POLICY CHANGES COULD REDUCE THE USE OF FLAME RETARDANTS WHILE MAINTAINING FIRE SAFETY

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Introduction

The recent phase out of PBDEs has led to regrettable substitutions with other halogenated and phosphate flame retardants known to be problematic or lacking adequate toxicological information. In some cases, flame retardants are being used to meet flammability standards that do not provide a significant fire safety benefit. Changing flammability standards so that flame retardants are not needed, while maintaining fire safety, can be a more effective strategy for protecting public and ecological health than regulating individual flame retardants.

For example, flammability regulations for furniture, plastic foam building insulation, and other products were established in North America starting in the 1960s and 1970s in an attempt to address escalating fire deaths and injuries. Halogenated and phosphate flame retardant chemicals have been used as a cost-effective means of complying with these regulations.[1,2] Recently, the use of flame retardants for furniture foam and foam plastic building insulation has been questioned based on:

1. Scientific studies associating some flame retardant chemicals with adverse health effects[1–4, 6–15]
2. Research finding a lack of fire safety benefit from flame retardants at levels and conditions typically used[3,4]

This paper will discuss impacts of flammability regulations for upholstered furniture and foam plastic insulation materials, including: flame retardant chemicals used to achieve compliance; recent policy changes affecting flammability regulations; and the potential effects of these changes on fire safety and flame retardant use.

Materials and methods

We conducted a literature review pertaining to fire behavior of, flame retardants in, and regulations for upholstered furniture foam and foam plastic building insulation materials. We also reviewed published standards and regulations governing the flammability of those materials. Interviews with legislators and subject experts, as well as in-person attendance and participation at public meetings, further informed this work.

Results and discussion

Upholstered Furniture:

The California residential furniture flammability standard Technical Bulletin 117 (TB117), implemented in 1975 by the Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation (BEARHFTI), required foam inside upholstered furniture to withstand a small open flame for twelve seconds.[5] For some filling materials, including polyurethane foams, this test was usually met by adding chemical flame retardants. Due to the size of the California market, liability concerns, and a desire to eliminate dual inventory, TB117-compliant furniture eventually became common across the United States and Canada.[2]

Flame retardants used in polyurethane furniture foam include pentabromodiphenyl ether (PentaBDE), *tris*(1,3-dichloroisopropyl) phosphate (TDCPP), and non-halogenated phosphate flame retardants, with a greater variety of flame retardants used since the 2005 phase-out of PentaBDE.[2] Many of the newer flame retardants, often organohalogens and phosphates that are similar in structure to phased-out flame retardants, do not have adequate health data. Numerous studies have linked older flame retardant chemicals with adverse outcomes, including persistence, endocrine disruption, cancer, and reproductive, neurological, and immune impairments.[1,6–15]

In 2012, California Gov. Edmund G. Brown Jr. directed BEARHFTI to revise TB117 to reduce the use of toxic flame retardant chemicals.[16] TB117 was updated in 2013 to a smolder test for assemblies of fabric, foam, interliner, and decking materials. The smoldering source is applied to cover fabrics, where fires start.[17] This new furniture flammability regulation, Technical Bulletin 117-2013 (TB117-2013), took effect on January 1, 2014 and will be mandatory for all new furniture manufactured for sale in California beginning January 1, 2015.[18,19]

Because smoldering ignition sources are the primary cause of home furniture fires with fatalities, TB117-2013 is expected to provide increased fire safety relative to TB117.[20,21]. Additionally, the California BEARHFTI will conduct a study of fire barrier technologies that could potentially be used to meet open flame test requirements.

The updated standard can be met without flame retardant chemicals. As a result, some retailers and manufacturers have begun complying with TB117-2013 without using added flame retardants, and many others have stated intent to do so. However, other manufacturers have expressed concern about removing flame retardant chemicals from furniture foam. Several factors contribute to this uncertainty:

- In January 2014, Chemtura, the leading manufacturer of flame retardants for use in California furniture, filed a lawsuit against the State of California on the grounds that TB117-2013 violates state law, which it claims requires residential furniture to meet an open flame standard. TB 117-2013 contains only a smolder standard. The suit asks that TB117-2013 be declared void, and that the original TB117 be reinstated.[22]
- Other regulatory and standard-making bodies, including the National Fire Protection Association (NFPA) and the Consumer Product Safety Commission (CPSC) have announced plans to investigate or develop open flame flammability standards for upholstered furniture, citing a void left by TB117-2013.

Open flame standards like the original TB117 often lead to the use of flame retardant chemicals in furniture foam, fabric, or barrier materials. If the State of California were forced to reinstate TB117, or if the NFPA or CPSC were to develop new open-flame standards, furniture manufacturers are concerned that they would need to use flame retardant chemicals to affordably achieve compliance. Thus, some manufacturers may continue to use flame retardants in furniture foam even though they are not needed to pass current regulations.

In Europe, proposed changes to the U.K. 1988 Furniture and Furnishings (Fire) (Safety) Regulations (FFRs) could reduce the use of flame retardants in furniture fabric. The Department of Business, Innovation and Skills (BIS) which is responsible for the FFRs stated, "Whatever the exact degree of harmfulness, BIS is concerned that this issue [of flame retardant chemicals], if not addressed, could jeopardize the future of the FFRs," citing both consumer concern and resistance from other EU countries due to adverse impacts from flame retardants.[37]

Plastic Foam Building Insulation:

