

## C. Decabromodiphenyl ether

CAS Number 1163-19-5

### 1. Overview

Decabromodiphenyl ether (decaBDE) is used as a flame retardant in a variety of products, including thermoset resin plastics, textiles, and adhesives. While decaBDE itself is not known to be highly toxic, it is capable of debrominating into other polybrominated diphenyl ether (PBDE) congeners such as pentabromodiphenyl ether (pentaBDE) or octabromodiphenyl ether (octaBDE) (Centers for Disease Control and Prevention [CDC], 2010; Environment Canada, 2010; Minnesota Pollution Control Agency [MPCA], 2008). These congeners can be more persistent, bioaccumulative, and toxic (PBT) than decaBDE (CDC, 2010; Environmental Protection Agency [EPA], 2009). Neither pentaBDE nor octaBDE have been produced in the United States since 2004, when the Great Lakes Chemical Corporation stopped production during a voluntary phase-out of the chemical (EPA, 2009).

Although pentaBDE and octaBDE are no longer produced in the U.S, they continue to be found in the environment and in humans (Environment Canada, 2010; EPA, 2009; MPCA, 2008). EPA reports that levels of these chemicals in the environment could be increasing (EPA, 2009). Various congeners of PBDEs have been found in human adipose (fat) tissue, urine, breast milk, and blood (Agency for Toxic Substances and Disease Registry [ATSDR], 2004; CDC, 2010). They are also known to bioaccumulate in fish at low levels (ATSDR, 2004; CDC, 2010). Possible sources of pentaBDE and octaBDE are imported items, decaBDE as it breaks down in the environment (EPA, 2009; MPCA, 2008) or when it is metabolized by animals or humans (EPA, 2009).

The most recent Inventory Update Reporting (IUR) data from the EPA show that decaBDE was manufactured or imported into the U.S. in a quantity of 50 to 100 million pounds in 2005 (EPA, 2010a).

A significant source of children's exposure to PBDEs might be household dust (CDC, 2010; MPCA, 2008). Crawling and mouthing behaviors could make a child's exposure to household dust relatively greater than an adult's exposure. EPA reports the PBDE found most frequently in household dust is decaBDE (EPA, 2009).

The health effects of PBDEs on humans at levels found in the environment and reported in biomonitoring studies are not known (CDC, 2010), though research is being done. In animal laboratory studies, ingested decaBDE has been found to affect behavior, the liver and other organs (CDC, 2010; EPA, 2008; EPA, 2009). While decaBDE is believed to be only moderately bioaccumulative, it can degrade to PBDE congeners which are known to be bioaccumulative (Environment Canada, 2010; Hazardous Substances Data Bank [HSDB], 2010; MPCA, 2008). There is concern that some congeners of PBDEs might affect human development and reproduction, in addition to producing neurobehavioral effects (ATSDR, 2004; CDC, 2010; EPA, 2009).



DecaBDE is being named a Minnesota Priority Chemical for its toxicity, persistence, and potential to degrade into congeners which are persistent, bioaccumulative and toxic. DecaBDE is used on some electronic products that are specifically excluded in Minn. Stat. 2010 116.9405, (i.e., consumer electronic products and electronic components). Therefore, the Priority Chemical designation is focused on the use of the chemical in textiles, polystyrene, polybutylene terephthalate, and other non-exempted consumer products.

Further information about toxicity, potential exposure pathways, and current state and federal actions is provided below.

**2. Exposure and Environmental Disposition**

(Note: This section includes examples of exposure and environmental information. This summary is not intended to be comprehensive.)

**a. Centers for Disease Control and Prevention**

(1) Agency for Toxic Substances and Disease Registry (ATSDR)

Sediments in bodies of water often are reservoirs of decaBDEs. PBDEs do not dissolve easily in water, but lower PBDE congeners have been found to bioaccumulate in fish (ATSDR, 2004).

