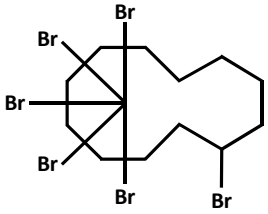
June 2019
Edited by NITE

Risk assessment for chemical substances contained in products

1, 2, 5, 6, 9, 10-Hexabromocyclododecane: Summary

Profile of the target substance

CSCL number	3-2254
CSCL name	1, 2, 5, 6, 9, 10-Hexabromocyclododecane
CAS_RN	3194-55-6
Molecular formula	$C_{12}H_{18}Br_6$
Structural formula	

In September 2004, 1, 2, 5, 6, 9, 10-hexabromocyclododecane was classified as a designated chemical substance, which means it is "suspected to be a chemical substance (Class I Monitoring Chemical Substance) (as of September 2013, it is called a Monitoring Chemical Substance that is highly bioaccumulative and non-readily degradable" under the Act on the Evaluation of Chemical Substances and Regulation of Their Manufacture etc. (Chemical Substances Control Law: CSCL). Thereafter, scientific knowledge was accumulated, and based on a conference of the parties to the Stockholm Convention on Persistent Organic Pollutants, it was decided that hexabromocyclododecane (HBCD) be added to the substances to be eliminated or restricted in May 2013. In June 2013, at three provincial joint councils (METI, MHLW, and MOE), it was judged to be appropriate to designate HBCD as a Class I Specified Chemical Substance under the CSCL because it is highly bioaccumulative, not readily degradable, and also has long-term toxicity.

HBCD, which is the subject substance of this risk assessment, is mainly used as flame retardant for resin and textiles, and is contained in consumer products such as insulation for building materials and flame retardant for curtains. The National Institute of Technology and Evaluation (NITE) conducted the risk assessment on the health effects for Japanese people who are exposed to HBCD via those products indoors and in a car.

Based on usage information in the investigation and notifications based on the CSCL, the results of an investigation of actual concentrations in Japan conducted by the Ministry of Economy, Trade and Industry (METI), and the data of risk assessments conducted in foreign countries, insulation for houses, core materials of tatami flooring, curtains, and automobile fabrics, by which Japanese people might be exposed to the substance in relatively high concentrations among the products that Japanese people use in their homes or cars, were set as the exposure sources to be investigated.

Adults and children under the age of 6 (infants), living in Japan, were set as the target groups of people in this risk assessment. The reason why the assessment was conducted so as to include infants was that their intake through mouthing behaviors such as holding objects in their mouth and licking objects or through dust (mouthing) is different from the intake of adults.

Hazard assessment

For hazard information, a NOAEL of 10 mg/kg/day was adopted for general toxicity and reproductive and developmental toxicity according to the two-generation reproduction toxicity test of rats used for determination of long-term toxicity of CSCL. The hazard assessment value of 0.050 mg/kg/day (50 μg/kg/day) for general toxicity (increase of absolute and relative weight of liver) was derived by dividing the NOAEL by an uncertainty factor of 200 (10 for animal-to-human extrapolation, 10 for human variability, and 2 in consideration of the use of NOAEL as well as the test period). The hazard assessment value of 0.10 mg/kg/day (100 μg/kg/day) for reproductive and developmental toxicity (reduction of the number of primordial follicles) was derived by dividing the NOAEL by an uncertainty factor of 100 (10 for animal-to-human extrapolation and 10 for human variability).

Exposure assessment

For the estimation of the exposure amount, the exposure scenarios were set for each environment (inside houses and cars) where the products to be investigated are used or exist, and the estimated equations according to the exposure scenarios and the parameters required for the estimated equations were set. The parameters of the estimated equations are used to determine the various conditions of exposure. The *estimated human exposure (EHE)* per day was calculated by summing the exposure amount estimated for each of the products.

In setting the parameters, a strict condition that the exposure amount be overestimated by a reasonable amount was adopted. Therefore, the *EHE* is calculated with this strict condition in force in most scenarios and parameters.

