Australian Government

Polybrominated diphenyl ether flame retardants (PBDEs)

What are brominated flame retardants?

Brominated flame retardants (BFRs), are commonly used to reduce the flammability of office and household items including computers, carpet, furniture fabrics and mattresses. They are also used in insulation products and in the upholstery and internal fittings of motor vehicles. Approximately 80 different types of brominated flame retardant are used commercially. The more widely used are the polybrominated diphenyl ethers (PBDEs).

What are PBDEs?

Polybrominated diphenyl ethers (PBDEs) are a very common class of BFRs, and have attracted the most attention to date because of their potential to persist in the environment. Two commercially produced compounds of PBDEs which are of particular interest are:

- **pentaBDE**
- **octaBDE**

Why are they used?

In addition to reducing the likelihood that an item will ignite, flame retardants inhibit the spread of a fire, and give occupants up to 15 times more escape time from a fire than if they are not used.

Where are they used?

PBDEs are reported to have been used in Australia as follows:

- **pentaBDE** - polyurethane foam products such as furniture and upholstery in domestic furnishing, and in the automotive and aviation industries *and*
- **octaBDE** - plastic products, such as housings for computers, automobile trim, telephone handsets and kitchen appliance casings.

Does Australia manufacture or import PBDEs?

PentaBDE and octaBDE are not manufactured in Australia. Information collected by the National Industrial Chemicals Notification and Assessment Scheme (NICNAS), the Australian Government regulator of industrial chemicals, shows that importation of these chemicals into Australia ceased in mid 2005.

Since 6 February 2007, importation and manufacture of octaBDE in Australia is not permitted except for use as a laboratory standard for analytical determination.

Since 6 March 2007, importation and manufacture of pentaBDE is not permitted in Australia. Information on the bans of octaBDE and pentaBDE is available at: http://www.nicnas.gov.au

How do PBDEs enter the environment?

Information is limited on how PBDEs incorporated in plastics and foams are released from articles to the environment. However, it is believed that PBDEs are released to the air when articles are being manufactured, during the article's life span, and in small amounts from landfills (by leaching) and emissions (from incineration of waste). More research is needed to understand how these chemicals move to and around the environment.

How do they affect living things in the environment?

Little is known about the impact of PBDEs on living organisms, however recent studies show that some PBDEs can inhibit growth in colonies of plankton and algae and depress the reproduction of zooplankton. Laboratory mice and rats have also shown liver disturbances and damage to developing nervous systems as a result of exposure to PBDEs.

A number of international studies show considerable concentrations of PBDEs in top predators indicating the potential for these chemicals to accumulate as they work their way up the food chain. Limited Australian studies suggest that pentaBDE accumulates in some predatory birds and mammals.

Examination of the environmental effects of PBDEs in Australia is being undertaken as part of full risk assessments by NICNAS, scheduled for release in mid 2007. These assessments will examine occupational, public health and environmental effects of PBDEs.

What do we know about PBDEs in the Australian environment?

In 2004, the Australian Government Department of the Environment and Water Resources (formerly the Department of the Environment and Heritage) commissioned the National Research Centre for Environmental Toxicology (EnTox) to study aquatic sediments across Australia to determine levels of PBDEs. Samples were collected from 39 remote, agricultural, urban and industrial locations from all states and territories for analysis.

The results show that PBDE levels are highest in sediments from urban and industrial areas, particularly downstream from sewage treatment plants. However, by international standards, PBDE levels in Australian sediment are low. The highest levels detected in Australia are comparable to the lower concentrations of PBDEs in sediments from some European and Asian countries. The findings of this study (available at http://www.environment.gov.au/settlements/publications/chemicals/bfr/aquatic.html) will contribute to the NICNAS risk assessments into occupational, public health and environmental effects of PBDEs to be released in mid 2007.

Are PBDEs in our homes and workplaces?

In 2004, the Department of the Environment and Water Resources also engaged EnTox to investigate levels of PBDEs in Australia's indoor environments – homes and offices. This study analysed samples collected from air, dust and surfaces from five homes and three offices in south-east Queensland.

Samples were taken from buildings with different characteristics such as age of the building, type of floor covering and presence or absence of air-conditioning. In addition, televisions, refrigerators, stereos and DVD player surfaces were wiped and sampled.

