May 2007

Issue Backgrounder - Proposed PBDE Regulations, DecaBDE, and Notice of Objection

Introduction

Environmental groups have filed a Notice of Objection to the federal government's proposed regulations on polybrominated diphenyl ethers (PBDEs). Urgent action is needed to restrict environmental releases of these harmful chemicals. Unfortunately, the regulations would exempt the most widely-used PBDE mixture – DecaBDE – from a proposed import ban. This backgrounder introduces the issues involved.

About PBDEs

PBDEs are a group of synthetic chemicals used as flame retardants. Their primary application is in polymer resins and plastics, including many consumer products such as televisions, stereos, computers, furniture, carpets, and curtains. PBDEs are also used, to a lesser extent, in textiles, adhesives, sealants, and coatings.[1]

PBDEs are not produced in Canada, but are imported by manufacturers and in consumer products. PBDEs are released into the environment during manufacturing operations, and as products containing these chemicals degrade (PBDEs collect in home and office dust) or when they are disposed. Biomonitoring studies have detected PBDEs in Canadians' blood samples and even in mothers' breast milk. One study found that the breast milk of Canadian women contains the second-highest PBDE concentrations in the world (behind Americans).[2] PBDE levels measured in breast milk samples from Vancouver women increased 15-fold from 1992 to 2002.[3] Researchers have also measured concerning levels of PBDEs contaminating Canadian landscapes, from the Great Lakes to the Arctic, and building up in the tissues of Canadian wildlife, including polar bears, grizzly bears, and killer whales.

Environment Canada has concluded that PBDEs are toxic and persistent.[4] Health effects include damage to the neurological, reproductive, immune, and hormonal systems. The most widely-used PBDE, decaBDE, is classified as a potential human carcinogen by the U.S. Environmental Protection Agency. Developing foetuses and young children are particularly vulnerable to the harmful effects of these toxic chemicals.

There are 209 possible PBDE congeners, with one to ten bromine atoms. PBDEs with four or more bromine atoms have been added to the List of Toxic Substances (Schedule 1 of the *Canadian Environmental Protection Act*):

- Tetrabromodiphenyl ether (tetraBDE)
- Pentabromodiphenyl ether (pentaBDE)
- Hexabromodiphenyl ether (hexaBDE)

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- Heptabromodiphenyl ether (heptaBDE)
- Octabromodiphenyl ether (octaBDE)
- Nonabromodiphenyl ether (nonaBDE)
- Decabromodiphenyl ether (decaBDE)

PBDEs are sold in the following three commercial mixtures:

- PentaBDE – primarily composed of tetraBDE, pentaBDE, and hexaBDE congeners
- OctaBDE – primarily composed of hexaBDE, heptaBDE, and octaBDE congeners
- DecaBDE – primarily composed of decaBDE with trace amounts of nonaBDE congeners.

Widely used until recently, Penta- and OctaBDE were voluntarily phased out of use in Canada in 2006, and these mixtures are no longer available on the market.[5]

CEPA and Proposed PBDE Regulations

CEPA requires the federal ministers of the environment and health to conduct screening assessments of potentially toxic substances in order to determine whether they present a risk to the environment or to human health. Substances found to be harmful to the environment or human health are considered toxic and may be regulated; those found also to be persistent, bioaccumulative, and entering the environment primarily due to human activity must be listed for virtual elimination.

Screening assessments for tetra- through decaBDE were completed in December 2004 (Health Canada) and June 2006 (Environment Canada).[i] The federal government then added these PBDEs to the List of Toxic Substances on December 7, 2006. On December 16, the Government proposed regulations to prohibit the use, sale, offer for sale, and import of tetra-, penta-, and hexaBDE, and mixtures, polymers and resins containing these substances.

In effect, the proposed regulations would ban the PentaBDE and OctaBDE commercial mixtures, which have already been phased out of use in Canada. The ban does not extend to the more prevalent DecaBDE commercial mixture. Furthermore, there is a wide exemption for PBDEs and products containing PBDEs "intended to be disposed of or recycled."

The proposed regulations also prohibit the manufacture of PBDEs in Canada. No domestic PBDE manufacturing facilities currently exist, nor have any been proposed.

