This report is designed to provide transparent and concise information on the progress of the Voluntary Emission Control Action Programme (VECAP). Any feedback or comments are welcome and will be considered for future editions.
Second year of EBP reporting allows comparable data and shows excellent progress.

- Over 80% coverage of the total 2013 volume for the four common brominated flame retardants sold by EFRA member companies.
- Potential emissions to land remain zero for DECA-BDE, TBBPA and HBCD.
- Important decrease in the potential emissions to land for EBP, dropping by about 35%.
- New focus given to workers clothing as an identified potential emissions source.
- Empty packaging is being managed responsibly for the majority of the volume sold by EFRA member companies.

VECAP is to CTF2000 not only a programme integrated in our environmental strategy to reduce emissions to the minimum, it also stimulates the opportunity to further analyse our internal processes, to improve continuously our way of working and to share our experiences with both our customers and suppliers.

VECAP has helped us look at every step in our process where potential emissions could occur. It’s not difficult – it’s very effective, and in fact, also very simple to apply.

I have been involved in environmental emissions control throughout my career and it is with great pride that I take over as the European lead for VECAP; a programme that I believe has achieved a great amount in the last ten years.

I strongly believe in VECAP and the success of the programme reflects the hard work of the people involved. It has been a pleasure to work with such a strong team.
INTRODUCTION

The Voluntary Emissions Control Action Programme is a pioneering product stewardship scheme for the responsible management of chemicals in the supply chain; run under the principles of Responsible Care®. VECAP was established 10 years ago by three of the main producers of flame retardants – all members of the Bromine Science and Environmental Forum (BSEF) - together with the UK Textile Finishers association and run by the European Flame Retardants Association (EFRA).

WHAT IS VECAP?

The industry voluntarily developed this programme to take responsibility for the management of flame retardants at the production and manufacturing stage. Initially VECAP only applied to the brominated flame retardant DECA-DBE; since 2004 the programme has been expanded to other products and European reporting now includes TBBPA and EBP as well as DECA-BDE and HBCD. VECAP ensures the environmentally responsible management of chemicals in all elements of the value chain, by reducing the potential for emissions of chemicals during the production and manufacturing process.

VECAP is founded on the philosophy of continuous improvement, reviewing what happens in practice each year through a survey. This has resulted in the creation of a collection of simple-to-implement best practices that could apply to all chemicals and users. Producers and downstream users who take part in VECAP apply these recommendations in order to control, reduce and continuously improve their ability to reduce the potential emissions of flame retardants to the environment.

A GLOBAL PROGRAMME

VECAP is a globally recognised product stewardship scheme designed to control the potential for environmental emissions of flame retardants. In the past 10 years more and more users in Europe and worldwide have adopted this programme. Individual BSEF members have promoted and implemented VECAP in Europe, North America, Mexico, China, Japan, Singapore, Thailand, Indonesia, South Korea and Taiwan. In all these countries users show their commitment to the scheme by participating to the programme, responding to the survey questionnaire that underpins the progress reports, sharing experiences and implementing the recommendations.

1 Responsible Care® is the global chemical industry’s unique initiative to improve health, environmental performance, enhance security, and to communicate with stakeholders about products and processes www.cefic.org/Responsible-Care
3 The Bromine Science and Environmental Forum www.bsef.com is the organisation representing the bromine industry, committed to investing in scientific research on bromine and brominated flame retardants (BFRs).
4 EFRA is a sector group of the European Chemical Industry Council (CEFIC) www.flameretardants.eu

Now available in thirteen languages
INTRODUCTION
VECAP is driven by the principle of continuous improvement, this means analysing the evolution of the VECAP programme: how it started and how it is working today. In this way, the VECAP programme adapts its methodology to better address new challenges, and translates experience into new best practice recommendations.

This commitment to continuous improvement is one of the reasons why the programme has been so successful in its first 10 years:

- **Certification**
  In 2009, a certification scheme was launched based on the principles of ISO 9000/14001. The VECAP certification process was developed in collaboration with independent environmental auditors Bureau Veritas. Certification allows producers and users engaged in VECAP to verify their commitment through a third party auditor. There are currently 11 VECAP certified manufacturing and user sites worldwide.

- **The VECAP Product Stewardship Team**
  In order to develop the best practices on which the programme is based, a group of product stewardship professionals is in charge of identifying the steps in the production and manufacturing processes that might lead to environmental emissions. The VECAP team members have knowledge of flame retardants production and application processes and, working closely with users, identify potential emission risks, and design, and develop best practice recommendations. In addition, the team develops the practical and communication tools needed to track progress and promote participation in VECAP.

- **The Survey Tool**
  An annual questionnaire is sent to participating users or discussed during an onsite visit. This questionnaire considers key steps of the user’s manufacturing process, in order to get an accurate understanding of the practices applied at potential emission points. Users are provided with feedback, highlighting sources of potential emissions and recommendations for achieving greater reduction of potential emissions.

