



May 3, 2006

Linda Gerber
Associate Director, Chemical Control Division
U.S. Environmental Protection Agency
Mail Code 7407
Office of Pollution Prevention and Toxics
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Re: VCCEP Data Needs Draft Matrix

Dear Ms. Gerber,

Enclosed please find a draft matrix prepared by the Brominated Flame Retardant Industry Panel (BFRIP). This document has been prepared as a follow up to our recent discussions concerning the U.S. Environmental Protection Agency (EPA) Data Needs Letter for decabromodiphenyl ether (decaBDE) in Tier 2 of the Voluntary Children's Chemical Evaluation Program (VCCEP). The matrix lists data needs as described in EPA's August 2005 letter, potential test methods noted by the Agency and studies identified by BFRIP that presently are available that might address such needs. The matrix also includes questions that BFRIP has concerning certain test methods and data needs. The Panel has developed the enclosed matrix as a draft to provide a focal point for future discussions intended to allow the Agency and BFRIP to update their respective understandings concerning the data that currently are available and pertinent to assessing children's potential to be exposed to decaBDE (including data that might have become available since EPA's August 2005 correspondence was prepared). BFRIP understands that EPA staff will review the matrix, provide comments to BFRIP and identify any newly-available data that might address specific data needs. We also understand EPA staff will add to the matrix additional details concerning the Agency's awareness of pertinent research currently underway (such as those studies identified in the EPA's PBDE Project Plan).

We look forward to your timely reply. If you have any questions, please feel free to contact me at (703) 741-5605 or nancy_sandrof@americanchemistry.com.

Sincerely,

Nancy Sandrof, M.P.H.
Manager, BFRIP
American Chemistry Council

Enclosure

BFRIP DRAFT MATRIX

Study Area or Data Need, Listed in Attachment 2, Letter of Aug 25, 2005		
Study Area or Data Need	Existing Data	
	Reference	Results and Questions
<p>Anaerobic Debromination in Aquatic Sediments</p>	<p>Nies L. EPA Grant Number R830251. EPA Star Grant Anaerobic microbial reductive debromination of PBDEs.</p> <p>Cited in EPA's Aug 6 '05 letter as suggested guideline, method or approach.</p> <p>Listed in PBDE Research and Assessment Activities Conducted by or Funded by EPA. Appendix C. EPA PBDE Project Plan. 2006, page 33.</p>	<p>Described in the EPA PBDE Project Plan: "will assess whether decaBDE undergoes reductive debromination, and, if so, will quantify the products of this biotransformation."</p> <p>Described by EPA in their Aug '05 letter as recently completed; however, the methods and results not available to BFRIP. Please provide a copy for BFRIP to review.</p> <p>Does this study provide the information EPA desires with respect to anaerobic debromination? Should this study be taken into consideration when determining whether BFRIP should conduct similar work?</p>
	<p>Schaefer and Flaggs. 2001. Potential for biotransformation of radiolabelled decabromodiphenyl oxide (DBDPO) in anaerobic sediment. Final Report. Project No: 439E-104. Wildlife International, Ltd. Easton, MD</p> <p>Cited in BFRIP's Dec '02 VCCEP Submission.</p>	<p>No evidence of DBDPO degradation after 32 weeks incubation in anaerobic sediment.</p> <p>Need to understand why this study, when considered with other studies and monitoring data, is not sufficient to reasonably conclude DBDPO does not degrade in sediments.</p>
	<p>De Wit C. 2000. Brominated flame retardants. Report 5065. Swedish Environmental Protection Agency, Stockholm, SE.</p> <p>Cited in BFRIP's Dec '02 VCCEP Submission.</p>	<p>Reported no evidence of DBDPO degradation after 2 years incubation in anaerobic sediment.</p> <p>Need to understand why this result, when considered with other studies and monitoring data, is not sufficient to reasonably conclude DBDPO does not degrade in sediments.</p>
	<p>Zegers et al. 2003. Environ. Sci. Technol. 37:3803-3807.</p> <p>Rayne and Ikonomou. 2002. Environ. Toxicol. Chem. 21:2292-2300.</p> <p>Song et al. 2004. Environ. Sci. Technol. 38:3286-3293.</p> <p>North K. 2004. Environ. Sci. Technol. 38:4484-4488.</p> <p>Ter Schure et al. 2004. Environ. Sci. Technol. 38:1282-1287.</p>	<p>Environmental monitoring does not support speculation that DBDPO debrominates.</p> <p>Sediments deposited in Europe over a 20-yr period and analyzed for 14 different BDE congeners, including DBDPO, BDE47, 99 and 100, had congener patterns characteristic of the PentaBDE product.</p> <p>Rayne and Ikonomou used pattern analysis in a source reconstruction of PBDEs detected in the Fraser River in British Columbia and concluded that the lower brominated DPEs detected originated from the Penta and OctaBDE products. They further determined that the most likely source was inefficient rural septic tanks with direct outflows to the river.</p> <p>Song et al. found that the PBDEs detected in Lake Superior sediment resembled the commercial PentaBDE product and concluded that the PBDEs detected originated from that commercial product.</p> <p>Analysis of PBDEs in sludge and effluent from a California wastewater treatment plant indicated that the PentaBDE mixture was the source of lower brominated DPEs detected, not DBDPO microbial degradation.</p> <p>Ter Schure et al. concluded that in environmental</p>