Notice of Objection

On February 14, 2007, Sierra Legal filed a Notice of Objection to the proposed PBDE regulations on behalf of the David Suzuki Foundation, the Canadian Environmental Law Association, and Environmental Defence. The basis for the Objection is twofold:

1. There is significant evidence that the higher-brominated PBDEs contained in the DecaBDE mixture are persistent and bioaccumulative, and therefore must be added to the list for virtual elimination under CEPA. Further, the higher brominated PBDEs debrominate or

[i] Although the Environment Canada Screening Assessment was published in 2006, it included only information available as of October 2004.

break down into the PBDEs that the regulations would ban, and as such the "parent" substance needs to be banned as well. For these reasons, the scope of the proposed regulations is too narrow; the use, sale, offer for sale, and import of *all* PBDEs must be prohibited.

2. The exemption for PBDEs and resins, polymers, or mixtures containing such a substance intended for disposal or recycling is too wide and ill defined to allow for any ban of PBDEs to be effective.

Through the Notice of Objection, the groups are petitioning the minister of the environment to establish a Board of Review to investigate these issues and to make recommendations for the effective regulation of PBDEs in Canada. The minister has not yet responded.

Deca: The Case for Virtual Elimination

Bioaccumulation

There is general consensus that all PBDEs are persistent and toxic, posing risks to human health and the environment. However, correspondence from the Office of the Minister of the Health indicates that the government does not consider the higher-brominated PBDEs contained in the DecaBDE mixture to be bioaccumulative, and on this basis the regulatory authorities are of the view that these PBDEs do not meet the criteria for virtual elimination under CEPA.

The ecological screening assessment is silent on the question of bioaccumulation for the higher-brominated PBDEs. But only information available as of October 2004 was included in this assessment.[6] Since such time, there has been an explosion of new studies on PBDEs. There is now a significant body of evidence indicating that the higher-brominated PBDEs do bioaccumulate, particularly in the terrestrial food web, and also showing a marked increase of higher-brominated PBDEs in the environment and people. For example:

- A study published in 2005, measured decaBDE[ii] in peregrine falcon eggs at levels that confirm the uptake and bioaccumulation of decaBDE in biota.[7]
- A study of decaBDE in glaucous gulls and polar bears in the Norwegian Arctic "clearly demonstrates that DecaBDE (BDE-209) are bioaccumulative, to a limited extent, in apex marine predators of the Norwegian Arctic."[8]
- A study on the red fox, published in 2006, "confirms unambiguously" that decaBDE does bioaccumulate in terrestrial top predators.[9]
- A study of Chinese birds of prey, published in 2007, found "remarkably" high levels of decaBDE. The authors concluded that the "results reinforce the growing view that significant bioaccumulation of BDE-209 can occur in some terrestrial food chains especially when abundant deca sources are present."[10]

Environment Canada regulations define bioaccumulation thresholds for the purposes of CEPA. The Notice of Objection analyzes the properties of decaBDE in relation to these legal tests and sets out how they are met.

[ii] For clarity, references to "decaBDE" refer to decabromodiphenyl ether (also called BDE-209), the primary chemical ingredient in the DecaBDE commercial mixture.

Debromination

Scientists have also shown that decaBDE in the environment can transform into lower-brominated PBDEs – a process known as "debromination." Debromination to tetra- through nona-BDE congeners has been shown as a result of metabolization, exposure to sunlight, or bacterial action. For example, a recent study of carp found that 65% of decaBDE was biotransformed in the liver, primarily down to hexaBDE.[11]

As Environment Canada states in the screening assessment:

> There is a weight of evidence suggesting that highly brominated PBDEs such as decaBDE are precursors of the more toxic, biaccumulative and persistent lower brominated PBDEs. While the degree to which this phenomenon adds to the overall risk presented to organisms from formation of the more toxic and persistent tetra to hexaBDE congeners is not known, there is sufficient evidence to warrant concern.[12]

Indeed, the evidence of debromination is reason enough to include DecaBDE in the ban. Virtual elimination of the lower-brominated PBDEs can only be achieved if the DecaBDE precursors are also eliminated.[iii]

Regulation vs. Voluntary Instruments

Instead of prohibiting DecaBDE in the PBDE regulations, Environment Canada is proposing to "manage" this toxic substance through Environmental Performance Agreements (EPA) with industry. While the details of the proposed EPA have yet to be announced, the general weaknesses of this approach are well known. Its effectiveness depends entirely on the voluntary compliance of industry; EPAs fail to provide a regulatory backstop in the event that industry does not comply with the agreement. Furthermore, it is not clear that the import of products containing DecaBDE could be prohibited or even restricted through an EPA – a significant loophole given that many application of DecaBDE involve products that are not manufactured in large quantities domestically (e.g. television sets).