(2) National Health and Nutrition Examination Survey (NHANES)

Surveys for several PBDE congeners in humans have been conducted by NHANES, though there has been no testing for decaBDE. The surveys show that several congeners continue to be found in human serum. Congener BDE-47 (with four bromine atoms) was found in nearly all of the participants. Four other congeners, BDE-28 (three bromine atoms), BDE-99 (five bromine atoms), BDE-100 (five bromine atoms), and BDE-153 (six bromine atoms) were found in more than 60% of the participants. Levels of BDE-47 appear to have been increasing in human samples in recent years. In several small studies, levels in the U.S. have been found to be greater than levels in residents of other countries, including Japan, Europe, Sweden and Norway (CDC, 2010). The source of these exposures is not entirely clear, but could include food, consumer products, environmental exposures, and the breakdown of more highly brominated chemicals, such as decaBDE (ATSDR, 2004; CDC, 2010).

**b. Environmental Protection Agency**

(1) Inventory Update Reporting (IUR)

Data from 2006 EPA Inventory Update Reporting (IUR) indicate that decaBDE is used in the following product categories at the indicated rates:

Chemical	Maximum concentration in product category	Used in a product intended for children up to age 14
Adhesives and sealants	1-30%	No
Electrical and Electronic products	1-30%	No

Fabrics, textiles and apparel	1-30%	No
Rubber and Plastic Products	1-30%	No
(EPA, 2010a)		

None of the data indicate that decaBDE was used in products specifically intended for children. However, children use consumer products in these categories, particularly the “fabrics, textiles and apparel” category. Because these data are from 2006, it is not clear how well they reflect current use of the chemical.

(2) Toxic Release Inventory (TRI)

The EPA TRI data show that in 2009 there were 509,839 pounds of decaBDE released in the U.S. In Minnesota in 2009, there were 4,100 pounds of decaBDE released from four companies. These releases were primarily related to on-site land disposal or transfer to a waste broker (i.e., a waste broker took the waste for disposal). This is down from a peak of 20,775 pounds reported released in Minnesota from five companies in 2006. The amount of decaBDE released appears variable since 1998, with an average reported release per year of 7,603 pounds (EPA, 2010c).

An agreement made among the main manufacturers and importers of decaBDE will result in the phase-out of manufacturing and importation of this chemical into the U.S. by 2013. Articles made with decaBDE and recycling of materials containing decaBDE are not affected by this agreement (EPA, 2009).

(3) National Center for Environmental Assessment

Primary sources of human exposure to PBDEs appear to be house dust. Ingestion and dermal contact both contribute to exposure. Infants have the highest exposure to PBDEs through breast milk (EPA, 2010b).

**3. Toxicity**

(Note: The section below contains information pertaining to toxicity. It is not intended to provide a comprehensive summary.)

**a. Centers for Disease Control and Prevention**

(1) Agency for Toxic Substances and Disease Registry (ATSDR)

ATSDR reports that nothing definite is known about the toxicity of PBDEs in humans. In laboratory studies, animals that ate small amounts of less brominated congeners of PBDEs over several weeks showed effects in the liver and thyroid, as well as some behavioral effects in the animals exposed as infants (ATSDR, 2004).

(2) National Health and Nutrition Examination Survey (NHANES)

NHANES remarks that decaBDE is less toxic than pentaBDE. The most sensitive endpoints of pentaBDE are neurobehavioral and reproductive toxicity, as shown in animal studies (CDC, 2010).

**b. Environmental Protection Agency**

Integrated Risk Information System (IRIS)

The IRIS program has listed information for decaBDE as follows, based on animal laboratory studies:

Oral Reference Dose:

7 x 10<sup>-3</sup> mg/kg/day (neurobehavioral effects)

Uncertainty Factor: 300 (EPA, 2008)

Cancer:

Suggestive evidence of carcinogenic potential (EPA, 2008)

**c. National Institutes of Health**

(1) National Toxicology Program (NTP)

NTP tested decaBDE in 1986 and reported some evidence of carcinogenicity in rats, equivocal evidence of carcinogenicity in male mice, and no evidence of carcinogenicity in female mice (National Toxicology Program [NTP], 1986).

(2) National Library of Medicine

Hazardous Substance Data Bank (HSDB)

Animal laboratory studies reported in the HSDB indicate liver effects. Neurobehavioral effects were also found in some studies (HSDB, 2010).

