

# PBDEs

## And Your Health

*Alaska Community Action on Toxics*

*September 2007*

### **WHAT ARE PBDEs?**

Polybrominated diphenyl ethers, or PBDEs, are a class of flame retardant chemicals added to many consumer products found in the home, office, automobiles, and airplanes.<sup>1</sup> Three mixtures used widely—penta-BDE, octa-BDE, and deca-BDE—made up 14%, 6%, and 80% of the 1999 worldwide production, respectively.<sup>2</sup> Commonly found in electronics, such as TVs, and used in some furniture foams, textiles, and kitchen appliances, industry voluntarily ended production in the United States of the formulations of penta and octa in 2004 after high levels were found in breast milk. However, the deca formulation is still being produced and used primarily in plastic electronics such as television and computer casings, and is also used in furniture and mattresses.<sup>3</sup>

PBDEs are also part of a broader chemical class called polyhalogenated aromatic hydrocarbons (PHAHs) which include other highly toxic chemicals such as PCBs and dioxins.<sup>2</sup> PBDEs are intrinsically hazardous because of their chemical characteristics: (1) they are stable, meaning that they are persistent in the environment and do not break down easily; (2) they are lipophilic, meaning that they accumulate in fatty tissues of living organisms; and (3) they have toxic properties, including the potential to act as endocrine disruptors.<sup>4</sup> Their persistence and fat solubility allow them to both bio-magnify and bio-accumulate, meaning that they build up in the bodies of animals and humans as they move through the food chain. However, the main component in deca-BDE, BDE-209, has a relatively short half-life in people,<sup>1</sup> making it probable that it does not accumulate unless there is continuous exposure.

### **HOW ARE WE EXPOSED?**

There are numerous ways that humans are exposed to PBDEs, including consumption of contaminated foods and through incidental ingestion of PBDE-contaminated dust. Because of the chemical characteristics of PBDEs, they do not fully bind to the products in which they are used. Deca, in particular, breaks down into more toxic products which volatilizes when exposed to ultraviolet (UV) light.<sup>5</sup> It is not entirely clear how deca is being released from products, though some think that it might even be from physical abrasion or deterioration of the product. Penta does not require UV light exposure to volatilize. PBDEs are released from furniture, electronics and other products when exposed to UV light, causing them to be present in the air we breathe and in dust. Though the production of penta-BDE and octa-BDE has stopped in the United States, exposure continues from old computers, furniture, fabrics, and other consumer sources that were manufactured before the discontinuation.<sup>6</sup> The main sources of exposure are thought to be fatty foods,<sup>7</sup> as PBDEs are fat-seeking and bio-accumulate in the food chain, and inhalation of contaminated dust.

### **PBDEs IN OUR BODIES**

Due to their widespread use, persistence and bio-accumulative properties, PBDEs have been found in humans at high levels. One study showed that five percent of American women have levels of PBDEs that approach the levels associated with reproductive problems in animals,<sup>1</sup> though we do not know if humans are more or less sensitive than animals. PBDEs have been found in mothers' breast milk and in the blood of mothers and their babies.<sup>8,9</sup> People of the

Arctic may experience an even greater risk due to their consumption of a traditional diet that is rich in fat from marine mammals.<sup>7</sup> Concentrations of PBDEs have increased over the years in marine mammals due to atmospheric transport and bioaccumulation.<sup>2</sup>

### **WHAT DOES EXPOSURE TO PBDES MEAN FOR OUR HEALTH?**

PBDEs have been linked to numerous adverse health effects, including:

Developmental Effects: Studies in rodents indicate that neonatal exposure to PBDEs permanently affects learning and memory functions, impairs motor activity, and is linked to aberrations in spontaneous behavior and hyperactivity that seems to be permanent.<sup>10,11</sup> However, it is not known what the developmental effects are in people or at what doses they occur.

Reproductive Effects: PBDEs have been correlated to cause cryptorchidism, or undescended testes in new born boys,<sup>12</sup> and permanently impair sperm development in rodent studies.<sup>11</sup> They have also been associated with the delay of puberty in both male and female rodents and alterations in sexual development and gender-specific sexual behavior.<sup>13</sup> Exposure to PBDEs has also been linked to birth defects, reduced weight gain during pregnancy, changes in ovary cells, and reduced sperm count.<sup>14</sup>

Cancer: One study suggests that in utero exposure to PBDE concentrations is associated with an increased risk of testicular cancer in men.<sup>15</sup> The Agency for Toxic Substances and Disease Registry (ATSDR) lists deca-BDE as a possible human carcinogen based on the development of liver tumors in rats that were given the substance.<sup>7</sup>

Thyroid Problems: Recent animal studies have shown that PBDE exposure is linked to decreased circulating concentrations of thyroid hormone<sup>11</sup> and to a decrease in thyroid weight in adult rodent offspring.<sup>13</sup>

### **REDUCING OUR EXPOSURE**

You can minimize your exposure to PBDEs by taking the following steps:

#### PBDE-free Furniture:

- Before purchasing furniture, find out which companies offer PBDE-free products. The following websites can help:
  - Safer Products Project: [www.safer-products.org](http://www.safer-products.org)
  - Smart Shopper's PBDE Card: [www.thegreenguide.com](http://www.thegreenguide.com)
- Contact the company directly if you cannot find whether the manufacturer uses PBDEs.