Environment Canada and Health Canada have noted the chemical industry's "strong position on maintaining the manufacture and use of this product [DecaBDE]."[13] Chemical industry lobbying should not dictate public policy on PBDEs when protection of health and the environment are at stake. Consistent with the precautionary principle and the requirements of CEPA, firm regulatory action is needed to ban DecaBDE.

Alternatives to DecaBDE

There are three options for eliminating PBDEs while maintaining fire retardancy objectives. One is to substitute a different chemical substance, another is to substitute a different product material that doesn't require DecaBDE to achieve flame-retardation, and a third is to change the design or construction of an item to make it inherently less flammable. The first option is likely the simplest,

[iii] Precedence already exists under CEPA for regulating the "parent" substance when it breaks down into a substance already targeted for regulation. Proposed regulations for perfluoroctane sulfonate (PFOS) explicitly target PFOS precursors (published Dec. 16, 2006 – see *Canada Gazette Part 1* Vol. 140 (50), pp. 4265-4282).

from the point of view of manufacturers, as it does not involve changes to any other component of the product. In this regard, several studies have confirmed the market availability of less hazardous alternatives to DecaBDE.

A comprehensive ban on PBDEs can be expected to prompt further innovations in this area, and the lack of a ban has been characterized as an impediment to wide-spread implementation of alternatives as has occurred in Europe.[14]

Already, many companies – including IKEA, LG, and Ericsson – have voluntarily eliminated DecaBDE and other PBDEs from their products.

Conclusion

Canadians are being insidiously exposed to PBDEs, which are prevalent in house, car, and office dust. The proposed PBDE regulations will be largely ineffective in protecting the health of Canadians and our environment against the risks that these chemicals pose – because the regulations fail to address DecaBDE, the most widely used PBDE mixture. The regulation must be revised to ban *all* PBDEs.

Sweden has already banned all PBDEs for health and environmental reasons. Likewise, a ban will come into affect next year in Washington State (USA), pending a study of alternatives. Legislation to ban DecaBDE has been introduced in several other U.S. states, as well. Canadians deserve comparable protection against PBDEs. CEPA requires nothing less.

Download the Notice of Objection: www.sierralegal.org/reports/pbde_final_07_02_14.pdf

Other Useful Information

Ecological Screening Assessment Report on PBDEs (Environment Canada)
www.ec.gc.ca/CEPARegistry/documents/subs_list/PBDE_SAR/PBDEs_SAR_EC_June_2006_(en).pdf

Proposed PBDE regulations (Government of Canada)
canadagazette.gc.ca/partI/2006/20061216/html/regle3-e.html

CEPA Registry FAQs www.ec.gc.ca/CEPARegistry/documents/subs_list/PBDE_draft/PBDEfaq.cfm

David Suzuki Foundation www.davidsuzuki.org/health

Sierra Legal Defence Fund www.sierralegal.org/toxics.html

Canadian Environmental Law Association www.cela.ca/coreprograms/detail.shtml?x=2310

Canadian Partnership for Children's Health and the Environment
www.healthyenvironmentforkids.ca/english/special_collections/fulltext.shtml?x=784

"Toxic Nation" (Environmental Defence) www.toxicnation.ca

Clean Production Action www.cleanproduction.org/Flame.php

Washington Toxics Coalition: www.watoxics.org/issues/pbde

Washington State Depart of Ecology: www.ecy.wa.gov/programs/eap/pbt/pbde/index.html

Environmental Working Group: www.ewg.org/issues/siteindex/issues.php?issueid=5008