**d. World Health Organization**

International Agency for Research on Cancer (IARC)

IARC has placed decaBDE in a Group 3 classification: “Not classifiable as to its carcinogenicity to humans.” (International Agency for Research on Cancer [IARC], 1999)

**4. Statutory Requirements**

The table and information summary below provide current information about decaBDE and how it meets the criteria of Minn. Stat. 2010 116.9401 – 116.9407.

Statute	Information	References
<b>Minn. Stat. 2010 116.9401</b>		
Subd. (e)(1) harm the normal development of a fetus or child or cause other developmental toxicity		
Subd. (e)(2) cause cancer, genetic damage, or reproductive harm		
Subd. (e)(3) disrupt the endocrine or hormone system		
Subd. (e)(4) damage the nervous system, immune system, or organs, or cause other systemic toxicity	Neurobehavioral effects	EPA 2008 CDC 2010

Statute	Information	References
Subd. (e)(5) be persistent, bioaccumulative, and toxic;	Remains in sediments. Accumulates in some species. Some breakdown congeners have been found to be persistent and bioaccumulative.	ATSDR 2004 Env. Canada 2010 EPA 2009
Subd. (e)(6) be very persistent and very bioaccumulative		
<b>Minn. Stat. 2010 116.9403</b>		
Subd. (a) (1): has been identified as a high-production volume chemical by the United States Environmental Protection Agency	50 to 100 million pounds	EPA 2010a
Subd (2) Meets any of the following criteria:		
Subd. (a)(2)(i): the chemical has been found through biomonitoring to be present in human blood, including umbilical cord blood, breast milk, urine, or other bodily tissues or fluids	Human adipose tissue, blood, breast milk, serum	ATSDR 2004 EPA 2009 HSDB 2010
Subd. (a)(2)(ii): the chemical has been found through sampling and analysis to be present in household dust, indoor air, drinking water, or elsewhere in the home environment	Indoor air, household dust	ATSDR 2004 EPA 2009 HSDB 2010
Subd. (a)(2)(iii): the chemical has been found through monitoring to be present in fish, wildlife, or the natural environment	Ambient air, birds, fish, mussels, water sediments	HSDB 2010 NHANES 2010

## **5. Current Regulations**

### **a. Federal**

There are currently no federal regulations related to decaBDE, though several bills were introduced in Congress in recent years (Library of Congress, 2010).

There is a voluntary phase-out agreement related to the production and importation of this chemical that will be fully in place by December 2013. This phase out does not include articles made with decaBDE or recycling processes (EPA, 2009).

### **b. States**

Within U.S. states, several pieces of legislation have been introduced. The following legislation is related to decaBDE or PBDEs. The summaries are from the Lowell Center for Sustainable Production US State Chemical Policy Database, available at <http://www.chemicalspolicy.org/chemicalspolicy.us.state.database.php>.

## **Minnesota**

Year: 2008

Minnesota legislation which restricted sale of articles with decaBDE (SF 657) was passed by the Legislature but vetoed by the governor in 2008.

Year: 2007

Minn. Stat. 2010 325E.385-325E.388 (2008)

Prohibits the manufacturing, processing, or distribution of a product or flame-retardant part of a product containing certain concentrations of pentabromodiphenyl ether or octabromodiphenyl ether. Requires the Commissioner of the Pollution Control Agency to review uses of decabromodiphenyl ether, availability of technically feasible and safer alternatives, fire safety, and any evidence regarding the potential harm to public health and the environment posed by commercial decabromodiphenyl ether and the alternatives. Requires that equipment, supplies, and other products that do not contain polybrominated diphenyl ethers be made available to all state agencies.

## **Hawaii**

Year: 2010

S.R. 107, 25th Leg., Reg. Sess. (Haw. 2010); H.R. 165, 25th Leg. Reg. Sess. (Haw. 2010); H.C.R. 235, 25th Leg., Reg. Sess. (Haw. 2010)

Statement of support for the phase-out of decaBDE production.