The lowest PBDE concentration in indoor dust was found in a house with no carpet, no air-conditioning, and which was older than five years. The highest concentration was found in an office with carpet and air-conditioning, and which had been refurbished in the last two years. The results also showed that concentrations of PBDEs were greater in indoor air than in outdoor air.

Due to the small sample size used in this study, the results are not necessarily representative of all indoor environments in Australia. However, this study shows that electronic equipment, furnishings and carpets may be potential sources for exposure to these chemicals in Australian indoor environments. NICNAS will undertake a study to identify the sources of PBDEs in the indoor environment, the results of which will be incorporated into the risk assessments into occupational, public health and environmental effects of PBDEs.

This study also found that Australian PBDE levels were generally lower or similar to other countries. Australian household dust results showed lower PBDE levels than dust samples from North America or the United Kingdom, but higher levels than dust samples from Germany. For office dust, the Australian data showed higher PBDE levels than those found in Europe but no data was available from North America. This report is available at: http://www.environment.gov.au/settlements/publications/chemicals/bfr/indoor.html

Are PBDEs in food?

The role of food in the overall human exposure to PBDEs, and any possible risk to public health from eating food containing PBDEs is the subject of ongoing research. Food Standards Australia New Zealand (FSANZ) is undertaking a study of PBDE levels in Australian food and will use these findings to conduct a dietary exposure assessment, which will be finalised in mid 2007.

Are PBDEs used to control bushfires?

No. The flame retardants used to control bushfires do not contain PBDEs.

Are PBDEs in people?

Yes, PBDEs have been found in people in many developed countries where they have been exposed to products and food that may contain these chemicals. However, they have also been found in the Inuit people of Canada suggesting that some PBDEs can be transported long distances from their sources. Further work is needed to confirm the levels in people from developing countries.

Globally, the general trend in humans has been one of increasing PBDE levels in blood and breast milk[1] samples. However, studies in Sweden, where use of pentaBDE was discontinued around 2000, showed that the overall levels of PBDEs in breast milk have been decreasing in recent years.

What do we know about PBDEs in Australians?

Up until 2002 there had been little research on PBDEs in Australia. In 2002, the Department of the Environment and Water Resources, on behalf of the Environment Protection and Heritage Council (EPHC), commissioned EnTox, to measure the levels of the PBDEs in human milk. The research showed that Australian levels were approximately double those found in European countries but at least five times lower than those reported for North America. To view the report of this study, visit the EPHC web site at: http://www.ephc.gov.au/ephc/ocp_pbde_human_milk.html

In 2004, the Department of the Environment and Water Resources engaged EnTox to undertake a wider study of the Australian community by looking at brominated flame retardants (specifically PBDEs) in human blood. Approximately 8130 blood samples were taken from males and females living in both urban and rural areas of Australia, ranging in age from 0>60 years.

[1] Measuring levels of chemicals in breast milk can provide a good indicator of levels of chemicals in our bodies.

The highest concentrations of PBDEs were found in the 0-4 age group with concentrations decreasing with age. EnTox put forward a number of reasons for this trend, including:

- exposure to PBDEs started in the 1970s, hence the oldest population has received relatively low PBDE exposure
- PBDEs have half-lives in the body that are substantially shorter compared to other persistent organic pollutants. This means that the effect of past PBDE exposure is observable for a shorter period and current PBDE blood concentrations reflects more recent exposure
- products containing PBDEs are primarily used indoors, so infants in particular are more exposed to PBDE contaminated dust as they are in close contact with the floor and tend to use their mouths for sensory perception *and*
- PBDEs are an integral component of some child specific items such as mattresses. Hence there is a potential for elevated exposure in infants via these pathways.

Overall, PBDE levels in Australian adults were much lower than those observed for adults in North America but slightly higher than those observed for adults in Europe and Asia. The concentrations of PBDEs in blood sera from Australians in the youngest age group were higher than children in Norway and lower than the concentrations found in children from North America. The report can be accessed at: http://www.environment.gov.au/settlements/publications/chemicals/bfr/blood.html

How are people exposed to them?

Studies have shown that people are mainly exposed to PBDEs through exposure to indoor dust at home and in the workplace. This is assumed to be due to the levels of PBDEs in products such as furniture and electronic equipment. Food is thought to be a minor exposure route, although this is still the subject of ongoing research.

Are they dangerous to human health?

