# Brominated Flame Retardants: What Your Kids, Cats, Couch, TV, and Food Chain Have in Common

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Several decades of research have shown that the flame retardants commonly used in furniture, mattresses, infant car seats, and electronics are increasingly found in humans and wildlife. Many of the commonly used brominated flame retardants – PBDEs (Polybrominated Diphenyl Ethers) are persistent, toxic chemicals that are now widespread in the environment. Far from benign, they have been shown to be endocrine disruptors and mutagens. PBDEs have demonstrated adverse effects on the immune system, thyroid function, reproductive effects, and cause developmental neurobehavioral toxicity. They are suspected of contributing to learning disorders and attention deficit disorders. Although many of the flame retardants have been shown to have adverse health effects, most lack critical toxicity data. Dust and breast milk studies show much higher levels of toxic flame retardants from our furniture in California, and Californians, than other states. This is likely to have huge health and environmental costs for our state.

**Flame Retardants in Kid's Pajamas**

"In the 1970s, the flame retardants brominated Tris [tris(1,3-dichloro-2,3-dibromopropyl) phosphate] and chlorinated Tris were removed from children's sleepwear after being shown to be mutagenic and absorbed through the skin into children's bodies. Today, chlorinated Tris is the second most commonly used fire retardant in furniture," says Arlene Blum, a biophysical chemist who was instrumental in getting the ban on Tris in kids nightwear, and who has been working on the flame retardant issues for decades. Tris is still widely used, especially in furniture, but no longer in pajamas. There are regulatory proposals to increase fire standards and Tris is one of many similar chemicals that could be used to meet standards for children's toys and pillows.

**Brominated Flame Retardants**

Many flame retardants are brominated. Some of these brominated flame retardants (BFRs) are similar in structure to PCBs (polychlorinated biphenyls) and PBBs. All are persistent, bioaccumulate in living organisms, are highly mobile in the food chain, and are toxic.

The most widely produced brominated flame retardants are decaBDE(decabromodiphenyl ether), TBBPA (tetrabromobisphenol A), and HBCD (hexabromocyclododecane). While decaBDE is used in electronics and TVs, pentaBDE (pentabromodiphenyl ether) has been the major product in furniture and cushions. Banned in Europe and the U.S. since 2004, pentaBDEs will continue to emanate from furniture and textiles for many years. Furthermore, decaBDE also appears to break down into lower more toxic forms, including pentaBDE.

**Brominated Flame Retardants Now Listed as Persistent Pollutants**

Substances found to accumulate in the environment pose special hazards to living organisms, and, thus, government agencies have regulated these types of chemicals known as Persistent Bioaccumulative Toxins (PBTs) or Persistent Organic Pollutants (POPs). These chemicals are usually fat soluble,

hydrophobic, and poorly metabolized. They travel long distances and move readily from land, air, water, and within migratory species. These chemicals have been found in high levels in whales, polar bears, and seals, as well as other mammals around the world. As these persistent chemicals migrate up food webs, they have unintended consequences on wildlife and humans. The Stockholm Convention on Persistent Organic Pollutants was ratified by 131 countries in 2004 to eliminate the worst offenders. The original dirty dozen toxic substances included DDT and PCBs. Brominated flame retardants were just added to this infamous list.[1]

**Highest Levels of BFRs in Californians and Children**

Flame retardants migrate out of our textiles, foam, and electronics. PBDEs are often an additive to the product and do not stay in the product, but slowly give off gas for years. They are found in high concentrations in indoor environments including house dust, vacuum cleaner bags, and washing machine effluent. A 2003 study on BFRs in the blood of San Francisco Bay Area women from the 1960's confirmed earlier studies showing a dramatic rise in BFR concentrations. Levels measured from samples from the 1990s reveal levels in California women to be 3 to 10 times higher than in Europe, in the same period. ***Stored samples from the 1960s showed no polybrominated diphenyl ether (PBDE) contamination present.***[2]

Levels are steadily increasing. Scientists at the Cal EPA Department of Toxic Substances Control announced, in 2004, that they had found that California seabird eggs have by far the highest levels of PBDEs measured in wildlife in the world.[3]

Concentrations measured in children are the highest because they crawl on the floor and furniture and then ingest the dust from their hands or toys. Nursing babies are at the top of the food chain. A well publicized study of an Oakland family showed the highest levels measured of PBDEs.[4] The toddler and infant studied had respectively 7 and 10 times higher levels of PBDEs than the parents. House dust contains PBDEs in significant amounts. The U.S. EPA estimates that children ingest on average 100 milligrams of house dust per day. The infant had a much higher level than the toddler or parents. This could be accounted for by breast feeding adding more PBDEs to the mix.

