

FACT sheet

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Brominated Flame Retardant **TBBPA**

Tetrabromobisphenol A

for Printed Circuit Boards
and ABS plastics

> Introduction

Brominated flame retardants are well recognized as being highly effective flame retardants. TBBPA¹ is the brominated flame retardant with the largest production volume today and is used to improve fire safety, mainly of laminates in electrical and electronic equipment. It is produced in Israel, the United States, Jordan, Japan and China. The use of TBBPA is permitted worldwide.

> Applications and fire safety

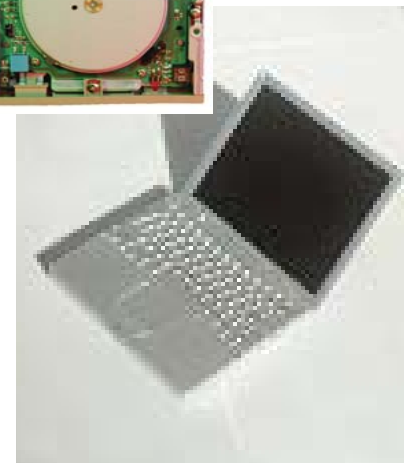
■ TBBPA contributes to the fire safety of electrical and electronic equipment and installations where printed circuit boards are used, such as consumer electronics (TVs, vacuum cleaners, washing machines etc), office and communication equipment (copiers, computers, printers, fax machines, radios, etc), automotive, aviation and all entertainment equipment .

■ In particular, TBBPA provides the necessary ignition resistance to comply with stringent fire safety standards such as UL 94 V0 - a standard for flammability of electronics with circuit boards and plastic materials for parts in devices and appliances.

■ The main application of TBBPA is in Printed Circuit Boards (PCB) or laminates. It is used in more than 95% of FR-4 printed wiring boards, the most commonly used board in electronic devices. In this application, TBBPA is a reactive flame retardant, in other words, it no longer exists as a free chemical in the final board but forms part of the polymeric backbone of the resin.

■ TBBPA is also used as an 'additive' flame retardant, mainly in ABS² plastic housings.

■ In addition, TBBPA is used as an intermediate in the production of other brominated FR systems, derivatives and brominated epoxy oligomers where it is integrated into the resin as well.



> Health and Environmental Profile

■ The EU Risk Assessment³ and WHO⁴ have established that TBBPA presents no risk to human health.

■ European Union studies twice have shown that exposure to TBBPA from consumer products is insignificant, or not detectable, depending on the application.

■ The EU environment Risk Assessment identified no risk to the environment when TBBPA is used in reactive applications such as printed circuit boards.

■ The product has been found in limited biota and sediment samples



which are linked to industrial emissions sites.

■ In Europe, TBBPA as a substance is classified as R50/53 (toxic to aquatic species), but it loses this classification when it is reacted into the PCB resin, which represents more than 80% of its uses.

■ For waste management, several studies have demonstrated that TBBPA is fully compatible with integrated waste management concepts used today to recycle various parts of the printed circuit boards

■ Because of its chemical structure, TBBPA has very low potential for formation of significant levels of dioxins/furans during recycling.

■ Among the available flame retardants for the production of printed circuit boards, TBBPA is by far the best researched from a health and environmental point of view.

> TBBPA in Europe



■ TBBPA has undergone an EU Risk Assessment for the Environment and Human Health. The conclusions of the EU Risk Assessment were published in the EU Official Journal on 18 June 2008.

■ In May 2005, the human health part of the Risk Assessment report concluded that TBBPA posed no risk to human health. No health effects were identified and consumer exposures were negligible. In addition, the low levels of exposure for regional exposure scenarios also revealed no human health concerns. Comparison of the exposure data with data available for repeated exposure toxicity and reproductive toxicity has provided reassurance that there were no issues of potential concern.

■ The Environment part of the Risk Assessment Report was finalised on June 2007. Experts found no risk concerns to the environment when TBBPA is used as a reactive component in printed circuit boards, and a low risk on the environment (water and sediment) when TBBPA is used as an additive to plastics. Potential risk was identified when sludge containing TBBPA is applied to agricultural soil.

■ A Risk Reduction Strategy (RRS) was drafted to address the local risk identified and recommended to reduce emissions only at one ABS compounding site in Europe through

IPPC (Integrated Pollution Prevention and Control Directive). This site has recently closed.

■ In 2006 industry initiated a Voluntary Emissions Control Action Programme (VECAP) with users. To date, all additive users in Europe have joined VECAP and are reducing emissions.

■ There are no legislative restrictions on the use of TBBPA in Europe.

