1 June 2009

Background document for hexabromocyclododecane and all major diastereoisomers identified (HBCDD)

Document developed in the context of ECHA's first Recommendation for the inclusion of substances in Annex XIV

1. Identity of the substance

Chemical 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 and CAS numbers 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

2. Background information

2.1. Intrinsic properties

HBCDD was identified as a Substance of Very High Concern (SVHC) meeting the criteria of a PBT substance pursuant to Article 57(d) and was therefore included in the candidate list for authorisation following ECHA's decision ED/67/2008 on 28 October 2008.

2.2. Imports, exports, manufacture and uses

2.2.1. Volume(s), imports/exports

The volume of HBCDD manufactured in the EU 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 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 200 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 12,000 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.

2.2.2. Manufacture and uses

2.2.2.1. Manufacture and releases from manufacture

According to available information, there is currently only one production site in Europe, the Netherlands (IOM 2008).

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.

Worst-case estimate of releases to the environment from manufacture are included in Table 3. These estimates take into account currently increasing manufacture volumes and improving emissions control (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).

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

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

2.2.2.2. Uses and releases from 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 of 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 HBCDD in EPS has increased from 3,500 tonnes/year (2002) till 5,300 tonnes per year in 2006 (IOM 2008).

XPS is mainly used as a thermal insulation in buildings (residential, industrial and agricultural), civil engineering applications, cold stores and vehicles (RCOM 2009). As with EPS, the use of HBCDD in XPS has also been increasing in the last few years (4,000 tones/year to 5,900 tonnes /year, from 2002 to 2006 respectively, IOM 2008). The mean concentration of HBCDD in EPS and XPS applications is around 0.7 %.

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 in 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 about 200 tonnes/year (IOM 2008).

Micronised HBCDD is used in textile applications to comply with 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 about 200 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 11,600 tonnes/year.

Table 2 Summary table of the different formulations of HBCDD

	Tonnes HBCDD /year	Number of sites
Expanded Polystyrene	5,300	21
Extruded Polystyrene	5,900	28
High Impact Polystyrene	200	3
Textile coating	200	16
Total	**11,600**	**47**

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 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 5,900 t HBCDD used in XPS and 530 kg from 5,300 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 HBCDD coated textiles from the EC (2008), they were estimated in 27 kg/year and 2 kg/year for wear and washing respectively. Brominated flame retardants released from textiles have been found in house dust, but the estimated resulting human exposure levels were considered insignificant (EC, 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. There are no estimates of the emissions from the recycling and waste handling.

Table 3 Estimated total emissions 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	< 1	0	3
	Micronising of HBCDD		X	< 1	0	0	< 1
Use of HBCDD in formulations	EPS and HIPS formulation		X	30	75	330	435
	XPS formulation		X	14	84	10	108
	Formulation of textiles		X	1	44	11	56
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	5	1	12
	Industrial use of back-coating		X	< 1	1130	283	1413
Releases during service life	Use as building insulation	X		70	0	0	70
	Textiles during service life	X		0	21	5	26
	From washing of textiles	X		0	2	0	2
	Total	**582**	**2559**	**665**	**1553**	**923**	**3141**

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).

2.2.2.3. Geographical distribution and conclusions in terms of (organisation and communication in) supply chain

As already mentioned in sections above, the only production site in Europe is located in the Netherlands (IOM 2008). HBCDD is also imported in relatively high quantities (around 5,500 t in 2006) to the EU (IOM 2008).

Then, HBCDD is further used in various preparations and articles.
As far as polystyrene applications are concerned, most of a total of 22 EPS manufacturing sites are located in Germany, Netherlands and France (IOM 2008, RCOM 2009). The 56 XPS manufacturing sites are more equally distributed throughout Europe, being the main locations Germany, Italy and Spain (RCOM 2009). A total of 78 formulation sites are distributed throughout Europe (IOM 2008).

About 600 EPS converters are distributed across Europe (RCOM 2009).

As for textile applications, due to specific fire safety regulations, furniture containing treated textile is believed to be mainly used in United Kingdom and Ireland (IOM 2008).

According to the available information, 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,
- 78 formulators for HBCDD in EPS, XPS,
- 24 producers of textile coatings,
- about 600 EPS converters,
- 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 and recyclers of insulation boards.

Therefore, 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. On the other hand, the amount of HBCDD used in textile coating is rather low (about 200 t/year, (IOM 2008)) and formulations containing HBCDD (and up to 20 other ingredients) are applied to the textile to create flame retarded fabrics that are mainly used in furniture fabric (IOM 2008), resulting in a not very complex supply chain.

