

FACT SHEET

March, 2003

Penta-Brominated Diphenyl Ether

PentaBDE or BDE-99

Penta-Brominated Diphenyl Ether (pentaBDE) has been accumulating in human tissues and breast milk over the last two decades. While there is very limited human health data and quite limited animal toxicology data on pentaBDE, some animal studies demonstrate that exposure can damage the thyroid and liver and cause hyperactivity, changes in motor behavior, and other brain functions. Because of their structural similarities to polychlorinated bi-phenyls, pentaBDE may cause developmental health effects similar to those of polychlorinated biphenyls (PCBs). PentaBDE is one of several compounds in the class of polybrominated diphenyl ethers (PBDEs) and is predominantly used as a flame retardant in polyurethane foam in furniture and electronics.

Health Effects

Although there is limited human toxicology data available on pentaBDE, animal studies have demonstrated that exposure can damage the liver and cause hyperactivity, changes in motor behavior, as well as in brain and thyroid function. Proper thyroid function is needed for normal metabolic activity. Due to structural similarities between pentaBDE and polychlorinated biphenyls (PCBs), there is particular concern about neurodevelopmental damage and cancer in the offspring of those exposed.

Because pentaBDE is not chemically bound to the polymer (plastic or textile), pentaBDE particles can leach out into the air. People can be exposed to pentaBDE through inhalation of airborne matter, direct skin contact in the work environment or home, and ingestion of pentaBDE-contaminated food and water. Fetuses can be exposed *in utero* and nursing infants can be exposed through ingestion of breast milk. Limited data on pentaBDE levels in the breast milk of U.S. and Canadian women indicate exposures roughly 40 times higher than those found in Sweden (where the chemicals have been subject to regulatory action) and levels of pentaBDE in human tissue, fish, and wildlife samples have been doubling every 5 years for the last 25 years. Consumption of pentaBDE-contaminated food and occupational exposures (polyurethane manufacturing, computer dismantling) are of particular concern due to frequent and direct contact. In 2003 the European Commission banned the marketing and future use of PBDEs (which includes pentaBDE) in electronics and electrical equipment and is finalizing a full marketing restriction.



Common Uses

PentaBDE is predominately used as a flame retardant in polyurethane foam in furniture and some building materials. Polyurethane foam typically contains 10-30% pentaBDE by weight. Other brominated diphenyl ethers—octaBDE and decaBDE—which can break down to pentaBDE—are used in hard plastics, such as computer casings and television sets. In the year 2000, approximately 18.3 million pounds of pentaBDE were used in the United States, and the U.S. accounted for 98% of global demand for pentaBDE in 1999.

Alternatives

Fire retardancy of materials is important and many alternatives to pentaBDE exist. Companies such as IKEA have already eliminated their use of pentaBDE by substituting such compounds as organic phosphorous and nitrogen compounds. Tetrabromobenzoate (TBBE), hydrated alumina, red phosphorous, chlorinated phosphate esters (sometimes used with melamine), and ammonium polyphosphates are possible pentaBDE alternatives. However, studies on the human health and safety and environmental impacts of these alternatives need further exploration and analysis. Alternatives to polyurethane foam, such as impregnated foam, or denser foam, as well as less flammable textiles which do not require treatment with pentaBDE or other flame retardants, are also on the market.

References

- Agency for Toxic Substances and Disease Registry (ATSDR). 2003. Toxicological profile for polybrominated biphenyls and polybrominated diphenyl ethers (Draft for public comment). Atlanta, GA: US Department of Health and Human Services, Public Health Service.
- Birnbaum, L.S. 2002. Brominated flame retardants: Cause for concern? US Environmental Protection Agency (EPA).
- Danish Environmental Protection Agency. 2000. Working Report No. 17. Alternatives to brominated flame retardants: Screening for environmental and health data.
- Eriksson, P., Viberg, H., Jakobsson, E., Orn, U., Freriksson, A. 2002. A brominated flame retardant 2,2',4,4',5-Pentabromodiphenyl ether: Uptake, retention, and induction of neurobehavioral alterations in mice during a critical phase of neonatal brain development. *Toxicological Science* 67: 98-103.
- Fowles, J.R., Fairbrother, A., Steppan-Baecher, L., and Kerkvliet, N.I. 1993. Immunologic and endocrine effects of the flame-retardant pentabromodiphenyl ether (DE-71) in C57BL/6J mice. *Toxicology* 86: 49-61.
- Hale, R.C., La Guardia, M.J., Harvey, E., and Mainor, T.M. 2002. Potential role of fire retardant-treated polyurethane foam as a source of brominated diphenyl ethers to the US Environment. *Chemosphere* 46: 729-735.
- Jakobsson, K., Thuresson, K., Rylander, L., et al. 2002. Exposure to polybrominated diphenyl ethers and tetrabromobisphenol A among computer technicians. *Chemosphere* 46: 709-716.
- Leonards, P.E.G., Santillo, D., Brigden, K., van der Veen, I., Hesselingen, de Boer, J., and Johnston, P. 2001. Brominated flame retardants in office dust samples. Abstract submitted to BFR 2001: Human levels and trends. http://www.kemi.se/aktuellt/BFR/bfr_del4.pdf.
- Letcher, R.J., Meerts, I.A.T.M., and Brouwer, A. 2001. Toxicological evaluation and endocrine activity of PBDEs. Abstract submitted to the Third Annual Burlington Workshop on Brominated Flame Retardants in the Environment.
- McDonald, T.A. 2002. Are PBDEs the PCBs of the future? Office of Environmental Health Hazard Assessment (OEHHA), California EPA.
- Sjodin, A. and Patterson, D.G. 2002. Occupational exposure to polybrominated diphenyl ethers (PBDEs) at recycling of electronic goods. Centers for Disease Control and Prevention, National Center for Environmental Health.
- Zhou, T., Ross, D.G., DeVito, M.J., and Crofton, K.M. 2001. Effects of short-term *in vivo* exposure to polybrominated diphenyl ethers on thyroid hormones and hepatic enzyme activities in weanling rats. *Toxicological Sciences* 61:76-82.

Additional Resources

- US EPA Region 9: http://www.greenstart.org/efc9/bfrs/global_info.htm
- Massachusetts Toxics Use Reduction Institute (TURI): <http://www.turi.org>
- Swedish Chemical Inspectorate (Kemi): http://www.kemi.se/default_eng.htm