- **Emissions Data Collection & Reporting**
  Each supplier collates questionnaires and registers the information in a dedicated database. The answers are then compiled and analysed, in a strictly confidential way, by the European Chemical Industry Council’s Statistical Services, resulting in an estimate in g/t of the potential emissions to the environment for each product. Reporting is only possible for substances where supplier anonymity can be achieved in order to comply with anti-trust laws.

- **Implementation of Best Practices**
  The VECAP team encourages companies to implement the Industry’s Code of Good Practices, which is regularly updated and includes Best Available Techniques (BAT) guidance documents useful for all VECAP participants.

- **Handling and treating chemicals**
  Flame retardant emissions can occur at different points of the manufacturing process, for instance in the handling of the packaging waste, where residues can remain, or dust which can be released during unloading and feeding operations. VECAP identifies these critical points and zero or near-zero potential emissions can be achieved through application of VECAP best practices.

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5 European Chemical Industry Council (Cefic) is the forum and the voice of the chemical industry in Europe
www.cefic.org

6 For references check the BSEF website
INTRODUCTION

BROMINATED FLAME RETARDANTS

Brominated flame retardants are present in many aspects of our lives. They are substances incorporated into materials such as plastic and textiles with the purpose of preventing or slowing down the spread of fire, as well as making materials self-extinguishing from fires.

They play a crucial role as nowadays many modern homes, offices and public spaces contain highly flammable materials, such as plastics, composites, foams and synthetic fibres. These materials make modern buildings more comfortable and energy-efficient but they also bring potential risks of fire.

Therefore, brominated flame retardants have become an important component in products to improve reaction to fire in plastic cables used in electronics, cars and public transport, in polyurethane foam in furniture, in synthetic textiles used in cinemas and theatres, and insulation foams in housing and public buildings.

WHY DO WE NEED FLAME RETARDANTS

BFRs act directly on the flame and interfere with its chemical process.

They effectively quench the chemical reactions occurring in the flame, reducing the heat generated and slowing down or even preventing the burning process.

Number of Furniture & Furnishings fires in the UK

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Fires</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>12,000</td>
</tr>
<tr>
<td>2005</td>
<td>6,000</td>
</tr>
</tbody>
</table>

Flame retardants also crucial in meeting fire safety standards, which have become stricter over the past few decades. These standards decreased the number of fires.

Flame retardants give people more time to escape and for the fire brigade to arrive before it is too late.

Studies show that flame retardants help prevent ignition from small open flame sources and slow down the spread of fire.

WHERE ARE BROMINATED FLAME RETARDANTS USED?

BFRs are used in many everyday objects, such as your TV!

8.4kg Plastic on average

6L Petrol in terms of potential heat release

Brominated flame retardants make the plastic used in TV casings more resistant to ignition and slow the progress of fire.

2 min When a non-flame-retarded CRT TV set catches fire, it gives less than 2 minutes of escape time.

30 min A flame-retarded TV can provide at least 30 minutes escape time.

WHEN ARE BROMINATED FLAME RETARDANTS USED?

15 minutes

highly flame-retarded sofas, which meet the UK standards, can give at least 15 minutes longer time to escape.

Furniture

From cinemas to theatres, comfortable chairs use materials such as polyurethane foam. Flame retardants help assure safety even in crowded places with a high concentration of such materials.

Insulation foams

Insulation foams are in the walls and roofs of our buildings, contributing to critical energy savings. Like the foams used in upholstered furniture, building insulation foams also carry the risk of being highly flammable, hence the need to make them flame-retarded.

Electronics with printed circuit boards

Printed circuit boards are essential for most modern electronics. Plastics used in them have to resist heat generated by the circuit board to be safe and reliable. The reliability of printed circuit boards using brominated flame retardants has been demonstrated in more than 20 years of use.

Upholstered furniture and bedding

Statistics show that lethal domestic fires frequently start either in beds or on sofas. This is why fire resistant fillings and textiles in furniture and bedding are essential.

Airplanes

Airplanes carry a large amount of fuel and the cabin contains plastics, polymers and composites. In ground accidents, flame retardants help ensure passengers can get out of the damaged airplane safe. Flame retardants were commended for saving lives after the 2013 Asiana Airlines crash in San Francisco, as well as after the 2005 crash of a passenger jet in Toronto, in which all 309 people aboard survived.

Trains

Curtains, seat covers and fillings, as well as vertical and horizontal paneling are all rendered fire safe by the application of flame retardants.

Cars

The fact that the materials used in cars are subject to a huge amount of daily thermal stress makes their use practically inconceivable without the application of flame retardants.
The VECAP programme has been tailored to provide support and guidelines to participating companies on how to control and reduce potential emissions of chemicals into the environment for the production phase of the value chain. Concrete and practical support to participants is a central pillar of the programme. Informative material and guidelines are provided to users, ensuring that all necessary measures for environmental protection are taken through implementation of recommended best practices. VECAP encourages users to adopt the industry's Code of Good Practice and the Best Available Techniques (BAT) guidance documents that have been developed for emptying bags and intermediate bulk containers efficiently. The best practices developed for VECAP are also applicable to other chemical processes.