State and local building codes in the United States and Canada are based on model building codes, such as the International Building Code (IBC) and the International Residential Code (IRC). The intent of these codes is to protect public and first-responder safety and health from fire and other hazards. Foam plastic insulation materials, which are affordable and energy efficient, but flammable, are required by codes to meet performance requirements of the fire test ASTM E84. Foam plastic insulation must also be protected against 15 minutes of flash-over fire by a code-compliant thermal barrier such as 0.5 inch thick gypsum wallboard, or equivalent.[23,24] Halogenated flame retardant chemicals are added to these materials to achieve compliance with ASTM E84 requirements. Polystyrene insulations contain hexabromocyclododecane (HBCD) at levels of about 0.7% for expanded polystyrene (EPS) and 2.5% for extruded polystyrene (XPS).[25,26] Polyurethane and polyisocyanurate insulations contain *tris*(1-chloro-2-propyl) phosphate (TCPP) at levels of 2 – 25%, depending on the use.[27]

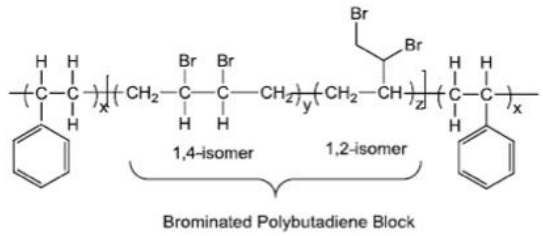

Figure 1. Brominated styrene butadiene copolymer (CAS No. 1195978-93-8).

In 2013, HBCD was listed as a persistent organic pollutant under the Stockholm Convention.[28] Its major replacement in polystyrene insulation is a brominated styrene butadiene copolymer (Fig. 1), synthesized by Dow Chemical Company and termed "PolyFR." Dow has licensed production of this compound to Chemtura, Albemarle, and ICL, where it is manufactured under the trade names Emerald Innovation™ 3000, GreenCrest™, and FR-122P, respectively. The US EPA Design for the Environment program identified this copolymer as a preferable substitute for HBCD in polystyrene insulation.[29] While marketed as a "non-PBT" (Persistent,

Bioaccumulative, and Toxic) flame retardant, the brominated PolyFR is expected to be highly persistent, and evaluations have been limited to high molecular weight formulations only. Environmental breakdown products of the brominated PolyFR have not been studied, and low molecular weight formulations or impurities may be PBT. Dust formation of the brominated PolyFR may be of concern due to a potential for lung overloading.[29] Questions remain about the life cycle of PolyFR, including possible occupational exposures to manufacturing workers and insulation installers, and potential environmental impacts from degradation products.

Studies have shown that compliance with the ASTM E84 requirements does not significantly improve fire performance of insulation within a wall cavity; compliant insulation has also been shown to perform poorly in fire tests of exposed or bare foam.[30–32] It can be argued that ASTM E84 requirements leading to flame retardant use in foam plastic insulation do not contribute to building fire safety.[4]

In 2013, California Assembly Member Nancy Skinner sponsored Assembly Bill 127 to allow for a reduced use of flame retardants in foam insulation where they provide no fire safety benefit. The bill instructs the State Fire Marshal to review and possibly propose updates to flammability standards in the California building codes that could allow manufacturers to meet fire safety requirements with or without the use of flame retardant chemicals.[33] The review process is under way and may lead to exemptions from ASTM E84 for foam plastic insulation used below grade between cement and soil, or separated from habitable spaces by a thermal barrier.

Plastic foam insulation is one of the leading uses of flame retardant chemicals, accounting in 2008 for approximately 80% of TCPP use and 90% of HBCD use.[25,27] Current projections estimate that production of the polymeric replacement for HBCD will exceed 25,000 MT by the end of 2014.[34] As energy efficiency becomes a priority in mitigating climate change, the use of foam plastic insulation is expected to increase. If the ASTM E84 requirements are waived for some applications of foam plastic building insulation, the use of flame retardant chemicals in these materials could be reduced.

While California represents only a portion of this flame retardant use, a change in the California Building Code could serve as a catalyst for similar changes in other state building codes or in the International Code Council model codes, which are on a three-year revision cycle. Proposals were made to the 2015 International Residential Code (IRC) to exempt certain uses of foam plastic insulation from ASTM E84 testing and failed after substantial discussion at code hearings.[35] Such efforts are expected to continue, especially because the brominated PolyFR replacement for HBCD in polystyrene insulation appears to be a chemical of concern.

It is notable that in Scandinavian countries like Sweden and Norway, regulations do not mandate foam insulation fire tests that are met with flame retardant chemicals. Foam building insulations in these countries consequently do not contain flame retardants.[4, 36] While a direct comparison of fire statistics across different countries cannot be made, there is nothing to suggest that fire losses in these countries are greater due to the use of flame retardant-free foam insulation materials.

Conclusions and Recommendations:

New policy decisions pertaining to flammability standards consider both fire safety and the possible health and ecological impacts of flame retardant chemicals. Increased awareness of potential health concerns and a lack of proven fire safety benefit from flame retardants as used in upholstered furniture and some applications of plastic foam insulation have shifted thinking among some decision makers about appropriate flammability regulations.

Flammability standards in California have had a national impact on upholstered furniture, and may potentially impact plastic foam building insulation in other jurisdictions. TB117-2013 maintains, or possibly increases, fire safety in home furniture while enabling manufacturers to use foam without added flame retardant chemicals

Some European countries already have flammability requirements that allow for flame retardant-free building insulation foams. California could be the first U.S. jurisdiction with similar requirements, as AB 127 may allow manufacturers of plastic foam insulation to meet fire safety standards without added flame retardants.

Updated flammability standards may provide better reproducibility and correlation to real-life fire scenarios. Further study is needed to determine the extent to which fire safety and flame retardant use may be impacted by

the new TB117-2013 or possible changes to the California building codes. Further study is also needed to improve understanding of health and ecological impacts of flame retardants, including the PolyFR flame retardant and its breakdown products, and to quantify emissions of flame retardants through product lifecycles.

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