BFRIP DRAFT MATRIX

		<p>samples "BDE47 and BDE99 are markers for the commercial Penta-BDE mixture" and that BDE47, BDE100 and BDE99 "originate from the commercial penta-BDE formulations."</p>
<p>Anaerobic Debromination in Sludge Digesters.</p>	<p>Gerecke et al. 2005. Environ. Sci. Technol. 39:1078-1083.</p> <p>Cited in EPA's Aug '05 letter as suggested guideline, method or approach.</p>	<p>Normal sludge residence time is ~28 d.</p> <p>After 114 d incubation in anaerobic sludge: no change in DBDPO concentration.</p> <p>After 238 d incubation w/primer: ~5% DBDPO appeared degraded to 2 of 3 NonaBDEs already present in the DecaBDE product. None of the most commonly found lower BDE's (BDE-47 and BDE-99) were reported as being formed. In fact, because debromination of BDE-209 occurred at the para position, this may indicate microbial anaerobic degradation of DecaBDE is not likely to cause formation of these common Tetra and PentaBDE congeners. Without primers the rate of degradation was much slower (approximately 1400 days vs. 700 days with primers).</p> <p>Results indicate DBDPO will not undergo debromination in a wastewater treatment plant's anaerobic sludge digester under typical operation conditions. The minimal debromination that might occur does not lead to formation of the more significant lower brominated BDEs such as BDE 47 or BDE 99.</p> <p>What additional data is EPA seeking on this endpoint and why?</p>
	<p>PBDEs in Calumet Water Reclamation Plant (Chicago). Appendix C. PBDE Research and Assessment Activities Conducted by or Funded by EPA. EPA PBDE Project Plan. 2006, page 33.</p>	<p>Project "will characterize levels of 14 PBDE congeners in aqueous and sludge samples at various stages in the treatment facility, including the influent, effluent, digestion sludge, and final sludge product. The project is a screening level analysis of fate (including transformations and degradations) of PBDEs within the water reclamation plant."</p> <p>BFRIP has no information on the design and conduct of this work. Does this work provide the information EPA desires with respect to anaerobic debromination in sludge digesters? Should this study be taken into consideration when determining whether BFRIP should conduct similar work?</p>
<p>Photolysis in the Indoor Environment</p>	<p>Soderstrom et al. 2003. Environ. Sci. Technol 38:127-132.</p> <p>Previous publications of this work cited in BFRIP's Dec '02 VCCEP Submission.</p> <p>Cited in EPA's Aug '05 letter as suggested guideline, method or approach.</p> <p>Included in BFRIP's Nov '05 presentation to EPA.</p>	<p>BDE47, 99, 100 only formed to a minor degree and only in toluene and/or silica gel – not in sand or sediment. BDE153 formed in toluene, sand-outdoors, sediment. Authors stated origin of these congeners in the environment "probably primarily from emissions of technical PBDE".</p> <p>Half-lives reported (100-200 hrs in sedm/soil) had very high S.D. (often >= means) and are inconsistent with stability of test concentrations in GLP guideline studies, other publications, and modeling.</p> <p>How is this photolysis work relevant to indoor photolysis and children's exposures? Are the conditions used in this study representative of indoor light? DBDPO is known to be adsorbed to particulates. Light indoors is not comparable to outdoors. Indoor photolysis of any substance is expected to be << outdoors due to reduction of light.</p>
	<p>Jafvert and Hua. 2001.</p>	<p>Investigated 6 different exposure scenarios for inducing</p>