Information about PBDEs and human health is available in the NICNAS interim public health risk assessment report on certain PBDE congeners. The report is available on the NICNAS web site at: http://nicnas.gov.au/Publications/CAR/PBDE.asp NICNAS has also produced a fact sheet on PBDEs, which is available at this website.

Should I change my diet to avoid PBDEs?

Risk to public health and safety from PBDEs in food, and the role of food in the overall human exposure to PBDEs, is the subject of ongoing research. However, based on the relatively low levels found in food, and from the limited data available on the toxicity of PBDEs to animals, the Joint FAO/WHO Expert Committee on Food Additives and Contaminants[2] concluded in 2005, that current intakes of PBDEs from food are not likely to be a significant health concern.

[2] The Joint FAO/WHO Expert Committee on Food Additives (JECFA) is an international scientific expert committee that is administered jointly by the Food and Agriculture Organization of the United Nations and the World Health Organization.

Should I breastfeed my baby?

Yes. Breast milk is the best food for babies, especially in their first six months. This is the advice of the World Health Organisation, and Australia's National Health and Medical Research Council. The level of PBDEs in breast milk is very low (one part in a hundred million) and is expected to fall as use of these chemicals declines. Babies are likely to be exposed to PBDEs even if they are not breastfed. Alternative foods for babies, such as infant formula, may also contain these chemicals.

Is there an Australian or international standard for an acceptable level of PBDEs in food?

Internationally, there is very little known about what, if any, impacts PBDEs actually have upon humans and the environment. With about 80 different types of brominated flame retardants with differing characteristics, it would not possible to set one international standard for brominated flame retardants.

What can I do to reduce PBDEs at home?

Articles and materials are not labelled to indicate the presence of PBDEs or other substances. Therefore, it is not recommended that you remove products that could potentially contain flame retardants from your home. Good housekeeping, particularly removing dust, is a good place to start. You can do this by:

- regularly vacuuming floors
- damp dusting and wiping surfaces of equipment
- allowing adequate ventilation and good air flow, particularly in rooms with computers *and*
- regularly cleaning air conditioners and heater inlets and vents.

If consumers are concerned about purchasing new products that may contain PBDEs, they should check the manufacturers' web sites or ask the retailer for information about what, if any, PBDEs are used in their products.

Is there a simple test I can use to find out if an article contains PBDEs?

The Australian Government National Measurement Institute in Sydney is currently the only accredited laboratory in Australia that can measure the presence of PBDEs in the environment, food and humans. There is currently no known simple, readily available test which can easily determine the presence of PBDEs in articles and materials.

What is the Australian Government doing to address PBDEs in Australia?

Several Australian Government departments and agencies are working together to gain a better understanding about PBDEs in Australia and what actions can be taken to reduce their presence.

- ***The National Industrial Chemical Notification and Assessment Scheme***

  The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) has released an interim public health risk assessment report on certain PBDE congeners derived from pentaBDE and octaBDE. The report is available at: http://nicnas.gov.au/Publications/CAR/PBDE.asp Having completed this interim public health risk assessment, NICNAS has taken a precautionary approach and banned the import and/or manufacture of pentaBDE effective 6 March 2007 in Australia. Information on the ban is available at: http://www.nicnas.gov.au This regulatory action is consistent with international regulatory activity.

  OctaBDE was removed from the Australian Inventory of Chemical Substances (AICS) on 6 February 2007. Manufacture and importation of octaBDE is also not permitted under the NICNAS exemption categories except as laboratory standards for analytical determination.

Persons importing octaBDE for analytical purposes must comply with annual reporting obligations as required under the *Industrial Chemicals Notification and Assessment Act*. Further information is available at:

www.nicnas.gov.au/Publications/Chemical_Gazette/Chemical_Gazette_February_2007.asp

NICNAS is currently undertaking risk assessments which will include an assessment of the occupational, public health and environmental effects of a number of flame retardants. NICNAS is also undertaking a study to identify the sources of PBDEs in the indoor environment, the results of which will be incorporated into the risk assessments scheduled for release in mid 2007. Information on these assessments is available on the NICNAS web site at:
http://www.nicnas.gov.au/Industry/Existing_Chemicals/PEC_Declarations.asp

- ***Food Standards Australia New Zealand***

  Food Standards Australia New Zealand (FSANZ) is currently undertaking an assessment of PBDEs in food. Samples from a variety of food were collected from states and territories with the aim of determining the estimated exposure to the Australian population from their diet. It is too soon to determine any results, although early indications support data from overseas studies which suggest that food is not a major source of exposure. The results from this survey are scheduled for release in mid 2007.

