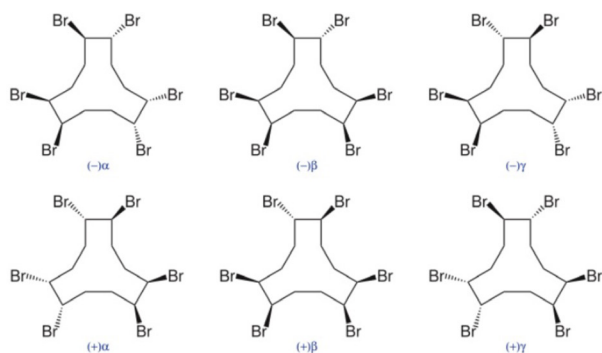




Putting out the Fire on Emerging Contaminants –Hexabromocyclododecane Flame Retardants

What are Hexabromocyclododecanes?

Hexabromocyclododecanes (HBCD) are a class of cyclic brominated compounds most used in flame retardants. Although there are 16 possible stereoisomers, the predominant commercial mixture consists of α -HBCD, β -HBCD and γ -HBCD which exist in diastereomeric form as illustrated below. Formulations may contain trace levels of other isomers. The different structure of isomers causes different properties between them, such as water solubility and hydrophobicity. This influences their behaviour in the environment while also helping to separate and identify these substances analytically.



Based on practical considerations the diastereomeric forms are not themselves separated into their unique enantiomers and each are quantified together as a single peak, with the three forms α -HBCD, β -HBCD and γ -HBCD reported individually.

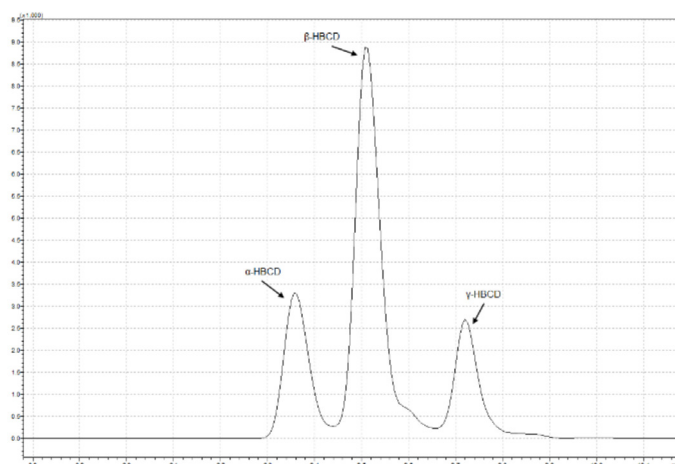


Figure 1: Total Ion Chromatogram
–Hexabromocyclododecane in Water at 10µg/L

Environmental Occurrence and Regulation

There is considerable uncertainty regarding the fate of HBCD in the environment. Some studies indicate that HBCD degrades faster under anaerobic conditions than aerobic conditions, while field data from sediments in the environment show a wide range of HBCD levels and poor anaerobic degradation. This suggests persistence in the environment is much longer than that shown in laboratory studies.

HBCD has been detected in environmental samples including soil and sediment, and biotic matrices including mammals, fish, and other aquatic organisms. Due to its persistence, toxicity and ecotoxicity, HBCD has attracted



regulation under various regimes. Most notably, the Stockholm Convention on Persistent Organic Pollutants lists HBCDs in Annex A, with specific exemptions for applications in extruded polystyrene in building materials and expanded polystyrene. Discarded building and household materials containing HBCD can often present challenges for landfill and water treatment operators alike.

Industrial Applications of HBCDs

Hexabromocyclododecane is mostly imported into Australia as liquid dispersions, in expandable and extruded polystyrene (EPS) resin and as a component of the plastic in finished domestic and industrial equipment and appliances. HBCD is an additive flame retardant, and it is used in building insulation, packaging, automotive upholstery and as a textile coating additive in fabrics and furnishings.

Consumers using the treated products may be exposed to HBCD through skin contact as HBCD diffuses out of the products. Indirect exposure to HBCD through the environment may occur by consumption of food and drinking water contaminated by HBCD. Exposure to HBCD could also occur through ingestion or inhalation of dust/soil, especially in children. Indoor dust may contain HBCD released from HBCD-containing articles in the home.

The majority of HBCD (>95%) is used to produce flame retardant EPS resins and the environment is unlikely to be directly exposed, except during disposal of the resins. However, since HBCD is not chemically bound in materials, but only dispersed, it is eventually released into the environment and can be detected in water, air, dust, sediments, soils, sludge and biota.

For further information please contact your ALS Account Manager or contact ALS via the details below:
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Service offering

ALS has recently expanded its scope of services to include HBCDs reported as the α -HBCD, β -HBCD and γ -HBCD racemates in water and biosolid matrices. Analysis is by LCMSMS, referenced to ALS method code EP238 and results are reported to the LOR values listed below:

Compounds	CAS No	Water LOR ($\mu\text{g/L}$)	Biosolid LOR ($\mu\text{g/kg}$)
α -HBCD	134237-50-6	1	10
β -HBCD	134237-51-7	1	10
γ -HBCD	134237-52-8	1	10

Table 1: LOR values for HBCDs in Waters and Biosolids

Biosolid samples are collected into glass jars and are subject to a 365-day holding time. There are no demonstrated holding times associated with HBCDs in aqueous matrices. If stored in the dark at $<6^{\circ}\text{C}$, aqueous matrices may be stored for up to one year.

The method has been adapted from an established method conducted at ALS Czech Republic and references:

- TrAC Trends in Analytical Chemistry, Volume 25, Issue 4, 2006: "Determination of the brominated flame retardant, hexabromocyclododecane, in sediments and biota by liquid chromatography-electrospray ionisation mass spectrometry".
- VZ_Sop_D6_03_197.A, ALS Czech Republic, July 2016: "Determination of BFR by liquid chromatography with mass detection".