BFRIP DRAFT MATRIX

	<p>Photochemical reactions of decabromodiphenyl oxide and 2,2',4,4'-tetrabromodiphenyl oxide. Final Report for BFRIP. Purdue University, West Lafayette, IN</p> <p>Cited in BFRIP's Dec '02 VCCEP Submission.</p> <p>Published as Hua et al. 2003. Environ. Toxicol Chem. 22:798-804.</p> <p>Cited in EPA's Aug '05 letter as suggested guideline, method or approach.</p>	<p>solar photochemical transformation in a model aqueous environment. Results of worst-case scenario (DBDPO precipitated on humic acid-coated sand particles & exposed to 12 days of summer sunlight): No evidence of production of tetra or pentaBDEs. Less than 10% of the DBDPO decayed.</p> <p>In light of these results and other data on photolysis, what additional data would EPA need to reasonably determine that DBDPO does not photolytically degrade indoors to any substantial extent?</p>
	<p>Eriksson et al. 2004. Environ. Sci Technol. 38:3119-3125.</p> <p>Soderstrom et al. 2004. Environ. Sci Technol. 38:127-132.</p> <p>De Rosa et al. 2003. Fresenius Environ. Bull. 12:940-945.</p> <p>Wantanabe and Tatsukawa. 1987. Bull. Environ. Contam. Toxicol. 39:953-959.</p> <p>Norris et al. 1974. JFF/Combustion Toxicology. 1:52-77.</p> <p>Norris et al. 1975. Environ. Health Perspect. 11:153-161.</p> <p>Zetch C. 2003. Observations on UV spectra, photolysis and photochemistry of polybrominated diphenyl ethers in organic solvent, adsorbed on particles in air and in aqueous suspension. Report to BSEF. University of Bayreuth, Germany.</p> <p>Nyden et al. 2004. 15th Annual BCC Conference on Flame Retardancy . June 7-9. CT.</p> <p>Sellstrom et al. 2005. Environ. Sci. Technol. 39:9064-9070.</p>	<p>Many research groups have studied photolytic degradation of DBDPO to lower brominated DPEs. DBDPO's low aqueous solubility (<0.1 ug/L) has frustrated attempts to directly study its breakdown in that media. Attempts using water/organic solvent mixtures have also been largely unsuccessful. Example: Eriksson et al. were unable to detect any degradation products of DBDPO in water, and suggested that DBDPO's disappearance from the solution may have been due to adsorption to the glass walls of the vessel.</p> <p>As a consequence, most photolysis studies have utilized organic solvents, where DBDPO has limited solubility. In organic solvents, natural and artificial sunlight cause the small amount of DBDPO in solution to undergo reductive debromination, ultimately, to diphenyl ether. Lower brominated DPEs are some of the many substances formed as intermediates during this process. Some of the components of the Penta and OctaBDE commercial products, plus other PBDEs, have been reported on a qualitative basis. These temporarily formed PBDEs were not those commonly found in environmental samples, and because of this Soderstrom et al. concluded that the PentaBDE mixture, and not degradation of DBDPO, was the most likely source of the tetra-, penta- and hexaBDEs found in the environment. These studies indicate that all of the PBDEs, including BDE47, 99 and 100, will undergo reductive debromination when in solution in organic solvents, with rates being proportional to the number of bromines on the aromatic rings.</p> <p>Nevertheless, photolysis studies performed in organic solvents are unlikely to be applicable to DBDPO's environmental fate. Early in its development as a commercial product and based on other halogenated aromatics, it was recognized that DBDPO's photolysis would likely proceed by different routes in water and organic solvents. In solvents capable of proton transfer, halogenated aromatics typically degraded by reductive dehalogenation. In water, oxidation led to the formation of phenolic compounds. Once photohydroxylation was initiated in water, its rate was expected to accelerate as electron-withdrawing halogens were replaced by electron releasing hydroxyl groups. These hydroxylated species were expected to adsorb light more strongly and this ultimately could result in rupture of the aromatic ring.</p> <p>Laboratory findings correlated with the predictions. Only minimal evidence of DBDPO's (98% purity) aqueous photodegradation was found over a 3-month exposure to natural sunlight, and degradants were not lower</p>

