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FLAME RETARDANTS CHEMICALS

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What are flame retardants?

Flame retardants are single chemicals or mixtures of chemicals that have been added to many consumer products for decades to reduce their flammability. Concern over the use of flame retardants (FR) began in the 1970's, when halogenated flame retardant chemicals were used in children's pajamas. A landmark study showed higher levels of the FR chemical 'brominated tris' in children after they slept in pajamas treated with this chemical, which was also known to be mutagenic and potentially carcinogenic.¹ Brominated tris was banned, and a close relative chemical, chlorinated tris, was also removed from the market (but not banned).

Beginning in the late 1970's and continuing to present day, flame retardant chemicals have been added to consumer products like couches, chairs, and upholstery. There are hundreds of possible flame retardant chemicals on the market, although only a subset has received attention in the scientific literature. Polybrominated biphenyls (PBBs) were used in products until they were phased out in 1976 after a labeling accident led to widespread exposure of animals and people in Michigan.² The main supplier of PBBs also produced animal feed supplement, and for a period of time mislabeled the flame retardant mixture as animal feed, thereby contaminating millions of animals with PBBs. This led to the culling of millions of animals, and the widespread uptake of this chemical into the food chain. PBBs were replaced by a very similar set of chemicals called PBDEs (polybrominated diphenyl ethers), which were used for decades until the mid-2000s, when these replacement chemicals were also banned. These chemicals, however, are highly persistent and can still be found in the environment across the globe despite having been phased out.³ There are many PBDE replacement flame retardant chemicals currently on the market, including chlorinated tris (originally removed from the market, but not banned, after the issue with the children's pajamas in the 1970's). Chlorinated tris belongs to a class of flame retardant chemicals known as phosphate flame retardants⁴, which include other chemicals such as tris (2-chloroethyl) phosphate, tris(1-chloro-2-propyl) phosphate, and triphenyl phosphate. Another flame retardant mixture identified by chemical manufacturers as a drop-in replacement for the phased out PBDE mixture is Firemaster 550, which is mostly used in upholstered furniture although may also be found in electronics.

How are we exposed to flame retardants?

Flame retardant chemicals have been manufactured and used since at least the 1960s. To meet a 1975 law passed in California that set performance-based flammability standards (TB117) for upholstered furniture and baby products, flame retardant chemicals were added to furniture and baby products at up to 5-30% of the total weight of a product.^{5,6} Because most of these chemicals are used as additives and are not covalently bound to materials in the consumer product, they can migrate from the product into air and dust.^{7,8} Therefore, a primary route of exposure to these chemicals is through inhalation and incidental ingestion of dust.⁹⁻¹¹ Many of these chemicals are also lipophilic compounds ("fat loving") so once they enter the body they accumulate in fatty tissues. They also bioaccumulate in the food web, resulting in a third important route of exposure – ingestion of contaminated food.¹⁰⁻¹²

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Because of these properties (widespread use for decades; persistent in the environment; lipophilic and bioaccumulative), flame retardant chemicals are ubiquitous in the natural and built environments. They are detected in the blood of nearly all people in the U.S., are routinely found in homes, offices, cars and airplanes, and can be detected in wildlife across the planet, even in remote places such as the arctic.¹²⁻²⁵

Why are chemical flame retardants a health concern?

There is extensive data concerning the adverse health effects of banned or phased out chemical flame retardants such as brominated and chlorinated tris and PBDEs. PBDEs were the most abundantly used flame retardant until 2005, when they began to be phased out of production and use in the U.S. Documented adverse effects of PBDEs include carcinogenicity,^{26,27} neurotoxicity and behavioral deficits,²⁸⁻³⁴ reproductive harm,³⁵⁻³⁸ and endocrine disruption.^{8,34,39,40} PBDE's structural similarity to the thyroid hormone thyroxine (T4), a hormone found naturally in the body, is a major contributor to its ability to alter normal thyroid hormone levels. The U.S. Consumer Product Safety Commission estimated that children's exposure to chlorinated tris, a widely used replacement for PBDEs and previously found in many consumer products, is 2-5 times higher than what is safe and acceptable.⁴² Chlorinated tris has since been found to be a two-sex carcinogen, among other health effects, and it is being phased out of use.⁴³ While several flame retardant chemicals have been phased-out or banned because of health concerns, they are frequently replaced by substances with similar chemical structures (and potentially similar toxicity profiles). However, adequate toxicological and human epidemiological data are lacking for many widely used flame retardant chemicals.

What can I do?

Fortunately, the California standard (TB117), compelling the widespread use of chemical flame retardants in upholstered furniture and baby products, has now been revised (TB117-2013). Products can meet strict flammability standards without the use of chemicals, and, in California, a new labeling law requires furniture to indicate whether the product contains added flame retardants or not. For the first time, consumers can choose products without these chemicals. Further, in many public buildings with automatic sprinkler systems, the use of these chemicals in upholstered furniture is unnecessary. Purchasers and designers can specify products that are free of flame retardant chemicals. Harvard has authored a pledge to not use these chemicals in upholstered furniture in spaces where permitted by law.



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