HEXABROMOCYCLODODECANE (HBCD) - POLYSTYRENE IN CONSTRUCTION

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Introduction

In 2008, hexabromocyclododecane (HBCD) was proposed for listing under Annex A to the Stockholm Convention and the substance is currently under review by the Convention's Persistent Organic Pollutants Review Committee. At present, the main uses of HBCD are in the polymer and textile industries. HBCD is used in four principal product types, which are Expandable Polystyrene (EPS), Extruded Polystyrene (XPS), High Impact Polystyrene (HIPS) and in polymer dispersions for textiles. Due to the increasing awareness related to HBCD and proposed restrictions, the European Union Polystyrene (PS) foam industry is carrying out intensive research on possibilities to substitute HBCD in PS foams. The industry is confident that within five to ten years, at least one appropriate alternative will be available and that the use of HBCD in this important sector will be completely phased out.

Problem statement

The table on the next page summarizes the emissions and discharges to waste of HBCD from investigated sources in the European Union and shows that significant amounts of HBCD are currently incorporated into new flame retarded products (more than 10,000 tons in 2010).

Polystyrene boards for construction

As shown in the table below, the most relevant quantities of HBCD are currently incorporated into EPS and XPS for construction. The waste figures for EPS and XPS for construction may significantly increase, due to huge amounts of HBCD incorporated into new EPS/XPS products for construction purposes and the relatively long lifetimes of the products.

In construction, EPS and XPS are mainly used for insulation purposes. It is expected that the market for these products will significantly increase in the next decades due to the necessity for better thermal insulation of buildings, in order to reduce greenhouse gas emissions.

Based on data of HBCD consumption in Europe, the consumption since the late 1980s can be estimated.

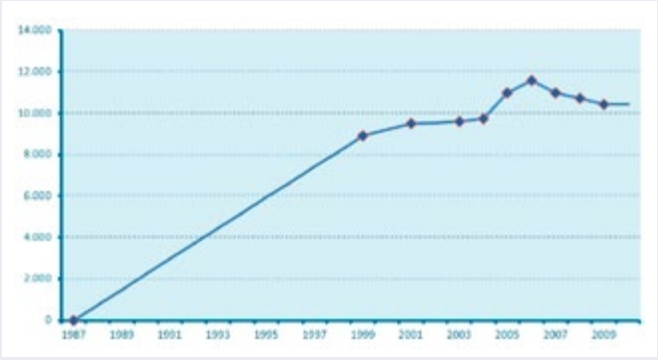
The development of the consumption in the future will depend on the market situation, changes in the legal situation and the availability of alternatives. The PS foam industry expects a significant increase for all types of insulation materials for construction due to changes in the construction sector.

If the use of HBCD in EPS and XPS products were to continue, very significant quantities of waste containing HBCD would have to be managed in the future (particularly after 2050) and may cause significant environmental and health risks, depending on the future deconstruction and waste management practices.

How the issue was addressed

International action:

HBCD is expected to be listed under the UNECE POPs Protocol and is being reviewed by the POPs Review Committee for possible inclusion in the Stockholm Convention, which will lead to increased awareness concerning possible risks related to HBCD.



Emissions and discharge of HBCD from investigated sources in the European Union (2010)[27]

[27] *European Commission (2011) Study on waste related issues of newly listed POPs and candidate POPs. Study prepared by BiPRO GmbH as part of the ESWI Consortium on behalf of the European Commission. Final Report, April 2011.*

Legal action at the European Union level:

At the European Union-level, HBCD was considered as a candidate for inclusion into the planned Annex III of the former RoHS Directive 2002/95/EC. In the current version of the Directive 2011/65/EU, which was approved by the European Parliament on 24 November 2010, Annex III is deleted. However, the substances which were listed in the planned Annex III were moved to recital 10 of the Directive: "The annexes to this Directive should be reviewed periodically to take into account, inter alia, Annexes XIV and XVII to REACH. In particular, the risks to human health and the environment arising from the use of HBCD, DEHP, BBP and DBP should be considered as a priority. With a view to further restriction of substances, the Commission should re-investigate the substances, which were subject to previous assessments, in accordance with the new criteria of this Directive as part of the first review". A review and amendment of the list of restricted substances shall be considered by the Commission within three years after the entry into force of the Directive, and periodically thereafter on its own initiative or following the submission of a proposal by a Member State (see Article 6 of the current version of the Directive).