Understanding the principles of the programme at all levels – from top management to operatives – is important for long term responsible practice. Therefore, information and educational materials, such as posters for the factory floor and offices, are provided to help staff become familiar with, understand and accurately apply VECAP recommended best practices.

This chapter discusses examples of where emissions to the environment can occur and what the VECAP recommended practices are to control and reduce them.

Potential emissions to the environment can occur at all stages of the production process: transport and storage, opening and emptying of packaging, and the disposal of that packaging at the end of the production process.

VECAP best practice recommends that bags are carefully checked on arrival, and when removed from storage, to ensure that they are not damaged and that all seals are intact. Any tears should be repaired immediately and spills cleaned up.

**OPENING & EMPTYING BAGS AND IBCs**

Once on site, intermediate bulk containers (IBCs) and bags containing chemicals are taken to filling stations where they are opened. At this stage chemicals might spill on the floor, be discharged into the air as dust, or adhere to the personal protective clothing of workers. Emptying bags and IBCs is also a critical point since any residues left in packaging could lead to environmental emissions during packaging disposal.

VECAP best practices recommend that when using a chemical in powder form, bags should only be opened in a sealed environment, with all windows and doors in the surrounding areas firmly closed. Furthermore, in well maintained places where powder materials are handled, a local exhaust ventilation system should be in place,
preferably a tiered system composed of several filters. This limits the risk of environmental emissions, allowing for the air to be filtered and appropriate disposal of residual dust. When making liquid slurry, the recommended practice is that bags are securely connected to the entrance of the machine (the mal) before opening them.

Bags should be thoroughly emptied shaking all four corners of the bag carefully to ensure the maximum content is removed. IBCs should be tilted in order to allow remaining product to be accessed and removed.

In the event that chemicals spill on the floor at any stage of the process, spillage should be cleaned immediately, preferably with dry cleaning via a vacuum system. If using a wet clean process, cleaning water should be collected and treated, either on site or at a municipal water treatment facility. Sludge collected from waste water treatment should be incinerated.

VECAP best practices extend to the end of the production process and the safe disposal of packaging and waste. Once bags and containers have been emptied, remaining solid and liquid additives are difficult to remove and represent the largest potential emissions to land and water.

A very important recommended best practice when handling solid chemicals is to try and use the product form that produces the least dust, such as choosing granules over powder. VECAP also encourages the use of the minimum necessary amount of packaging. For example, in case of polymer additives, big bags are preferred and it is recommended to use 20-25kg paper or plastic bags only if the process requires that specific size of packaging. Empty bags should be carefully scrapped out to eliminate residues and then ‘foiled’ or folded and sealed into another bag. Stored empty packaging should be kept protected from the weather before being sent for appropriate disposal such as incineration, controlled landfill or controlled recycling. For liquids, VECAP recommends the cleaning and re-use of IBCs rather than their disposal.

The waste products collected through the applications of VECAP recommended best practices should be handled carefully and appropriately disposed of to avoid potential emissions to the environment. Filters from the ventilation system and the collected dust should be handled as chemical waste. Equally, all waste water should be filtered to remove residues prior to discharge and the resulting sludge should be treated as chemical waste. Unavoidable waste water streams, for instance from rinsing the process baths and the cleaning of IBCs, should ideally be reused in the next production run and not sent to waste water treatment. When treating waste water, it is possible for emissions to still occur because many polymer additives have a low solubility in water and may not degrade biologically in waste water treatment systems. There is also a resulting sludge from waste water treatment that needs to be suitably discarded, preferably through incineration.

VECAP Code of Good Practice:
Central to the success of VECAP is its process of continuous improvement with the development of new best practice recommendations based on experience.

During the 2014 survey the evaluation of users’ experience identified a potential source of emissions to the environment from the cleaning of workers’ personal protection clothing. This applies where workers use permanent clothing, as opposed to disposable clothing.

In order to assess the potential emissions from this source a new question has been added to the 2015 VECAP survey. The recommended best practice is for contaminated clothing to be washed at an industrial facility where waste water is treated and the sludge is incinerated as hazardous waste.

VECAP continues to recommend that users ensure the Personal Protective Equipment (PPE) provided to operators is in line with the requirements specified in the Safety Data Sheet for the product.

**AWARENESS AND HOUSEKEEPING**

VECAP addresses all steps in the value chain where polymer additives are handled as a powder, liquid or aqueous dispersion regardless of the application.

Employees should be trained on the benefits of timely, regular and thorough cleaning of work areas. Guidelines for good housekeeping should be made available to everyone. Waste from spills should be clearly marked and kept in designated closed containers. Protective clothing should be cleaned professionally. When possible product form choices should consider potential for emissions.