BFRIP DRAFT MATRIX

		<p>brominated DPES. Evidence for degradation of only 0.57% of the amount initially present (10 g/8 L water). Was detected after 98 d sunlight exposure. In contrast, DBDPO (7 ppm) in octanol decomposed with a half-life of 4 h. In xylene, a strong absorber of UV light, DBDPO photodegraded by reductive debromination with a half-life of 15 h on exposure to a 125 watt Hg lamp.</p> <p>In air, DBDPO is expected to be associated with particulates, rather than in the gaseous phase, because of its low vapor pressure (4.63×10^{-6} Pa) and high adsorption coefficient (1.8×10^6). DBDPO deposited on silica particles, suspended in dry air, and irradiated with artificial sunlight was found to be photoinert. No measurable degradation to PBDEs occurred.</p> <p>Soderstrom et al. reported that irradiation of DBDPO deposited on moist sand, silica gel, sediment or soil resulted in slow formation of unidentified products as well as PBDEs of differing composition from those commonly found in the environment. BDE47, 99 and 100 were not detected after irradiation of soil, sand or sediment, and these researchers concluded that DBDPO was not the source of the tetra and pentaBDEs typically detected in the environment. In their concluding paragraph, they said "In this investigation the most commonly found PBDEs in environmental samples (BDE47, 99, 100) were only formed to a minor degree from the photolysis of DecaBDE and only in toluene and/or silica gel. BDE153 was formed in toluene, on sand outdoors and on sediment. The origin of these congeners in the environment is probably primarily from emission of technical PentaBDE products and possibly from other degradation pathways of DecaBDE." The study provides no basis to suggest that photolysis of DBDPO in the environment is a source of lower brominated DPES.</p> <p>Sellstrom et al. (2005) recently reported that no evidence of photolytic debromination of DBDPO was found in agricultural soils, which had been amended with sewage sludge containing DBDPO. The authors also stated that DBDPO showed high persistence in soil based on levels 20 years after the last spreading of sewage sludge.</p> <p>In light of this data, what additional information would EPA need to reasonably determine that DBDPO does not photolytically degrade indoors to any substantial extent?</p>
<p>Rate of Release from Sources in the Indoor Environment</p>	<p>National Academy of Sciences. 2000. Toxicological Risks of Selected Flame Retardants. Cited in BFRIP's Dec '02 VCCEP Submission.</p>	<p>Estimated child's exposure due to suckling FR-upholstery: 0.03 mg DBDPO/kg bw.</p> <p>Calculated oral RfD: 4 mg/kg bw.</p>
	<p>Kemmlin et al. 2003. Atmos. Environ. 37:5485-5493. Cited in EPA's Aug '05 letter as suggested guideline, method or approach. Included in BFRIP's Nov '05 presentation to EPA.</p>	<p>Insulating rubber: DBDPO volatile emission not detected over 230 d.</p> <p>TV housing: DBDPO volatile emission not detected over 105 d. DBDPO detected on collection chamber walls (sink effect, particle binding). Area specific emission rate based on level detected on chamber walls: 0.3 ng/m²/hr. BFRIP estimated emission rate from TV housing = 7 ng/m²/d.</p> <p>What would EPA want done differently given Kemmlin</p>