Under REACH, HBCD and all major diastereoisomers has been identified as a "substance of very high concern" (SVHC) and is included in the candidate list of SVHC since 28 October 2008 due to its "persistent bioaccumulative and toxic" (PBT) properties (Decision number ED/67/2008). As a consequence, HBCD underlies specific obligations resulting from the inclusion in the Candidate List of SVHC. The specific provisions on obligations linked to the substances on the Candidate List of SVHC are laid down in the REACH Regulation in Articles 7.2 (Notification to ECHA), 7.3 (Supply of appropriate instructions), 31.1 (Provision of Safety Data Sheet) and 33 (Duty to communicate safe use information or responding to customer requests).

Producer responsibility and increased awareness:

Society and the PS foam industry have become aware of the possible risks related to HBCD. As a consequence, the PS foam industry and the construction sector have been increasingly deliberating upon possible alternatives but no appropriate drop-in chemical alternative which would fulfil the specific requirements for EPS and XPS products was found to be available.

Sector/Activity	Emission [t/y]	Waste [t/y]	Product [t/y]
EPS for Construction	0.65	68.82	4,471
XPS for Construction	0.71	75.8	4,922
EPS/XPS (other than Construction)	0.10	3.9	626
HIPS for EEE	0.03	181	208.8
Polymer dispersions for Textiles	1.35	866.7	207.4
Total	~2.84	~1,196	~10,435

Estimation of the consumption of HBCD in tons in Europe from the late 1980s until 2010 (estimation taken from EC 2011)

Implementation of the approach to developing sustainable alternatives

Industry therefore started carrying out intensive research on alternative flame retardants for EPS and XPS products with the aim to develop sustainable alternatives with no PBT properties and entailing no health or environmental risks[27]. The stepwise approach puts the emphasis on demonstrating that the substances are not PBT/POPs. It consists of three Tiers:

- Tier 1: Screening (physical and chemical properties; modelling including ecotoxicity);
- Tier 2: Ecotoxicity and health (base set ecotoxicity: biodegradability/ aquatic toxicity etc; base set human health: mutagenicity, acute toxicity, sensitization etc);
- Tier 3: Ecotoxicity and health (longer term ecotoxicity tests depending on Tier 1/2: bio-concentration factor (BCF), sediment toxicity, etc.; human health: mammalian repeated dose toxicity/reproductive toxicity, etc.).

In 2003, a programme was initiated by the European PS insulation industry and common tests were carried out at companies in the region. Thirty to forty commercial substances and some novel substances were selected for screening and testing on laboratory scale. As a result, a short-list of possible chemical alternatives was generated, and made subject to larger scale samples tested on pilot scale. The most promising substances were tested for further optimization at individual companies with the objective to produce EPS and XPS products with appropriate suspension stability and bead size distribution (for EPS), extrusion heat stability (for XPS) product properties, fire performance and cell size.

Currently industry considers two options for scale-up on the basis of pilot plant testing and is confident that within five to ten years, appropriate alternatives will be available[28].

Outcomes / impacts

The bulk of HBCD used in new products becomes waste upon the end of the products' lifetime. Depending on the practices, deconstruction and waste management may thus be related to environmental and health risks due to the HBCD content of waste. According to the long lifetime of EPS and XPS products for construction of 50 years and longer, these problems will particularly arise in the long term (after 2050).

Considering the current and increasing demand for insulation products for construction purposes, huge quantities of corresponding waste will have to be managed in the future. The substitution of HBCD in EPS and

[28] *Source: PlasticsEurope, Exiba, EUMEPS: Track B Report on HBCD - The Perspective of HBCD Users, Comments by the European Polystyrene Insulation Industry. Presentation at UN-ECE POPs Task Force Meeting 18-20 May 2010.*

XPS products will therefore have a particularly important impact on the future waste management and is an essential contribution to sustainable production. Risks arising from construction and demolition would be eliminated in the long term.

Currently about 10,000 tons of HBCD are consumed annually within the European Union, with more than 9,000 tons used for EPS/XPS for construction. If it is possible to substitute this use, related releases to the environment and future waste management problems will be avoided.

This possible success should not override the fact that about 200,000 tons of HBCD, which have been incorporated into products by now, will in any case become waste within the next decades, with an expected peak around 2050. The corresponding waste will have to be managed in a safe and appropriate way.

Lessons learned / conclusion

Increasing awareness due to the proposal and review of substances under the Stockholm Convention as well as regional legal activities and appropriate producer responsibility contribute to trigger industry initiatives to substitute substances of concern. Action should generally be taken as soon as possible in order to minimise the amount of POPs circulating in products, waste and the environment.