The validity of *EHE* was confirmed by monitoring data of concentration in indoor air reported in the existing literature. Comparing with the monitoring data of HBCD in indoor air and dust inside houses and cars, it was confirmed that *EHE* did not fall below the maximum value of actual measurement, and the orders of both were roughly the same; therefore, we thought that the validity of these estimates was confirmed.

Risk assessment

In the risk assessment, the *Hazard Quotient (HQ)* was obtained by dividing the *EHE* by the hazard assessment value, and it was decided that if the HQ was 1 or larger, then the risk is at a level of concern, and if the HQ was less than 1, then the risk is not at a level of concern.

Regarding general toxicity, the *HQ* was obtained by *EHE* averaged over a lifetime, which is the average

exposure amount over a life-span of 70 years, from birth to adulthood (weighted average exposure amount in 70 years), assuming exposure to HBCD inside houses and cars.

With regard to reproductive and developmental toxicity, the *HQ* was obtained separately for adults and infants, and the *EHE* during each exposure period was used.

The results of exposure assessment and risk assessment for each product are shown in the table below.

The results of the exposure assessment suggested that the *EHE* via oral route by mouthing of curtains in infancy occupied a large proportion of *EHE* inside houses and cars of HBCD contained in insulation for houses, core materials of tatami flooring, curtains, and automobile fabrics.

As a result of the risk assessment, with respect to general toxicity, the hazard assessment value was 50 μg/kg/day, while that for the *EHE* averaged over a lifetime was 0.4 μg/kg/day, indicating an *HQ* of 0.008, which was below 1. Regarding reproductive and developmental toxicity, the hazard assessment value was 100 μg/kg/day, whereas the *EHE* was 0.1 μg/kg/day and the *HQ* was 0.001 for adults, which was below 1. Additionally, for infants, the *EHE* was 7 μg/kg/day, and the *HQ* was 0.07, which was below 1.

From the above, it is considered that the level of human health risks is not at the level of concern, even if the HBCD-containing products targeted in this risk assessment will be continuously used.

Table Exposure Assessment Result and Risk Assessment Result

Product type	Exposure scenario	*EHE* (percentage of total *EHE*)		
		Average over a life-span (*4)	Adulthood	Infancy
Insulation for houses	Exposure via inhalation route of dissipated gas	0,021 (5.7%)	0.020 (18%)	0.032 (0.5%)
Core material of tatami flooring	Exposure via inhalation route of dissipated gas	*1	*1	*1
Curtains	Exposure via inhalation route of dissipated gas	2.8×10^{-3} (0.8%)	2.7×10^{-3} (2.4%)	4.4×10^{-3} (<0.1%)
	Exposure via oral route of the indoor dust adsorbed by HBCD	0.18 (48%)	0.091 (80%)	1.1 (16%)
	Exposure via oral route by mouthing	0.17 (46%)	–	5.9 (84%)
Automobile fabrics	Exposure via inhalation route of dissipated gas	9.6×10^{-6} (<0.1%)	9.1×10^{-6} (<0.1%)	1.5×10^{-5} (<0.1%)
	Exposure via oral route of the indoor dust adsorbed by HBCD	*2	*2	*2
	Exposure via oral route by mouthing	*3	*3	*3

	Exposure via dermal route by skin contact	4.5×10^{-5} (<0.1%)	4.3×10^{-5} (<0.1%)	7.0×10^{-5} (<0.1%)
Total estimated exposure amount		0.4	0.1	7
Hazardous items		General toxicity (Hazard assessment value = 50 μg/kg/day)	Reproductive and developmental toxicity (Hazard assessment value = 100 μg/kg/day)	
Result of risk assessment: *HQ*		0.008	0.001	0.07

*1: It is assumed that dissipation from the core material sandwiched between the plates, migration to the dust, and direct contact can be neglected.

*2: This is included in the estimated exposure amount by adsorption to the indoor dust of curtains.

*3: This is included in the estimated exposure amount by mouthing of curtains.

4: Average exposure amount over a life-span = (Exposure amount as adult × 64 years + exposure amount as infant × 6 years)/70 years *: Exposure period for mouthing is 2 years