Materials are available in multiple languages to encourage awareness of best practice at all levels of a company from the factory floor to top management.

- Chemical spills should be cleaned immediately and stored in a chemical waste container; a dry vacuum process is preferred.
- If possible use low dust form of polymer additives e.g. granules are preferred to powder.
- Used personal protective equipment should be disposed of as chemical waste or cleaned in an environmentally sound manner.
- Employees at all levels should be aware of best practices in addition to product safety data sheets VECAP producers provide posters, brochures and video as training materials.
TRANSPORT AND STORAGE

Solid chemicals are transported and stored in bags. Liquid chemicals are transported and stored in intermediate bulk containers (IBCs).

To avoid emissions to the environment, polymer additives should be stored in a designated closed building or container.

As damage to the bags can cause product leaks, VECAP best practice is for bags to be checked for any damage on arrival and when collected from the warehouse.

Polymer additive products should be stored so as to avoid entering the environment via wind or rain.

Check if the bags are damaged; with all seals intact.

Any tears should be repaired immediately and spills cleaned.

OPENING AND EMPTYING BAGS AND IBCs

On site, bags and IBCs containing chemicals are taken to filling stations where they are opened.

During the opening and emptying of bags and IBCs chemicals can be emitted into the air as dust, spilled or adhere to personal protection clothing.

VECAP recommended practices help ensure that the maximum residue is removed from containers and the minimum product emitted to the environment.

A local exhaust ventilation system should be in place to capture dust. Filters should be maintained and cleaned.

For liquids IBCs should be tilted to ensure all the product is removed.

Windows and doors should be firmly closed to avoid interference with ventilation system.

For solids, ensure that bags are securely connected to the ‘mait’ before opening. Shake bags by the corners to avoid residue.

END OF PRODUCTION PROCESS

The final steps in all production processes of polymer additives - safe disposal of wastes, packaging and treatment of water - are very important to reduce emissions.

In previous years VECAP methodology has demonstrated major potential environmental emissions from used packaging, filter residues and for water based production untreated waste water.

Packaging should be minimised; all waste including empty packaging should be stored away from the elements; IBCs should be cleaned before re-use; bags should be disposed of in an environmentally sound manner; process water should be reused; waste water should be treated, and sent out of rainwater drainage or sewers; sludge from water treatment should be incinerated.

For polymer additives, big bags are preferred to encourage a reduction in the amount packaging used.

Empty bags should ‘foiled’ or folded and sealed in another bag. They should then be incinerated, sent to controlled landfill or recycling with best practice.

Water streams should ideally be reused in the next production run.

Filters from the ventilation system and the collected dust should be reused in production or treated as chemical waste.

Contaminated water should be treated to remove residues. Sludge resulting from waste water treatment should be disposed of as chemical waste.
The 2014 survey results show that VECAP is still broadly applied in the manufacturing process of the 4 common brominated flame retardants sold by EFRA member companies. The participation rate remains high: over 80% of the 2013 total sales volume of the substances was covered.

The 2014 survey shows a drop in coverage compared to the 2013 survey due to decreased sales and the challenge of engaging users who are no longer active customers. The VECAP team is however working hard to maintain a high engagement in the programme.

The 2014 survey results show that total potential emissions per tonne sold of the four common flame retardants remain very low, as shown in figure 1.

Second year of reporting on EBP allowed for the first comparison of data. The survey shows again a high participation rate for EBP and for TBBPA as well as a significant drop of about 35% for potential emissions to land for EBP. The survey also shows that packaging waste is being managed responsibly for all four brominated flame retardants reported.

Although this report cannot cover those brominated flame retardants sold by non-EFRA members, it is reasonable to assume that users who handle volumes from other sources will also apply the same best practices as those supplied by EFRA member companies.

---

**FIGURE 1: 2014 survey results for the four Brominated Flame Retardants**

<table>
<thead>
<tr>
<th></th>
<th>Total Volume Sold the previous year (metric tonnes per year)</th>
<th>Total Potential Emissions (metric tonnes per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deca-BDE</td>
<td>1000-2500</td>
<td>&lt; 0.1</td>
</tr>
<tr>
<td>HBCD</td>
<td>5000-7500</td>
<td>&lt; 0.5</td>
</tr>
<tr>
<td>TBBPA</td>
<td>1000-2500</td>
<td>&lt; 0.002</td>
</tr>
<tr>
<td>EBP</td>
<td>2500-5000</td>
<td>&lt; 0.3</td>
</tr>
</tbody>
</table>
FIGURE 2: Comparative flame retardants survey results (2008-2014) by emission type (g/t)
Decabromodiphenyl ether is a highly effective brominated flame retardant which increases resistance to fire and allows more time to escape in the event of fire. It is used in a variety of sectors including textiles, automotive and aviation industries as well as in construction (wires, cables and pipes).