## **Illinois**

Year: 2005

H.B. 2572, 94th Gen. Assemb., Reg. Sess. (Ill. 2005)

Prohibits the manufacture, processing, or distribution of products or flame retardant parts of a product containing more than one tenth of 1% penta-BDE or octa-BDE. Directs the Illinois Environmental Protection Agency to review current literature on the health impacts of and alternatives available to decaBDE by 2006 and submit this report to the Governor. (The Illinois EPA was also instructed to do a follow up study on the environmental impacts of decaBDE in a letter from the governor in 2006.)

## **Maine**

Year: 2010

L.D. 1568, 124th Leg., 2nd Reg. Sess. (Me. 2009)

Prohibits the manufacture and sale of shipping pallets or any product manufactured from recycled shipping pallets containing decaBDE. Permits the Department of Environmental Protection to restrict the use of other flame retardants in plastic shipping pallets if the flame retardant is harmful to the public health and the environment and a safer alternative to the flame retardant is available. Requires that decaBDE be replaced with safer alternatives. Prohibits the replacement of decaBDE with a chemical alternative that is a persistent, bioaccumulative, and toxic chemical or another brominated or chlorinated flame retardant. Permits the Department to supervise an alternatives assessment study to determine the availability of safer alternatives to the use of decaBDE in shipping pallets.

Year: 2009 (Amended)

Me. Rev. Stat. Ann. tit. 38, § 1609 (2008)

Prohibits the sale or distribution of a product containing more than 0.1% of the "penta" or "octa" mixtures of polybrominated diphenyl ethers. Restricts the manufacturing and sale of any mattress, mattress pad, upholstered furniture for indoor use, television or computer that has a plastic housing or contains plastic fibers with the "deca" mixture of polybrominated diphenyl ethers. Permits the Commissioner of Environmental Protection to adopt rules to prohibit the manufacture, sale or distribution of certain products with a flame retardant deemed harmful to human health and the environment and an alternative exists.

Year: 2009

L.D. 1568, 124th Leg., 2nd Reg. Sess. (Me. 2009).

A prohibition on the manufacturing and sale of shipping pallets or materials made with shipping pallets containing decaBDE. The law also requires that decaBDE be replaced with an alternative that is not persistent, bioaccumulative or toxic.

## **Maryland**

Year: 2010

S.B. 556, 427th Gen. Assemb., Reg. Sess. (Md. 2010).

Phases out the use of decaBDE in products. Prohibits the manufacture, lease, sale, or distribution for sale or lease of mattresses, upholstered furniture designed for residential use, and electrical or electronic equipment containing decaBDE by 2010. Prohibits of manufacture, lease, sale, or distribution for sale or lease any product that contains decaBDE by 2012. Prohibits the manufacture, lease, sale, or distribution for sale or lease of transportation equipment, military equipment, or components of transportation or military equipment by 2013.

Year: 2005

Md. Code Ann., Envir. §§ 1201-1205 (2008).

Prohibits the manufacture, processing, sale, or distribution of a new product or flame-retardant part of a new product that contains more than a specified amount of penta- or octa-brominated diphenyl ether. Requires the Department of the Environment, in conjunction with interested parties, to report to the Legislature on the use of decabrominated diphenyl ether (decaBDE) in products sold in the state, any data available on the human body burden or environmental occurrence of decaBDE, recommendations regarding the use, sale, and disposal of products containing decaBDE, and any other recommendations to further protection of public health and the environment from decaBDE.

## **New York**

Year: 2004

N.Y. Env'tl. Conserv. Law § 37-0111 (2008).

Prohibits the use of pentabrominated diphenyl ether or octabrominated diphenyl ether in any product or as use as a flame retardant. Creates the state task force on flame retardant safety to, at a minimum, review and report on relevant studies, risk assessments, findings,

or rulings in connection with the flame retardant decabrominated diphenyl ether and evaluate the availability of safer alternatives to decabrominated diphenyl ether.

### **Oregon**

Year: 2009

S.B. 596, 75th Leg. Assemb., Reg. Sess. (Or. 2009).

Prohibits introduction or delivery for introduction into commerce any product containing more than one-tenth of one percent by mass of decaBDE.

Year: 2005

S.B. 962, 73rd Leg. Assemb., Reg. Sess. (Or. 2005).

