BROMINATED FLAME RETARDANTS: AN OVERVIEW

M. Alaee[1], S. Sakai[2], and I. Watanabe[3]

[1]National Water Research Institute, 867 Lakeshore Rd. P.O. Box 5050, Burlington, Ontario, L7R 4A6, Canada
[2] National Institute for Environmental Studies, Onogawa, Tukuba, Ibaraki 305-8506, Japan
[3] Osaka Prefectural Institute of Public Health, Nakamichi, Higasinariku, Osaka 537-0025, Japan

Since the formation of polybrominated dibenzo-p-dioxins (PBDDs) and polybrominated dibenzofurans (PBDFs) during the pyrolysis of some brominated flame retardants (BFRs) was demonstrated in the latter half of 1980s, PBDDs/DFs have been of great interest to the participants in the *DIOXIN Symposium series*. Therefore, there have been a number of presentations on brominated flame-retardants and their thermal by-products at various Dioxin Symposiums for the past two decades. In addition to these toxic thermal by-products, some brominated flame-retardants themselves have also attracted social attention as ubiquitous environmental pollutants due to their lipophilic and persistent properties since the PBB accident in Michigan in 1973. In the earlier environmental studies on BFRs in Europe and Japan in the 1980s, some BFRs such as PBDEs, tetrabromobisphenol-A (TBBPA) and hexabromocyclododecan (HBCD) were revealed as worldwide pollutants.

During Dioxin 98 in Stockholm, brominated flame-retardants were featured in the Polymer Additives and Monomers session. In the course of Dioxin 98, 13 papers from five countries were presented on BFRs. During this symposium, Noren and Meironyte presented their study on human breast milk showing that the levels of PBDEs were doubling every five years. In the subsequent year, at DIOXIN 99 in Venice, for the first time a special session was dedicated to BFRs, where 14 papers from five countries were presented. Temporal trends from Europe presented at this symposium indicated that PBDEs in the European environment were leveling off. During DIOXIN 2000 in Monterey 33 papers from 10 countries covering a wide range of topics from formation to levels in human tissue were presented. The highlight of this conference was the increasing levels of PBDEs in the North American environment.

Once again, this year at DIOXIN 2001, BFR issues continue to gain more attention. A plenary presentation on BFRs will be delivered by Professor Bergman from Stockholm University, and presentations on BFRs are not limited to the special session. To provide a complete overview of BFRs at DIOXIN 2001 is an impossible task, therefore the focus of this overview is on the presentations at the BFR session.

The presentations at the BFR session are divided into five categories, keynote presentation, toxicity and metabolism, determination and environmental levels, sources and risk assessment. The session will begin with the keynote presentation by Dr. Watanabe on Environmental Release and Behavior of Brominated Flame Retardants. The keynote presentation addresses the trends of annual consumption of BFRs; present status of waste flame-retarded products such as television sets in Japan, possible emission sources, environmental behavior of BFRs, temporal

trends of PBDEs levels, and by-products of BFRs.

At this session, there are six presentations on metabolism and toxicity; which are divided into two oral presentations. The first on metabolism of commercial Pentabromodiphenyl Ether mixture by Huwe *et al.* followed by a talk on metabolism of BDE-209 by Morck *et al.* Discussions on toxicity and metabolism continue during the poster sessions with additional four posters. During this session Behnisch *et al.* discusses DR-CALUX and EROD-TEF values for brominated flame-retardants and their by-products. Metabolism and distribution of BDE-47 in pike will be presented by Keikegaard *et al.*; synthesis and identification of hydroxylated and metoxylated PBDEs will be discussed by Marsh *et al.*, and the possibility of naturally produced hydroxylated PBDEs in the Baltic Sea will be discussed by Asplund *et al.*

Determination and environmental levels includes four oral presentations. The first oral presentation by de Boer *et al.* discuss the temporal trends of PBDEs in Europe; followed by a presentation on PBDEs in various trophic levels in the North Sea food web by Zegers *et al.*, Lebeuf *et al.* discuss the levels of PBDEs in beluga whales from St. Lawrence Estuary. Alaee *et al.* discuss the atmospheric levels of PBDEs in the Arctic and Laurentian Great Lakes. The two poster presentations on determination and environmental levels are presented by Choi *et al.*, and Ohta *et al.* Choi *et al.* discuss a clean-up method for sediments using activated carbon columns, and Ohta *et al.* discuss the photolysis products of BDE-209.

During this session there will be four presentations on the sources of BFRs into the environment; the oral presentation will be given by Allchin *et al.*, and Sakai *et al.* Poster presentations will be delivered by Sinkkonen *et al.* and Shibakawa *et al.* Allchin *et al.* surveyed river sediment from the River Tees in the UK to determine the sources of PBDEs. Sakai *et al.* describe levels of BFRs in electrical and electronic waste and potential for the formation of brominated dioxins and furans during incineration is discussed. During the poster session, results on the levels of brominated aromatics from a car scrap plant in Finland will be presented by Sinkkonen *et al.*; and a study on brominated dioxins and furans in an MSW incineration plant will be presented by Shibakawa *et al.*

Finally, to put everything into perspective the probabilistic human health risk assessment of penta-, octa-, and deca- brominated diphenyl ethers will be delivered by Wenning.