Acronyms

CEPA	Canadian Environmental Protection Act
DecaBDE	Decabromobiphenyl ether; DecaBDE is also the name of the most prominent commercial mixture of PBDE flame retardants, which is composed primarily of decabromobiphenyl ether with trace amounts of nonabromobiphenyl ether.
EPA	Environmental Performance Agreement; a non-regulatory instrument for managing toxic substances through voluntary negotiations with industry.
PBDE	Polybrominated biphenyl ether

Glossary of Key Terms

Bioaccumulation	The concentration of a chemical up the food chain, such that the concentration of the chemical in an animal is higher than in the animal's food source or, or, in the case of aquatic environments, higher than in the water.
Congener	One of many variants of a common chemical structure.
List of Toxic Substances	CEPA defines as toxic any substance that "is entering or may enter the environment in a quantity or concentration or under conditions that (a) have or may have an immediate or long-term harmful effect on the environment or its biological diversity; (b) constitute or may constitute a danger to the environment on which life depends; or (c) constitute or may constitute a danger in Canada to human life or health" (sec. 64). Substances found to meet these criteria are listed in Schedule 1 of the Canadian Environmental Protection Act, and the government is required to take action to control or prevent the release of substances on this list.
Virtual Elimination	CEPA requires the "virtual elimination" of toxic substances that are persistent and bioaccumulative. The release of these substances into the environment must be reduced below a specified concentration, defined as "the lowest concentration that can be accurately measured."

Endnotes

[1] Environment Canada, "Frequently Asked Questions – Polybrominated Dipheyl Ethers (PBDEs)," *CEPA Environmental Registry Substances List*, <http://www.ec.gc.ca/CEPARegistry/documents/subs_list/PBDE_draft/PBDEfaq.cfm> (last update 2004-05-12).

[2] J.J. Ryan. "Polybrominated Diphenyl Ethers in Human Milk: Occurance Worldwide" (presented at the Third International Forum on Brominated Flame Retardants, Toronto, June 6-9, 2004).

[3] J.J. Ryan *et al*., "Recent trends in levels of Brominated Diphenyl Ethers (BDEs) in Human Milks from Canada," *Organohalogen Compounds* 58 (2002): 173-176.

[4] Environment Canada, *Ecological Screening Assessment Report on Polybrominated Diphenyl Ethers*, June 2006: 16.

[5] *Polybrominated Diphenyl Ethers Regulations - Regulatory Impact Analysis Statement*, Canada Gazette 2006, Part I (Dec. 16): 4294.

[6] Environment Canada, *Ecological Screening Assessment,* 2.

[7] Katrin Vorkamp *et al.*, "Temporal Development of Brominated Flame Retardants in Peregrine Falcon (Falco peregrinus) Eggs from South Greenland (1986-2003)", *Environmental Science and Technology* 39, no. 21 (2005): 8199-8206.

[8] Jonathan Verreault *et al.*, "Flame Retardants and Methoxylated and Hydroxylated Polybrominated Diphenylethers in two Norwegian Artic Top Predators," *Environmental Science and Technology* 39, no. 16 (2005): 6021-6028.

[9] Stephan Voorspoels *et al.*, "Remarkable Findings Concerning PBDEs in the Terrestrial Top-Predator Red Fox (VulpesVulpes)," *Environmental Science and Technology* 40, no. 9 (2006): 2937-2943.

[10] Da Chen *et al.*, "Polybrominated Diphenyl Ethers in Birds of Prey from Northern China," *Environmental Science and Technology* 41, no. 6 (2007): 1828 –1833.

[11] Heather M. Stapleton *et al*., "In Vivo and In Vitro Debromination of Decabromodiphenyl Ether (BDE 209) by Juvenile Rainbow Trout and Common Carp," *Environmental Science and Technology* 40, no. 15 (2006): 4653-4658.

[12] Environment Canada, *Ecological Screening Assessment*,13-14.

[13] *Order Adding Toxic Substances to Schedule 1 of the Canadian Environmental Protection Act – Regulatory Impact Analysis*, Canada Gazette 2006, Part 1 (July 1): 1942-1943.

[14] Pure Strategies, Inc., *Decabromodiphenylether: An Investigation of Non-Halogen Substitutes in Electronic Enclosure and Textile Applications.* (Lowell, MA: The Lowell Centre for Sustainable Production, 2005), 3, 7, 30.