Restricts the introduction into commerce of any product containing pentabrominated diphenyl ether or octabrominated diphenyl ether.

### **Rhode Island**

Year: 2006

R.I. Gen. Laws §§ 23-13.4-1-23-13.4-6 (2008).

Restricts the manufacturing or distribution of flame retardants containing pentaBDE or octaBDE. Requires study on decaBDE.

### **Vermont**

Year: 2009

H. 444, 2009-2010 Leg., Reg. Sess. (Vt. 2009)

Prohibits the sale or distribution of a product containing octaBDE or pentaBDE. Prohibits the manufacture, sale, or distribution of a mattress or mattress pad, upholstered furniture intended for indoor use in a home or other residential occupancy, or a television or computer with plastic housing containing decaBDE. Prohibits a manufacturer from replacing decaBDE with a chemical that is classified as "known to be a human carcinogen" or "reasonably anticipated to be a human carcinogen" or is identified by the U.S. EPA as causing birth defects, hormone disruption, or harm to reproduction or development.

### **Washington**

Year: 2007

Wash. Rev. Code Ann. §§ 70.76.005-70.76.110 (2008)

Restricts the sale of noncombustible products containing PBDEs and mattresses containing commercial decaBDE. Requires the Department of Ecology and the Department of Health to study alternatives to PBDEs and decaBDEs. Restricts the sale of televisions, computers, and residential upholstered furniture containing decaBDE as a result of the Departments' finding that safer and technically feasible alternatives that meet fire safety standards are available.

(Lowell Center for Sustainable Production, 2010)

## **6. Planned Actions**

### **a. Federal**

#### Environmental Protection Agency

The EPA has created a Chemical Action Plan for PBDEs. Within the plan, risks to children's health are discussed, as well approaches to control these risks through both regulatory and voluntary actions (EPA, 2009). Some of the planned actions include:

- Support voluntary phase out of manufacture or importation of decaBDE. A voluntary phase out is already underway, with an ultimate cessation of manufacturing and importation of decaBDE by December 31, 2013. EPA states it will encourage other importers that are not participating in this agreement to also cease importation. However, articles made with decaBDE are not currently part of this agreement (EPA, 2009) and importation of articles already treated with decaBDE could continue.
- Initiate significant new use rule (SNUR) rulemaking under the Toxic Substances Control Act (TSCA) that would prohibit manufacturer or importation of decaBDE (excluding articles containing decaBDE). A SNUR would require a 90-day notice be filed with EPA before beginning manufacture or importation of a chemical. Under TSCA, EPA could evaluate the use and impose restrictions or prohibitions on the new activity.
- EPA proposes simultaneously creating a SNUR designating manufacture and importation of decaBDE and articles made with decaBDE a significant new use, and a test rule under section 4 of TSCA. The test rule would require information about effects of manufacturing, use or other activities related to decaDBE. It would implement this test rule, rather than the SNUR, if decaBDE continues to be manufactured or imported into the U.S.
- Initiate rulemaking under TSCA section 5(b)(4) to add commercial PBDE mixtures and congeners to a list of chemicals which could present unreasonable risk to health or the environment.
- Conduct an alternatives analysis for commercial decaBDE mixtures. This analysis would be intended to assist users of decaBDE in finding suitable alternatives.

Activities not related to decaBDE that EPA intends to initiate:

- Initiate significant new use rule (SNUR) rulemaking under the Toxic Substances Control Act (TSCA) that would prohibit manufacturer or importation of articles with added pentaBDE or octaBDE.

## **b. States**

### Washington

Under the Children's Safe Products Act, Washington has named decaBDE a Chemical of High Concern for Children. Washington plans to implement reporting requirements for manufacturers related to this designation (Washington, 2010).

## **7. Conclusion**

The toxicity, persistence, pervasiveness and potential to degrade into lower congeners are characteristics for which decaBDE is being named a Minnesota Priority Chemical. The planned phase-out of this chemical may help to reduce the presence of decaBDE and its breakdown products in the environment. However, decaBDE may continue to be used in articles and will continue to be present during recycling activities. New information about the chemical that becomes available will be monitored.

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