**Toxicity of Brominated Flame Retardants**

Studies have shown that brominated flame retardants can cause developmental neurotoxicity affecting learning, memory, and alter habituation behavior in mice.[5] Fetal and neonatal exposure to neurotoxicants can adversely affect brain development, especially in critical brief windows of rapid brain growth.

This may be due to interference with thyroid hormone balance. Studies have shown PBDEs to act as hormone disruptors. Zhou showed a reduction in L-thyroxine with exposure to PBDEs in mice.[6] Ilonka, *et. al.* found that PBDEs, which resemble the hormone L-thyroxine (T4 ), bind competitively with transthryetin, a protein found in serum and cerebral spinal fluid, which transports L-thyroxine. A striking finding was that many of the flame retardants studied were more powerful than T4 in their binding capacity.[7]

Some brominated flame retardants have been shown to activate breast cancer cells and stimulate or inhibit aromatase. Unfortunately, much more research needs to be done on these compounds that are increasing and that are being substituted with other compounds of questionable safety. Firemaster 550 replaced pentaBDE, in 2004, and is now found in dust and sewage sludge. Chemical analysis showed it to contain Bis(2-ethylhexyl) tetrabromophthalate and three other probable toxins. Reproductive and developmental neurotoxicity studies are to be completed by 2009. Firemaster 600 will replace Firemaster 550 in December 2008.

**Fire Retardants Appear Especially Toxic to Cats**
Scientists at the Environmental Protection Agency have noted a possible connection between thyroid disease and flame retardants. Hyperthyroidism has become increasingly common in older cats. Prior to 1980s, it was virtually unheard of. This rise in thyroid disease has paralleled the rise in brominated flame retardants in the environment and also the tissues of cats. Cats participating in the study had 23 to 100 times the levels of PBDEs than people in North America, who already have the highest levels measured. Dry cat food had significantly more PBDEs and those cats, which consumed dry food had high levels of PBDEs.[8] Cats also lick their fur and, thus, ingest more PBDEs through dust.

**Recycling and Brominated Flame Retardants**
Greening of ourselves and our planet considers that, ideally, everything we buy or consume can have another life, be recycled, or biodegrade into harmless substances. As flame retardants can be found in everything from computer casings, circuit boards, plastics, paints, paper, polystyrene, carpet backing, a variety of textiles, and foam cushions, an area of concern arises with production and disposal. No labeling is required to determine the identification of flame retardants used. How do we recycle products that have a toxic waste component? In this age of recycling, computer manufacturers are now concerned this will be a major problem as the flame retardants, when added to the plastic, render the casing not only un-recyclable, but also convert it to hazardous waste.

**Fire Risk Assessment**
California passed a stringent fire standards code, TB117, in 1980. Since then, levels of brominated flame retardants in California dust and breast milk have risen dramatically, compared to other states. Just because a retardant has been added to the product doesn't mean it is not combustible. It is just less combustion able. With burning, the flame retardants release toxic dioxins and furans, as well. "There is no fire data to show that 28 years of TB117 has impacted fire deaths in Californians," according to scientist Arlene Blum, a visiting scholar at U.C. Berkeley.

In addition, cigarettes are considered the number-one cause of fire deaths in the U.S., about 600–800 per year. Fire-safe cigarettes have been implemented in 22 states, including California in 2007. Companies state they add speed bumps of extra layers of less porous paper. If unattended, the cigarette will self extinguish, instead of smoldering and possibly starting a fire. Deaths from cigarette related fires reduced by 33%, when New York's law went into effect in 2004.

The question then is where do we really need flame retardants and are there less toxic alternatives? Wool, for instance, is much less likely to burn than polyester. Mark Leno's California Assembly Bill 706, if passed, will address some of these issues and begin using hazard assessment for moving to safer alternative chemicals.

**Limiting Exposure**
Aside from avoiding products with flame retardants (i.e., polyurethane foam, TVs) in the home, these tips may help to reduce exposure:

- Keep house as dust-free as possible.
- Use a vacuum cleaner with hepa or other high efficiency filter.
- Keep house well ventilated.
- Cover mattresses with dust covers.
- Wash bedding regularly to control dust.
- Turn off electronics that are not in use. Standby mode maintains temperatures that can result in continuous off-gassing.

Ultimately, government regulation, both locally and on an international level, will be necessary to replace these poorly studied dangerous chemicals with safer alternatives that are properly studied prior to their use. Otherwise, we are just trading one danger for another that may have more catastrophic and global consequences. Green chemistry alternatives will be safer for our children, ourselves, and the environment.

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