- ***Department of the Environment and Water Resources (formerly the Department of the Environment and Heritage)***

  The Department, in consultation with the EPHC, is investigating the potential for Australia to harmonise with the European Union Directive on the restriction of certain hazardous substances in electrical and electronic equipment (RoHS Directive). This would ban the use of six hazardous materials in electronic equipment (lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl and some polybrominated diphenyl ether flame retardants).

  It is also working with industry to develop national collection and recycling schemes for used televisions and computers. Both of these activities aim to reduce the release of BFRs and other toxic substances into the environment at the end of the life of a product.

- ***Environment Protection and Heritage Council***

  Through the EPHC, Environment Ministers are overseeing work on the development of a national approach to improve the way we protect the environment from chemical risks – a National framework for Chemicals Environmental Management in Australia (or NChEM). An important aim of NChEM is to ensure a strategic and coordinated approach to emerging chemical issues such as PBDEs. EPHC released a public discussion paper on NChEM proposals in July 2006. More information is available at:
  http://www.ephc.gov.au/ephc/chemicals_mgt.html#DiscPaper

What is Australia doing internationally?

Australia is a Party to the Stockholm Convention on Persistent Organic Pollutants which aims to protect human health and the environment from the effects of these pollutants with a range of control measures. Persistent organic pollutants (POPs) are hazardous and environmentally persistent substances which can be transported between countries by the earth's oceans and atmosphere. POPs accumulate in living organisms and have been traced in the fatty tissues of humans and other animals. There is general international agreement that they require global action to reduce their impact on humans and the environment.

PentaBDE is currently being considered for possible inclusion on the Stockholm Convention and octaBDE has been submitted recently for consideration. The process involves an initial assessment against criteria to determine the chemical's persistence in the environment, its ability to bio-accumulate, potential for long-range transport and its adverse effects on human health or the environment. If it meets these criteria a risk profile is then prepared which covers details on sources (production data, uses and releases), hazard assessment, environmental fate, monitoring data, exposure, risk evaluation, and status of the chemical under international conventions. The next step involves preparing a socio-economic evaluation to determine the costs and impacts from listing a chemical on the Convention.

Given the lengthy process of assessing a chemical, any decision to include pentaBDE is not expected to be considered until a meeting of the Conference of the Parties in 2009.

If the Parties agree to include a chemical on the Stockholm Convention, the Australian Government will give the decision further consideration in accordance with the Australian domestic treaty process. This involves the Government preparing a National Interest Analysis (NIA) which assesses the impact a decision will have on Australian governments, business and the general community. The NIA is tabled in both Houses of Parliament and is also considered by the Joint Standing Committee on Treaties.

Where can I find further information on PBDEs?

Department of the Environment and Water Resources:

- *Assessment of Concentrations of Polybrominated Diphenyl Ether Flame Retardants in Aquatic Environments in Australia* report: http://www.environment.gov.au/settlements/publications/chemicals/bfr/aquatic.html

- *Assessment of Concentrations of Polybrominated Diphenyl Ether Flame Retardants in Indoor Environments in Australia* report: http://www.environment.gov.au/settlements/publications/chemicals/bfr/indoor.html

- *Assessment of Concentrations of Polybrominated Diphenyl Ether Flame Retardants in the Australian Population: Levels in Blood* report: http://www.environment.gov.au/settlements/publications/chemicals/bfr/blood.html

- *Organochlorine Pesticides (OCPs) and Polybrominated Diphenyl Ethers (PBDEs) in the Australian Population: Levels in Human Milk* report: http://www.ephc.gov.au/ephc/ocp_pbde_human_milk.html

- Department of the Environment and Water Resources web site: http://www.environment.gov.au

National Industrial Chemical Notification and Assessment Scheme (NICNAS):

- *Interim Public Health Risk Assessment of Certain PBDE congeners*: http://www.nicnas.gov.au/Publications/CAR/PBDE.asp

- NICNAS PBDE fact sheet: http://www.nicnas.gov.au/Publications/CAR/PBDE.asp