■ TBBPA is not part of the substances restricted by the RoHS Directive⁵. On 3 December 2008, the European Commission released a text for the revision of the RoHS and did not add any new substances. The proposed text lists four substances in a new Annex for priority review at a later stage but TBBPA is not included.

■ The Directive on Waste of Electrical & Electronic Equipment⁶ (WEEE) aims to reduce the amount of waste being produced by encouraging re-use, recycling and recovery. The Directive requires that plastics containing brominated flame retardants, including TBBPA, and printed circuit boards greater than 10 cm² are given separate treatment from other collected WEEE. However, recent technical studies and legal reviews⁷ demonstrate that TBBPA is compatible with the Directive and its objective to directly include plastic waste with brominated flame retardants in integrated waste

management systems (such as incineration, mechanical recycling, energy recovery systems) without the need to separate these plastics from other collected plastics. Furthermore, trials have demonstrated that printed circuit board waste can be handled on a large scale in metal smelter plants without leading to any environmental health or safety concerns.

■ TBBPA is part, among other substances, of an EU initiative to evaluate potential endocrine disrupting effects. EU scientific experts have reported initial results showing “no major endocrine effects” from TBBPA⁸.

■ As a BFR, TBBPA is covered by the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic. OSPAR is committed to base any future decision on TBBPA on the conclusions of the EU Risk Assessment.

¹ CAS number: 79-94-7

² ABS Plastics: Acrylonitrile-butadiene-styrene plastics used in a large number of applications: e.g. Plastic casing for TVs and other electronic devices

³ TBBPA EU Risk Assessment report for Health & the Environment can be found at: <http://ecb.jrc.it>

⁴ World Health Organisation International Programme on Chemical Safety (IPCS): Environmental Health Criteria 172 : Tetrabromobisphenol A and Derivatives, 1995

⁵ Directive 2002/95/EC of the European Parliament and of the Council - 27 January 2003 – on the restriction of the use of certain hazardous substances in electrical & electronic equipment

⁶ Directive 2002/96/EC of the European Parliament and of the Council - 27 January 2003 – waste electrical and electronic equipment (WEEE)

⁷ See Ebfrp position paper at: <http://www.bsef.com/newsmanager/newstemplate.php?id=186>

⁸ <http://www.credocluster.info/fire.html> and latest newsletter of January 2006: <http://www.credocluster.info/docs/newsletter/credonews5.pdf>

> TBBPA in Asia



- The use of TBBPA is not subject to any regulatory restriction in Asia.
- TBBPA is produced by several manufacturers in Japan and in China.

■ Asia's significant use of TBBPA is linked to a dominant electronics industry in Taiwan, Korea, China and Japan.

■ The major application of TBBPA in Asia is as a reactive flame retardant (more than 80% of the total use) in either FR-4 resins to produce PCB laminates, or as a building

material for brominated epoxy oligomers and polymers.

■ In Japan, the government has recognized that TBBPA is not bioaccumulative or toxic to human health. Tests conducted by authorities have demonstrated that the chemical is safe and that there is no need for further tests to be conducted.

> TBBPA in the United States



■ TBBPA is produced by two producing companies in the US and allowed usage without any restrictions.

■ TBBPA is listed as a SARA 313 substance and therefore manufacturers, users and processors may need to report TBBPA released into the environment to the US Environmental Protection

Agency each year. The BSEF members making and importing TBBPA inform all of their customers of this reporting requirement on an annual basis.

> BSEF Emissions Control Programme

■ In 2000 BSEF initiated the first detailed assessment of TBBPA levels in the environment, conducted in Northern Europe by the Dutch Institute for Fisheries Research (RIVO). Data showed that levels found in the environment were in the low ppb (part per billion) range and related to industrial sites of user industries, since TBBPA is not manufactured in Europe.

■ BSEF has implemented a programme to manage TBBPA in Europe and in the US, the Voluntary Emissions Control Action Programme (VECAP™).

■ The objective of VECAP is to control emission levels of TBBPA in



both water and sediment and to handle any waste produced during industrial usage.

■ BSEF is working on this programme together with user industries. A Code of Good Practice was established to support users in their efforts to manage TBBPA, including advice on the best ways to store, handle

and use products and how to best dispose of waste.

■ To date in Europe almost all additive customers and more than 70% in volume of reactive users have committed to VECAP.

For more information on VECAP please consult: www.vecap.info

Summary:

- TBBPA has been through a thorough risk assessment by the European Union without risks identified to human health or the environment in its main use as a reactive flame retardant in printed circuit boards
- TBBPA complies with all current European Directives
- TBBPA has no restrictions on its use

For further information on Brominated Flame Retardants, please visit:

www.bsef.com

BSEF is the international organisation of the bromine chemical industry, whose remit is to inform stakeholders and commission science on brominated chemicals such as flame retardants