

Deca-BDE: Human Health and Environmental Concerns

Deca-BDE accounts for 83% of PBDE use worldwide¹. Recent research demonstrates that deca-BDE can be absorbed and metabolized by humans and other animals. Deca-BDE breaks down readily with exposure to sunlight to the more toxic lower-brominated compounds. Deca-BDE can also be broken down by bacteria in the environment to more toxic metabolites. Deca-BDE is present in our homes, workplaces, and outer environment, and is continuing to bioaccumulate in our tissues along with the lower congener PBDEs.

Deca-BDE can be absorbed and broken down by biological systems

The primary component of the deca-BDE commercial mixture is the congener BDE 209. Numerous studies have found BDE 209 in fish, birds, grizzly bears, and other animals at high concentrations, demonstrating that deca-BDE can be absorbed by biological systems². Other studies have shown that deca-BDE can be absorbed by dietary intake in carp, lake trout and rats³. Concentrations in terrestrial animals have been found to be particularly high⁴, and given that animals do not readily absorb deca-BDE (uptake rates are usually in the range of 1-3% of a given dose of BDE-209⁵) this suggests that deca-BDE can bioaccumulate in animals⁶. In some species, such as the European red fox, BDE-209 contributed as much as 70% of the total PBDE content of animal tissues⁷. Additional studies will be shortly in press showing deca-BDE breakdown by rats, birds and cows⁸. More significantly, deca-BDE can be metabolized by some of these animals to the more toxic lower congeners; carp in particular seem to be able to debrominate deca-BDE to penta-, hexa-, hepta- and octa-BDE⁹.

Deca-BDE breaks down in the environment into more toxic lower congener PBDEs

Deca-BDE debrominates into lower congener PBDEs when exposed to sunlight or ultraviolet light. The rate of debromination can vary from a few minutes to hours to up to several years depending on whether the deca-BDE is dissolved in organic solvents or water or is adsorbed on to sediment and minerals. Deca-BDE dissolved in organic solvents breaks down within minutes while deca-BDE adsorbed on to wet sand or soil breaks down within hours or days¹⁰. In soils, sediments and house dust, deca-BDE exposed to sunlight debrominates to hepta-, octa- and nona-BDEs. Deca-BDE dissolved in water or organic solvents breaks down into tri-, tetra- and penta-BDE congeners¹¹.

Debromination of deca-BDE can also occur as a result of metabolism by bacteria in sewage sludge¹². Two studies have shown that debromination of deca-BDE by microbes in an anaerobic environment produce nona- and octa-BDE congeners, although the debromination takes place over a timescale of months. Of greater concern is that a 2006 study conducted by scientists at the University of California at Berkeley and the Lawrence Berkeley National Laboratory has shown that the octa-BDE can be further debrominated into hexa-, penta- and tetra-BDEs by different subsets of anaerobic bacteria.

Deca-BDE is present in our homes, workplaces, consumer products, air and food

Deca-BDE has been found in house dust at concentrations up to 10,000 ppb and can comprise up to 90% of the total PBDEs in dust¹³. Deca-BDE has been found in the organic film that develops on win-

dows in urban areas¹⁴. Total PBDE concentrations were 1.5 to 20 times higher on samples obtained from inside the windows than from outside the windows, suggesting that most PBDE sources are indoors. Deca-BDE was the predominant congener found in indoor window films, comprising over 50% of the total PBDE concentration¹⁵.

A January 2006 study of dust and windshield film samples from automobiles showed deca-BDE to be the most common congener in interior automobile dust, consistent with its use in automobile textile backings, wire insulation and other automobile interior applications. Interestingly the concentration of deca-BDE in interior windshield film samples was very low or absent, suggesting that exposure to sunlight contributes to rapid breakdown of deca-BDE in automobiles¹⁶.

Market basket studies of food in U.S. grocery stores show that a wide variety of foods are contaminated with PBDEs¹⁷. Fish, meat and dairy products contain the highest levels of PBDEs proportionate to fat content, and while penta-BDE dominated most of the samples, deca-BDE predominated in at least one fish sample. Studies from Japan, Canada and Spain show similar ubiquitous PBDE contamination of food globally¹⁸ and a very recent study from Spain reports the first detection of BDE-209 breakdown products in food¹⁹.

Deca-BDE and overall PBDE concentrations in humans continue to increase

Levels of PBDEs in the human population have been rising steadily for the past thirty years and concentrations are doubling approximately every five years²⁰. Deca-BDE levels are rising along with

the levels of other PBDEs in the general population²¹. Deca-BDE has been measured in human blood and breast milk²² and at high levels in electronics recycling workers²³. Of greatest concern is that children appear to be receiving a higher exposure to PBDEs than adults, most likely from breast milk and house dust²⁴. One U.S. study found BDE 209 concentrations

up to 230 ppb in an 18-month-old boy²⁵. These exposure levels in children are close to levels of BDE-209 known to generate developmental and neurotoxic effects in laboratory animals²⁶.

Industry claims that consumer products containing deca-BDE in U.S. homes are an unlikely route of human exposure to PBDEs. A Canadian research team

used measured and modeled concentrations of PBDEs in indoor and outdoor air, soil, dust and food to estimate exposures to total PBDEs and concluded that inadvertent ingestion of house dust is the largest contributor to exposure for both children and adults, except for infants, for whom breast milk is another significant source²⁷.

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