In conclusion, according to the information available, the supply chains for HBCDD appear to be relatively complex, because involving for its main uses a rather limited number of different industries, but a large number of end-users throughout EU.

2.3. Availability of information on alternatives

When assessing any alternative for HBCDD attention should be paid to proper functioning of the alternatives in different applications (IOM 2008).

On the basis of 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. 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. Furthermore, novel potential alternatives for the use of HBCDD as a flame retardant in EPS and XPS have been studied in different projects and programs.

Halogenated flame retardants, such as Decabromodiphenylether (decaBDE), decabromodiphenylethane (decaBDEthane) or Thylenebis(tetrabromo phtalimide) (EBTBP) in conjunction with antimony trioxide (ATO), have been used as alternatives to HBCDD in HIPS (IOM 2008).

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 that there is experience in using alternatives (IOM 2008).

To conclude, there appears to be information on alternatives to HBCDD and their suitability for most of its uses. Furthermore the available information indicates that substitution of HBCDD is already ongoing for certain specific uses.

On the other hand, some available information suggests that a more complicated situation to conclude whether or not the transfer to alternatives is feasible may appear; particularly for some applications the possible alternatives might not provide the necessary technical requirements. This is the case, for instance, where the potential alternatives are changing the key materials rather than only replacing HBCDD by another substance in the same polymer. Additionally, some information indicates that it might be necessary to assess whether the addition of a flame retardant such as HBCDD is necessary for certain applications, particularly for EPS and XPS uses (RCOM 2009).

2.4. Existing specific Community legislation relevant for possible exemption

No data available.

2.5. Any other relevant information (e.g. for priority setting)

No data available.

3. Conclusions and justification

3.1. Prioritisation

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.

HBCDD is used as a 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 80 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 are associated with a not insignificant release of HBCDD to the environment. Although release rates appear to be low, monitoring data show ubiquitous presence of HBCDD in the environment and in 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 like EPs and XPS) and environmental releases will continue for a long time into the future. Furthermore, no reliable data for releases from post-consumer waste are so far available, but were assumed to be bigger than those of earlier life stages (EC 2008). Hence, all uses of HBCDD can be considered as wide dispersive.

Given that HBCDD is a PBT substance with wide dispersive uses of end products containing it, involving very high volumes and leading to releases over the full life-cycle of articles and preparations, ECHA recommends to include HBCDD in Annex XIV.

3.2. Recommendation for Annex XIV entry

3.2.1. Transitional arrangements

Based on the information available, it is anticipated that the preparation of applications for authorisation will require some collaborative efforts by a potentially large number of actors, even though they represent a rather limited number of different industries.

The available information also suggests that, even though fairly much work has already been done to identify and assess potential alternatives, the preparation of the analysis of alternatives may require some additional time for certain uses, and in particular where the potential alternatives are changing the key materials rather than only replacing HBCDD by another substance in the same polymer.

Hence, in light of the available information, ECHA recommends a somewhat longer period for preparing applications than the minimum and the following transitional arrangements:

- *Latest application date*:
  27 months after the entry into force of the Decision to include the substance in Annex XIV

- *Sunset date*:
  45 months after the entry into force of the Decision to include the substance in Annex XIV

3.2.2. Review periods for certain uses

Neither the available information for HBCDD nor the comments following the public consultation of 14 January 2009 provide information that would support defining review periods for any uses in accordance with article 58(1)(d).

ECHA therefore recommends not to include any review periods for uses of HBCDD.

3.2.3. Exempted (categories of) uses

During the public consultation on the draft recommendation, ECHA received a number of requests for use-specific exemptions of HBCDD.

ECHA did not see grounds for recommending general exemptions for HBCDD for the reasons set out in the "*Responses to comments*" document.

Hence, ECHA does not recommend any exemptions of uses for HBCDD.

3.2.4. Application of authorisation to product and process oriented research and development (PPORD)

Neither the available information for HBCDD nor the comments following the public consultation of 14 January 2009 provide information that would support introducing exemptions from the authorisation requirement for product and process oriented research and development (PPORD) on the basis of Article 56(3) of the REACH Regulation.

Therefore ECHA does not recommend to exempt the use of HBCDD in PPORD from authorisation.

3.3 Possible route for authorisation

The substance meets the criteria in Article 57(d).
Therefore, pursuant to Article 60(3) of the REACH Regulation, it would appear that an authorisation can only be granted in accordance with Article 60(4) of the REACH Regulation ('socio-economic route').

4. References

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

RCOM (2009): "*Responses to comments*" document. Document compiled from the commenting period 14.01-14.04.2009

IOM (2008): Data on manufacture, import, export, uses and releases of HBCDD as well as information on potential alternatives to its use.
Report prepared for ECHA.