ENVIRON

Industry Use of Brominated Flame Retardants in Electronic Equipment

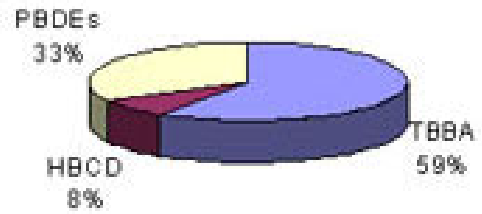
PBB

Polybrominated biphenyl (PBB's) compounds have historically been used in electronic equipment, however worldwide production of such compounds ceased in May 2000 due to concerns over the compounds being potential endocrine disrupting chemicals. PBBs have not been produced in the U.S. since 1976.

PBDE

Polybrominated diphenyl ethers (PBDE's) continue to be used in electronic products, on a limited basis, primarily in plastics. The three commercially available types are penta BDE, octa BDE and Deca BDE. Due to legislative and market pressures, however, the use of PBDEs in electronics is declining sharply. By 1999, the use of PBDE flame retardants in electronic equipment had fallen to 33%.

Demand for brominated flame retardants in electronic equipment in 1999[1]



- Penta-BDE is used primarily in flexible polyurethane foam for furniture and upholstery, and to a lesser extent in rigid plastics and adhesives, and may make up 10% by weight of the finished product. Manufacture of Penta-BDE in the EU ceased in 1997 and usage rates have fallen steadily in the past decade.

- Octa-BDE is used in high-impact plastic products, such as housings for FAX machines and computers, automobile trim, telephone handsets and kitchen appliance casings.

- Deca-BDE is used in plastics, such as wire and cable insulation, adhesives, coatings and textile coatings. Typical end products include housing for television sets, computers, stereos and other electronics and audiotape cassettes.

PBB and octa- and penta-BDE flame retardants will be banned under the RoHS Directive. The marketing and use of penta-BDE and octa-BDE is banned in EC member states from 15 August 2004 onwards. However, the findings of an EU risk assessment published in July 2004 allow the continued use of deca-BDE.

[1] Bromine Science and Environmental Forum, July 2000.

TBBA

Tetrabromobisphenol-A (TBBA) is widely used as a flame retardant in printed circuit boards. Approximately 96% of printed circuit boards contain TBBA. A typical printed circuit board may contain 1-2% TBBA content[2].

TBBA is not banned under the RoHS Directive. However, Annex II of the WEEE Directive requires any plastics containing brominated flame retardants to be removed from any separately collected WEEE for separate disposal.

TBBA is used both as a reactive flame retardant (primary use, where the chemical reacts with and is chemically bound to the polymer) or as an additive flame retardant (mixed with the polymer before it sets). Limited viable alternatives have been found for TBBA's use as a reactive flame retardant that equal TBBA on cost, fire safety and human health risk.

Electronics OEMs, industry associations and suppliers are evaluating the technical and environmental aspects of halogen-free board materials such as organophosphorus and metal hydroxides. When assessing the feasibility of using halogen-free flame retardants in printed circuit boards, it is important to assess both the technical feasibility of using these compounds as flame retardants along with the potential toxicity and/or environmental risks.

In the mean time, to comply with WEEE Annex II requirements and ensure products meet fire safety requirements, many electronics companies use TBBA in circuit boards and triarylphosphate esters (halogen-free) in mechanical plastic parts.

EHS impacts of Brominated Flame Retardants

Brominated flame retardants have received negative publicity over the past decade due to concerns over the environmental and toxicological risks posed by certain brominated compounds upon disposal and/or incineration, particularly in Japan and Europe.

Plastics (many of which contain flame retardants) represent an average of 20% by weight of current electronic products; in areas where landfill space is limited (i.e. Japan) significant amounts of plastics from waste electronic products are incinerated upon disposal. Upon incineration, certain flame retardants (PBBs and some PBDEs) have the potential to form dioxin compounds which are released into the environment and can have adverse human health and ecological effects.

According the Bromine Science and Education Forum (BSEF), concerns over dioxin and furan formation during incineration have been rendered a thing of the past by the advanced incinerator technology that is now available (incinerate at temperatures >800 F). As to any potential risk due to exposure to dioxins and furans from accidental fires, studies have shown that even firefighters who face a high number of accidental fires are not adversely affected.

In 1995, the World Health Organization (WHO IPCS) undertook a full scientific assessment of the environmental and human health impacts of TBBPA. Key findings from this study [3]

[2] HDPUG DfE Project, published in 2003 IEEE/ISEE Symposium proceedings

indicated: (1) TBBPA has little potential for bioaccumulation, (2) environmental detection is limited to very few sediment/soil samples, and (3) the human health risks associated with TBBPA for the general population is considered to be insignificant.

Because of its chemical structure and use as a reactive flame retardant, TBBA has very low potential for formation of significant levels of dioxins/furans upon disposal[4]. A study presented at the Dioxin 99 conference showed no evidence of adverse endocrine effects of TBBA.

A recently completed study (ERGO, 2002) examined the consumer exposure to TBBPA from computer monitors. Emissions were studied in a chamber experiment and in a real-office experiment. Measured emissions were in the range of 1 ng/m3 and were found to decline during the lifetime of the product. The study found that all emissions were coming from the housing material (additive application of TBBPA), no emissions from the printed circuit boards could be detected (reactive application of TBBPA[5]).

Phosphorus-based flame retardants have not been shown to form dioxins or furans upon incineration. Little to no data has been published regarding the leachability of phosphorus-based flame retarded material upon landfilling.

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[3] Source: WHO (IPCS) Environmental Health Criteria 172, Tetrabromobisphenol-A and Derivatives, 1995. Available online at http://www.inchem.org/documents/ehc/ehc/ehc172.htm.
[4] Ranken et al., Bul. Soc. Chim. Belg., 103/5-6, 1994 (US EPA study)
[5] EFRA Flame Retardant Fact Sheet on TBBPA, available at : http://www.cefic-efra.org/frames/f_how_fr_work.html?=how_fr_work.html