#### Reduce Your Dust Exposure:

- Wash your hands frequently to remove dust particles that your hands pick up throughout the day on everything you touch.
- Use a wet rag or cloth while dusting to avoid kicking up the dust in the air.

#### PBDE-free Electronics:

- Many companies are beginning to make electronics with alternatives to PBDEs. Certain PBDE-free products are available from Canon, Dell, HP, Intel, Erickson, Apple, and Sony.

#### Reduce Your Fat Intake:

- Choose lean meat and poultry cuts.
- Cut off visible fat before you cook meat.
- Choose cooking methods that remove excess fat such as broiling, grilling, and roasting.

## REGULATIONS FOR PBDES

There have been many strides in the regulation of PBDEs in recent years, but much more is needed to ensure the safety of public health. Internationally, Sweden was the first to initiate a phase out of PBDEs in the late 1990s, followed by the European Union—first phasing out penta-BDE and octa-BDE and then deca-BDE in 2006.<sup>16</sup> In the United States, industry voluntarily ended production of penta-BDE and octa-BDE in 2004, but deca-BDE remains allowed in consumer products.<sup>16</sup> Some states such as Washington, Maine, California, Hawaii, and New York have passed laws to ban some forms of PBDEs in consumer products.

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<sup>1</sup> McDonald TA. 2005. Polybrominated diphenylether levels among United States residents: Daily intake and risk of harm to the developing brain and reproductive organs." *Integrated Environmental Assessment and Management* 1(4):343-354.

<sup>2</sup> Ikonomou MG, Rayne S, Addison RF. 2002. Exponential increases of the brominated flame retardants, polybrominated diphenyl ethers, in the Canadian Arctic from 1981 to 2000. *Environmental Science & Technology* 36(6):1886-1892.

<sup>3</sup> Toxic-Free Legacy Coalition Report. 2006. Pollution in People. Available: <http://www.toxicfreelegacy.org>.

<sup>4</sup> Hooper K, McDonald TA. 2000. The PBDEs: An emerging environmental challenge and another reason for breast-milk monitoring programs. *Environmental Health Perspectives* 108(5):387-392.

<sup>5</sup> Washington State Department of Health and Washington State Department of Ecology. 2006. Washington State Polybrominated Diphenyl Ether (PBDE) Chemical Action Plan: Final Plan. Available: <http://www.ecy.wa.gov/pubs/0507048.pdf>.

<sup>6</sup> Northwest Watch. 2004. Flame retardants in the bodies of pacific northwest residents: A study of toxic body burdens. Available: <http://www.sightline.org/>

<sup>7</sup> Agency for Toxic Substances and Disease Registry (ATSDR). 2004. Toxicological Profile for Polybrominated Biphenyls and Polybrominated Diphenyl Ethers. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry. Available: <http://www.atsdr.cdc.gov/toxpro2.html>.

<sup>8</sup> Schechter A, Pavuk M, Papke O, Ryan JJ, Birnbaum L, Rosen R. 2003. Polybrominated diphenyl ether (PBDEs) in U.S. mother's milk. *Environmental Health Perspectives* 111(14):1723-1729.

<sup>9</sup> Mazadai A, et al. 2003. Polybrominated diphenyl ethers in maternal and fetal blood samples. *Environmental Health Perspectives* 111(9):1249-1252.

<sup>10</sup> Eriksson P, Jakobsson E, Fredriksson A. 2001. Brominated flame retardants: A novel class of developmental neurotoxicants in our environment? *Environmental Health Perspectives* 109(9):903-908.

<sup>11</sup> Kuriyama SN, Talsness CE, Grote K, Chahoud I. 2005. Developmental exposure to low-dose PBDE-99: Effects on male fertility and neurobehavior in rat offspring. *Environmental Health Perspectives* 13(2):149-154.

<sup>12</sup> Main KM, Kivirant H, et al. Accepted for print, May 2007, to be published. Flame retardants in placenta and breast milk and cryptorchidism in newborn boys. *Environmental Health Perspectives* doi:10.1289/ehp.9924 Available: <http://dx.doi.org/> [Accessed 31 May 2007].

<sup>13</sup> Lilienthal, Hellmuth, et al. 2006. Effects of developmental exposure to 2,2',4,4',5-pentabromodiphenyl ether (PBDE-99) on sex steroids, sexual development, and sexually dimorphic behavior in rats. *Environmental Health Perspectives* 114(2):194-201.

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<sup>14</sup> Schreder E. 2006. Pollution in People: A Study of Toxic Chemicals in Washingtonians. Available: [www.pollutioninpeople.org](http://www.pollutioninpeople.org).

<sup>15</sup> Hardell L, van Bavel B, Lindström G, Eriksson M, Carlberg M. 2006. In utero exposure to persistent organic pollutants in relation to testicular cancer risk. *International Journal of Andrology* 29:228-234.

<sup>16</sup> Northwest Watch. 2004. Flame retardants in the bodies of pacific northwest residents: A study of toxic body burdens. Available: <http://www.sightline.org/>