BFRIP DRAFT MATRIX

	<p>University of Surrey, UK. 2005 Report on Release of FR from Upholstery Textiles.</p> <p>Summary included in BFRIP's Nov '05 presentation to EPA.</p>	<p>et al. was listed as a suggested method?</p> <p>Release from fabric due to wear and aging. Cotton backcoated with typical load level of 2.4 mg DBDPO/cm² fabric.</p> <p>No volatile DBDPO detected during aging and wear tests.</p> <p>UV-aging caused fabric to disintegrate; thermal aging had no effect on fabric wear.</p> <p>Wear test results: FR-fabric produced lower particle counts, release rates & mass concentrations than non-FR fabric when subjected to wear. All wear debris contained <DBDPO than original fabric. UV-aged wear debris had more DBDPO than nonUV-aged wear debris. Assuming maximum wear over lifetime (~20 yr): total release would be 3 (no UV) or 10 (UV) mg DBDPO/m² fabric.</p> <p>Release due to blotting or extraction: No DBDPO detected on contact blotting (simulated skin contact). <1% DBDPO extracted from unaged, thermally aged or UV-aged fabric (simulated child's suckling). Assuming 10 kg child suckles 50 cm² fabric for 90 minutes: 0.05 mg DBDPO/kg bw. US NAS 2000 estimate of same: 0.03 mg DBDPO/kg bw.</p> <p>BFRIP estimated emission rate from upholstery textile: No UV aging 410 ng/m²/d; with UV aging 1370 ng/m²/d.</p> <p>What additional data are needed and why?</p>
	<p>Clausen et al. 2004. Environ. Sci. Technol 38:2531-2537.</p>	<p>Emission and sorption experiments with DEHP. Dust sorbed 4X the DEHP as emitted to ambient air.</p> <p>DBDPO is known to adsorb to particulates. What would information from a study like this tell us about potential exposures to children?</p>
	<p>NIST Studies. Appendix D. PBDEs Research and Assessment Activities at Other U.S. Federal Agencies. EPA PBDE Project Plan. 2006, page 38.</p>	<p>The PBDE Project Plan lists studies conducted by NIST: "examine the rates by which PBDEs are emitted from plastics over time due to natural weathering, increased temperatures and irradiant exposures"; "measure PBDEs in house dust." BFRIP has no information on the design and conduct of the emission studies; nor the results. Please provide a progress report on the study results.</p> <p>Does this work provide the information EPA desires with respect to rates of release from indoor sources? Should this study be taken into consideration when determining whether BFRIP should conduct similar work?</p>
	<p>ASTM D5116-97. Small-scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.</p> <p>ASTM D6670-01. Full-scale Chamber Determinations of Volatile Organic Emissions from Indoor Materials/Products.</p> <p>Cited in EPA's Aug '05 letter as suggested guideline, method or approach re designing/selecting laboratory cells or chambers.</p>	<p>Data on emissions from TV housing and rubber have been collected in a small-scale chamber and published as Kemmlein et al.</p> <p>BFRIP has expressed an interest in discussions with EPA to expand on this work by measuring actual DBDPO levels in the home: settled dust (wipe samples of nonporous surfaces), vacuumed dust (bare floor, carpet), interior window film, entryway, exterior and interior dust deposition. EPA methods recommended – see Nishioka et al. 2001 EHP 109:1185-1191.</p>