### 2014 Survey Results for Deca-BDE

The 2014 survey shows that potential emissions into the environment for Deca-BDE remain very low. Unfortunately the coverage of the 2014 survey was lower than previous years, at 58% of the volume sold in 2013; this reflects the challenge of engaging downstream users in completing the survey if they are no longer using a product. Overall potential emissions of Deca-BDE remain low at less than 0.1 metric tonnes.

Two of the three major global producers of brominated flame retardants stopped sales of Deca-BDE in 2013. As a result this is the last report in which common reporting for Deca-BDE progress is possible. EFRA member companies still selling Deca-BDE will continue to apply VECAP. The 10 year period over which VECAP has been employed has significantly reduced potential emissions of Deca-BDE.

#### FIGURE 3: Deca-BDE 2014 Survey Results

<table>
<thead>
<tr>
<th>Survey Year</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Volume Sold the previous year</strong> (metric tonnes per year)</td>
<td>5000-7500</td>
<td>7500-10000</td>
<td>2500-5000</td>
<td>2500-5000</td>
<td>1000-2500</td>
</tr>
<tr>
<td>Total Potential Emissions (metric tonnes per year)</td>
<td>&lt; 1.5</td>
<td>&lt; 0.5</td>
<td>&lt; 0.3</td>
<td>&lt; 0.1</td>
<td>&lt; 0.1</td>
</tr>
</tbody>
</table>

#### FIGURE 4: Percentage of Volume covered by the Programme

- **2011** (% volume sold): 10%
- **2012** (% volume sold): 16%
- **2013** (% volume sold): 11%
- **2014** (% volume sold): 42%

2011: 90% Volume covered by the programme
2012: 84% Volume covered by the programme
2013: 89% Volume covered by the programme
2014: 58% Volume covered by the programme
The 2014 survey shows a decrease in potential emissions of DECA-BDE to land, dropping from 5 g/t to 0 g/t. Potential emissions to water remained stable while unfortunately potential emissions to air increased to an estimated 20 grams per metric tonne sold, due to some poor practices. (see figure 5)

Over the 10 years of VECAP the identification and implementation of best practices has significantly reduced the potential emissions of DECA-BDE into the environment.

As shown in figure 6, 100% of the packaging used for Deca-BDE covered by the survey in 2014 was managed responsibly.

Following the work done to identify good and bad practices with packaging recycling, the 2014 survey confirmed that the 7% of Deca-BDE packaging was recycled with good practice resulting in zero potential land emissions.
Hexabromocyclododecane (HBCD) is a flame retardant mainly used in thermal insulation foams in order to protect properly from fire. Its main application in Europe is in expanded and extruded polystyrene (EPS and XPS) insulation foam boards widely used in the construction sector. It was historically also used in textiles and in electrical boxes (HIPS).

### 2014 Survey Results for HBCD

The 2014 survey of HBCD shows that the majority of downstream users have taken part in the survey. There has been a significant decrease of the total potential emissions of HBCD, now less than 0.2 metric tonnes.

#### FIGURE 8: HBCD 2014 survey results

<table>
<thead>
<tr>
<th>Survey year</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Volume Sold the previous year (metric tonnes per year)</td>
<td>7500-10000</td>
<td>10000-12500</td>
<td>10000-12500</td>
<td>10000-12500</td>
<td>5000-7500</td>
</tr>
<tr>
<td>Total Potential Emissions (metric tonnes per year)</td>
<td>&lt; 0.6</td>
<td>&lt; 0.5</td>
<td>&lt; 0.25</td>
<td>&lt; 0.5</td>
<td>&lt; 0.2</td>
</tr>
</tbody>
</table>
The 2014 survey results reported zero potential emissions of HBCD to land, demonstrating that the proper implementation of the VECAP programme can reduce potential emissions completely.

Potential emissions to water increased slightly; this may indicate that a higher proportion of the volume sold was used in liquid processes in 2014.

Reporting of potential emissions to air shows a great decrease, from 47.3 g/t to 17.3 g/t. This shows success in communicating best practices, with a greater number of users choosing granular HBCD over its powder form and installing air filters. The VECAP team continues to work closely with downstream users to encourage the shift to low-dust granules.

Figure 11 shows that again 100% of the HBCD packaging waste was disposed of responsibly through using appropriate waste treatment options.

**Destinations of HBCD Packaging**

- **Controlled landfill:** 8%
- **Incineration:** 92%
- **2014 Data represent 98% of total volume**

**FIGURE 10: Comparative HBCD survey results (2008-2014) by emission type (g/t)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Potential Emissions to Land</th>
<th>Potential Emissions to Water</th>
<th>Potential Emissions to Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>35 g/t</td>
<td>7 g/t</td>
<td>170 g/t</td>
</tr>
<tr>
<td>2009</td>
<td>29 g/t</td>
<td>7 g/t</td>
<td>22 g/t</td>
</tr>
<tr>
<td>2010</td>
<td>49 g/t</td>
<td>3 g/t</td>
<td>9 g/t</td>
</tr>
<tr>
<td>2011</td>
<td>36 g/t</td>
<td>2 g/t</td>
<td>3 g/t</td>
</tr>
<tr>
<td>2012</td>
<td>16 g/t</td>
<td>2 g/t</td>
<td>1 g/t</td>
</tr>
<tr>
<td>2013</td>
<td>47.3 g/t</td>
<td>1.5 g/t</td>
<td>0 g/t</td>
</tr>
<tr>
<td>2014</td>
<td>17.3 g/t</td>
<td>2.3 g/t</td>
<td>0 g/t</td>
</tr>
</tbody>
</table>

