phosphate); DPCP = Diphenyl cresyl phosphate; PU = Polyurethane; PIC = Polyisocyanurate.

The relatively low quantity of HBCDD used in textile coatings and the high reduction in its use in the last few years was assumed to reflect the availability of equally effective alternatives (IOM 2008).

8 Existing Community legislation relevant for possible exemptions

No data available

9 Other information

No data available

10 References

EC (2008). European Union Risk Assessment report: Hexabromocyclododecane CAS-No.: 25637-99-4, EINECS-No.: 247-148-4. Final draft.

IOM (2008). Data on manufacture, import, export, uses and releases of HBCDD as well as information on potential alternatives to its use. Contract ECHA/2008/02/SR4/ECA.226).

Sweden (2008). Proposal for identification of a substance as a CMR CAT 1 or 2, PBT, vPvB or a substance of an equivalent level of concern. Proposal for identification of Hexabromocyclododecane as a SVHC.