BFRIP DRAFT MATRIX

	<p>ASTM D6661-01. Field Collection of Organic Compounds from Surfaces Using Wipe Sampling.</p> <p>Cited in EPA's Aug '05 letter as suggested guideline, method or approach re dislodging behavior of E-goods.</p>	<p>BFRIP has expressed interest in discussions with EPA to measure DBDPO levels in the home, including collecting wipe samples. EPA methods recommended – see Nishioka et al. 2001 EHP 109:1185-1191.</p>
	<p>ASTM E1973-99. Collection of Surface Dust by Air Sampling Pump Vacuum Technique for Subsequent Lead Determination.</p> <p>Cited in EPA's Aug '05 letter as suggested guideline, method or approach re dislodging behavior of drapery/upholstery fabric.</p>	<p>BFRIP has expressed to the Agency its interest in measuring DBDPO levels in the home, including vacuumed dust. EPA recommended methods – see Nishioka et al. 2001 EHP 109:1185-1191.</p>
	<p>Methods published by American Asso. Textile Chemists and Colorists for home laundering, dry cleaning and abrasion.</p> <p>Cited in EPA's Aug '05 letter as suggested guideline, method or approach re leaching from sources (e.g. curtains) during laundering.</p>	<p>Abrasion data on FR-upholstery fabric available. See UK Surrey study in BFRIP information presented to EPA at Nov '05 meeting.</p> <p>What is the relevance of laundering or dry cleaning to children's potential exposure to DBDPO? Main items laundered in the home are clothes, sheets and towels. None of these are flame retarded with DBDPO.</p> <p>Most upholstery fabric is not removable from furniture. The most common flame retarded fabrics in homes are used in upholstery. This is occasionally laundered if in the form of slip-covers; frequency expected as \leq once or twice a year. Same frequency expected for curtains. Slip-covers seldom if ever dry-cleaned & dry cleaning of fabrics not typically done in the home. Fixed upholstery not laundered in washing machine – spot cleaned in place.</p> <p>The suggested methodology was designed for testing color-fastness. In what way is this methodology intended to be applied to DBDPO? Measure [DBDPO] in wash water or fabric backcoat? Level of sensitivity needed to detect change in concentration before and after washing achievable? DBDPO difficult to analyze and water solubility <0.1 ug/L. What will the results from studies of this type tell us about potential exposures to children?</p>
<p>Migration from Land-Disposed Goods, and Subsequent Anaerobic Biodegradation under Landfill Conditions.</p>	<p>ASTM D6776-02. Anaerobic biodegradability of radiolabeled test materials in a laboratory-scale simulated landfill environment.</p> <p>Ejlertsson et al. 2003. Adv. Environ. Res. 7:949-960.</p> <p>Bauer and Hermann. 1997. Sci Tot Environ. 208:49-57.</p> <p>Pohland et al. 1998. Wat. Sci. Tech. 38:169-175.</p> <p>Cited in EPA's Aug '05 letter as suggested guideline, method or approach</p>	<p>Given DBDPO's physical/chemical properties, why is DBDPO migration out of land-disposed goods suspected to be of a magnitude that results in a quantity of degradants sufficient to reach children at meaningful concentrations?</p> <p>How will any degradants, if formed, reach children if degradation occurs in a landfill?</p> <p>What timeframe for this sequence of events is expected, and how does this timeframe compare to the duration of childhood?</p> <p>What degradants are of concern?</p> <p>What amount and rate of degradation would be of concern?</p>
	<p>Norris et al. 1973, 1974.</p> <p>Cited in BFRIP's Dec '02 VCCEP</p>	<p>DBDPO not extracted from plastic by water, acetic acid or cottonseed oil.</p>

BFRIP DRAFT MATRIX

	Submission.	Given DBDPO's low solubility in water and organic solvents and negligible vapor pressure, on what basis would one reasonably suspect that significant amounts of DBDPO would be expected to migrate from plastics?
	USGS studies. Appendix D. PBDEs Research and Assessment Activities at Other U.S. Federal Agencies. EPA PBDE Project Plan. 2006, page 39.	<p>The PBDE Project Plan lists studies conducted by USGS: "measure indoor air levels of PBDEs in homes and offices"; "evaluate the environmental fate of PBDEs"; "determine the potential for weathered recycled computer equipment to contaminate nearby soil and sediments". BFRIP has no information on the design and conduct of these studies. Please provide an update or study results.</p> <p>Does this work provide the information EPA desires with respect to a) environmental fate, and b) potential for migration from disposed electronics? Should this work be taken into consideration when determining whether BFRIP should conduct similar work?</p>
	NIST Studies. Appendix D. PBDEs Research and Assessment Activities at Other U.S. Federal Agencies. EPA PBDE Project Plan. 2006, page 38.	<p>The PBDE Project Plan lists studies conducted by NIST: "examine the rates by which PBDEs are emitted from plastics over time due to natural weathering, increased temperatures and irradiant exposures"; "measure PBDEs in house dust." BFRIP has no information on the design and conduct of the emission studies.</p> <p>Does this work provide the information EPA desires with respect to potential emissions from disposed products? Should this study be taken into consideration when determining whether BFRIP should conduct similar work?</p>
	University of Florida. Appendix C. PBDE Research and Assessment Activities Conducted by or Funded by EPA. at Other U.S. Federal Agencies. EPA PBDE Project Plan. 2006, page 32.	<p>The PBDE Project Plan lists a study conducted by University of Florida to "evaluate potential impact of flame retardants in plastics in electronic devices, including potential for leaching of flame retardants from the plastics. BFRIP has no information on the design and conduct of this work; please provide an update and the study results.</p> <p>Does this work provide the information EPA desires with respect to emissions from disposed products? Should this study be taken into consideration when determining whether BFRIP should conduct similar work?</p>