**FIGURE 11: Survey 2014 (volume 2013) destination of HBCD packaging**

**FIGURE 12: HBCD potential land emissions from packaging waste residues**

<table>
<thead>
<tr>
<th>Year</th>
<th>Potential Emissions to Land from Packaging Residues</th>
<th>Potential Emissions to Land (others)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>153 g/t</td>
<td>17 g/t</td>
</tr>
<tr>
<td>2010</td>
<td>2.1 g/t</td>
<td>2.0 g/t</td>
</tr>
<tr>
<td>2011</td>
<td>0.5 g/t</td>
<td>0.1 g/t</td>
</tr>
<tr>
<td>2012</td>
<td>0.0 g/t</td>
<td>0.1 g/t</td>
</tr>
<tr>
<td>2013</td>
<td>0 g/t</td>
<td>0 g/t</td>
</tr>
<tr>
<td>2014</td>
<td>0 g/t</td>
<td>0 g/t</td>
</tr>
</tbody>
</table>
TBBPA

Tetrabromobisphenol A (TBBPA) is widely used in electrical and electronic equipment in order to improve fire safety. It is primarily used in reactive applications to form a brominated epoxy resin, such as the FR-4 printed circuit boards, the most commonly used board in electronics.

2014 SURVEY RESULTS FOR TBBPA

The 2014 survey covered 91% of the volume of TBBPA sold in 2013 by EFRA member companies. Potential emissions of TBBPA remained constant at very low levels, below 0.002 metric tonnes.

FIGURE 13: TBBPA 2014 survey results

<table>
<thead>
<tr>
<th>Survey year</th>
<th>Total Volume Sold the previous year (metric tonnes per year)</th>
<th>Total Potential Emissions (metric tonnes per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1000-2500</td>
<td>&lt; 0.5</td>
</tr>
<tr>
<td>2011</td>
<td>1000-2500</td>
<td>&lt; 0.005</td>
</tr>
<tr>
<td>2012</td>
<td>1000-2500</td>
<td>&lt; 0.003</td>
</tr>
<tr>
<td>2013</td>
<td>1000-2500</td>
<td>&lt; 0.002</td>
</tr>
<tr>
<td>2014</td>
<td>1000-2500</td>
<td>&lt; 0.002</td>
</tr>
</tbody>
</table>

FIGURE 14: Percentage of volume covered by the programme

- 2011 (% volume sold): 8% Volume covered by the programme
- 2012 (% volume sold): 5% Volume covered by the programme
- 2013 (% volume sold): 7% Volume covered by the programme
- 2014 (% volume sold): 9% Volume covered by the programme
POTENTIAL EMISSIONS TO AIR, WATER AND LAND

The reported amount of overall potential emissions of TBBPA remained very low. This is a great example of the results that can be achieved through the continuous commitment to and participation of producers and users in VECAP.

DESTINATION OF TBBPA PACKAGING

Out of the total volume of TBBPA covered by VECAP in 2014, 100% of the resulting packaging waste was disposed of responsibly contributing to zero potential land emissions.

FIGURE 15: Comparative TBBPA survey results (2008-2014) by emission type (g/t)

<table>
<thead>
<tr>
<th>Year</th>
<th>Potential Emissions to Land (g/t)</th>
<th>Potential Emissions to Water (g/t)</th>
<th>Potential Emissions to Air (g/t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>175 g/t</td>
<td>14 g/t</td>
<td>10 g/t</td>
</tr>
<tr>
<td>2009</td>
<td>58 g/t</td>
<td>0.1 g/t</td>
<td>2 g/t</td>
</tr>
<tr>
<td>2010</td>
<td>259 g/t</td>
<td>0.2 g/t</td>
<td>12 g/t</td>
</tr>
<tr>
<td>2011</td>
<td>0 g/t</td>
<td>0.2 g/t</td>
<td>1 g/t</td>
</tr>
<tr>
<td>2012</td>
<td>0 g/t</td>
<td>0.01 g/t</td>
<td>1 g/t</td>
</tr>
<tr>
<td>2013</td>
<td>0 g/t</td>
<td>0.0 g/t</td>
<td>0.6 g/t</td>
</tr>
<tr>
<td>2014</td>
<td>0 g/t</td>
<td>0.008 g/t</td>
<td>0.5 g/t</td>
</tr>
</tbody>
</table>

FIGURE 16: Survey 2014 (volume 2013) destination of TBBPA packaging

Out of the total volume of TBBPA in 2014, 91% of the volume was incinerated, 9% was disposed of at controlled landfills, and 9% of the data represent the total volume.

FIGURE 17: TBBPA potential land emissions from packaging waste residues
EBP

1,1’-(ethane-1,2-diyl)bis [pentabromobenzene], also known as EBP, is a flame retardant applied to plastic and textile applications in Europe. It is commonly used in transport, furnishing, construction and electric and electronic equipment in order to meet fire safety regulations.

### 2014 SURVEY RESULTS FOR EBP

Second year reporting on EBP allowed for the first comparison of data. The 2014 survey results covered 81% of the volume of EBP sold by EFRA member companies in 2013.

By comparing the figures from the 2013 and 2014 surveys, it is clear how well VECAP has worked for controlling potential emissions of EBP. While there was a significant increase in sales, coverage of EBP decreased slightly due to new users joining the programme for the first time. However, the VECAP team members are working to ensure new users will fully embrace the VECAP best practices in the future.

#### FIGURE 18: EBP 2014 survey results

<table>
<thead>
<tr>
<th>Survey year</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Volume Sold the previous year (metric tonnes per year)</td>
<td>0-2500</td>
<td>2500-5000</td>
</tr>
<tr>
<td>Total Potential Emissions (metric tonnes per year)</td>
<td>&lt; 0.3</td>
<td>&lt; 0.3</td>
</tr>
</tbody>
</table>

#### FIGURE 19: Percentage of volume covered by the programme

2013 (% volume sold) 87% Volume covered by the programme

2014 (% volume sold) 81% Volume covered by the programme
Potential emissions to land have dropped by a third, from 117 g/t in 2013 to 79 g/t in 2014, while potential emissions to water and air remain at default values. The VECAP team is committed to encourage greater participation and implementation of the recommended best practices.

![FIGURE 20: EBP survey results 2014 by emission type (g/t)]

Disposal of empty packaging is the highest contributor to potential emissions to land for EBP. 92% of the potential land emissions in the 2014 survey were attributable to the end of life of EBP packaging. The VECAP team is committed to keep working hard to ensure that all users of EBP apply the recommended best practices, which have been demonstrated to reduce emissions to land to zero.

Figure 21 shows how the packaging that contained EBP was managed at its end of life according to the 2014 survey. Packaging waste was managed using different waste management treatments, including recycling, incineration, controlled and uncontrolled landfill. The VECAP team is committed to exploring the destination of EBP packaging further, to get a clear understanding and to share information on the best practices that control and reduce environmental emissions.

![FIGURE 21: Survey 2014 (volume 2013) destination of EBP packaging]

![FIGURE 22: EBP potential land emissions from packaging waste residues]
LESSONS LEARNT OVER 10 YEARS

The 2001 Green paper of the European Commission promoting a European Framework for Corporate Social Responsibility (CSR) defines CSR as a ‘concept whereby companies decide voluntarily to contribute to a better society and a cleaner environment’. The 2011 EU strategy 2011-2014 for CSR renewed the European commitment within the broader Europe 2020 strategy for growth, encouraging EU enterprises to adhere to international guidelines and principles and achieve their full potential to boost wealth and jobs.

This trend has only continued to increase with results of the recent European public consultation on the Commission’s work in the area of CSR showing that industry, civil society, and public authorities all have a greater and greater interest in having a solid CSR strategy for the years to come.

It is in this context that the VECAP product stewardship programme reiterates its voluntary commitment to taking responsibility for the environmentally sound management of chemicals. Ten years after the launch of the programme, greening production and the value chain is an increasing priority for all industry sectors and through VECAP the brominated flame retardants industry seeks to reduce the environmental footprint of its value chain and ensure resources are used as efficiently and sustainably as possible.

VECAP CONTRIBUTION

The programme originated from EFRA member companies and the UK Textile Finishers Association (TFA), who in 2004 initiated a code of good practice calling on the UK textiles industry to audit their processes and take action to reduce emissions of the flame retardant Deca-BDE. A decade later, VECAP is an integral part of responsible environmental management for all companies involved. Participation in the scheme is high and the programme continues to improve based on experience and to expand to new regions.

Since its launch the programme has seen the active involvement of more than 100 professionals, including sales operators, trained distributors, customers and industry representatives and up to 180 total downstream user sites.

Two years after its launch the programme was expanded to include European, North American and Canadian participating downstream users in the textile and plastic industry. The following year, VECAP was being promoted by individual companies in Mexico, China, South Korea, Taiwan and Japan.

2009 marked the start of an independent certification system of participating users based on ISO 9000/14001 principles. The scheme was
developed in association with Bureau Veritas, with environmental audits carried out by independent auditors. The process was designed to be simple to implement and encourage new users’ participation. There are currently 11 VECAP certified manufacturing and user sites worldwide. Overall VECAP has significantly reduced the potential for emissions of brominated flame retardants into the environment and has engaged many downstream users. The industry commitment to the environmentally sound management of brominated flame retardants is a commitment reiterated and strengthened over the last ten years. Find out more about how the programme has evolved and how easy it is to implement through the materials available on our website.

VECAP addresses all steps in the value chain where polymer additives are handled as a powder, liquid or aqueous dispersion regardless of the application.

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12 http://www.vecap.info/publications-2/
EFRA member companies and Textile Finishers Association (TFA) launch the programme in the UK.

Establish a Code of Good Practice for polymer additives.

2004

2006

First European progress report published

Plastics and textile users covered: equivalent to all FR applications

2007

First North American progress report published

Individual companies initiatives in

Mexico, China, South Korea, Taiwan, Japan

2009

Launch of VECAP Certification Scheme with Bureau Veritas based on ISO 9000/14001 Principles

CTF2000 becomes first certified textiles user

2010

Campine becomes first certified polymers user
Potential emissions to land from Packaging Residues for TBBPA, HBCD and Deca-BDE Reduced from 676g/t in 2008

93% of the total volume of the 4 brominated flame retardants sold by EFRA member companies

2013

4 brominated flame retardants reported

100% of the total volume of the 4 brominated flame retardants sold by EFRA member companies

2012

Certified manufacturing and users sites worldwide

Communication Materials available in 10 languages

Programme promoted in Japan

2014

First Japanese progress report published

VECAP aims to reduce the potential for emissions of flame retardants during the manufacturing stage by promoting environmental good practice among producers and downstream users of polymer additives. The programme reduces emissions to the environment by:

- Increasing understanding of chemicals management in the value chain
- Promoting and facilitating open and constructive dialogue with industry, regulators and other stakeholders
- Raising awareness among all those involved throughout the process, from site personnel to company top management

Summary of BFR potential emissions reduction in Europe

- Emissions (% of volume sold)
- Volume sold (10000-25000 mt/year)

<table>
<thead>
<tr>
<th>Year</th>
<th>Emissions</th>
<th>Volume sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008*</td>
<td>0.03%</td>
<td>0,000%</td>
</tr>
<tr>
<td>2009*</td>
<td>0.02%</td>
<td>0,01%</td>
</tr>
<tr>
<td>2010*</td>
<td>0.01%</td>
<td>0,02%</td>
</tr>
<tr>
<td>2011*</td>
<td>0.00%</td>
<td>0,03%</td>
</tr>
<tr>
<td>2012*</td>
<td>0.00%</td>
<td>0,02%</td>
</tr>
<tr>
<td>2013*</td>
<td>0.00%</td>
<td>0,01%</td>
</tr>
<tr>
<td>2014**</td>
<td>0.00%</td>
<td>0,00%</td>
</tr>
</tbody>
</table>

* Year reported ** 2014 also includes sales of EBP
The European Flame Retardants Association (EFRA) brings together the leading companies which manufacture or market flame retardants in Europe. EFRA covers all types of flame retardants: chemicals based on bromine, chlorine, phosphorus, nitrogen and inorganic compounds. EFRA is a sector group of Cefic, the European Chemical Industry Council.

www.flameretardants.eu

The Bromine Science and Environmental Forum (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.

www.bsef.org

**ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAT</td>
<td>Best Available Technique</td>
</tr>
<tr>
<td>BFR</td>
<td>Brominated Flame Retardant</td>
</tr>
<tr>
<td>BSEF</td>
<td>Bromine Science and Environmental Forum</td>
</tr>
<tr>
<td>Cefic</td>
<td>European Chemical Industry Council</td>
</tr>
<tr>
<td>CSR</td>
<td>Corporate Social Responsibility</td>
</tr>
<tr>
<td>Deca-BDE</td>
<td>Decabromodiphenyl ether</td>
</tr>
<tr>
<td>EBP</td>
<td>1,1’-(ethane-1,2-diy)bis [pentabromobenzene]</td>
</tr>
<tr>
<td>EFRA</td>
<td>European Flame Retardants Association</td>
</tr>
<tr>
<td>HBCD</td>
<td>Hexabromocyclododecane</td>
</tr>
<tr>
<td>IBC</td>
<td>Intermediate Bulk Container</td>
</tr>
<tr>
<td>ISO</td>
<td>International Standards Organisation</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
</tr>
<tr>
<td>TBBPA</td>
<td>Tetrabromisphenol-A</td>
</tr>
<tr>
<td>TFA</td>
<td>UK Textile Finishers Association</td>
</tr>
<tr>
<td>VECAP</td>
<td>Voluntary Emissions Control Action Programme</td>
</tr>
</tbody>
</table>

**FOR FURTHER INFORMATION**

www.vecap.info

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Transparency Register ID: 05504109526-45
VECAP is a voluntary programme of member companies of the European Flame Retardants Association (EFRA) together with the industry’s global organisation, the Bromine Science and Environmental Forum (BSEF).