Voluntary Children's Chemical Evaluation Program Pilot (VCCEPP)

Tier 1 Assessment Of The Potential Health Risks To Children Associated With Exposure To The Commercial Pentabromodiphenyl Ether Product

Appendix I: List of Brominated Diphenyl Ether (BDE) Congeners

Appendix I. List of brominated diphenyl ether (BDE) congeners.

Table includes the common BDE congeners (out of the 209 total possible congeners) using the numbering system developed for polychlorinated biphenyls (PCBs).

Numbering System	Number of Bromine Atoms	Congener Name	
BDE-0	0		diphenyl ether
BDE-1	1	2-	monobromodiphenyl ether
BDE-2	1	3-	monobromodiphenyl ether
BDE-3	1	4-	monobromodiphenyl ether
BDE-7	2	2,4-	dibromodiphenyl ether
BDE-8	2	2,4'-	dibromodiphenyl ether
BDE-10	2	2,6-	dibromodiphenyl ether
BDE-11	2	3,3'-	dibromodiphenyl ether
BDE-12	2	3,4-	dibromodiphenyl ether
BDE-13	2	3,4'-	dibromodiphenyl ether
BDE-15	2	4,4'-	dibromodiphenyl ether
BDE-17	3	2,2',4-	tribromodiphenyl ether
BDE-25	3	2,3',4-	tribromodiphenyl ether
BDE-28	**3**	**2,4,4'-**	**tribromodiphenyl ether**
BDE-30	3	2,4,6-	tribromodiphenyl ether
BDE-32	3	2,4',6-	tribromodiphenyl ether
BDE-33	3	2',3,4-	tribromodiphenyl ether
BDE-35	3	3,3',4-	tribromodiphenyl ether
BDE-37	3	3,4,4'-	tribromodiphenyl ether
BDE-39	3	3,4',5-	tribromodiphenyl ether
BDE-47	**4**	**2,2',4,4'-**	**tetrabromodiphenyl ether**
BDE-51	4	2,2',4,6'-	tetrabromodiphenyl ether
BDE-66	**4**	**2,3',4,4'-**	**tetrabromodiphenyl ether**
BDE-71	4	2,3',4',6-	tetrabromodiphenyl ether
BDE-75	4	2,4,4',6-	tetrabromodiphenyl ether
BDE-77	4	3,3',4,4'-	tetrabromodiphenyl ether
BDE-85	**5**	**2,2',3,4,4'-**	**pentabromodiphenyl ether**
BDE-99	**5**	**2,2',4,4',5-**	**pentabromodiphenyl ether**
BDE-100	**5**	**2,2',4,4',6-**	**pentabromodiphenyl ether**
BDE-101	5	2,2',4,5,5'-	pentabromodiphenyl ether
BDE-105	5	2,3,3',4,4'-	pentabromodiphenyl ether
BDE-116	5	2,3,4,5,6-	pentabromodiphenyl ether
BDE-119	5	2,3',4,4',6-	pentabromodiphenyl ether
BDE-128	6	2,2',3,3',4,4'-	hexabromodiphenyl ether
BDE-138	6	2,2',3,4,4',5'-	hexabromodiphenyl ether
BDE-140	6	2,2',3,4,4',6'-	hexabromodiphenyl ether
BDE-151	6	2,2',3,5,5',6-	hexabromodiphenyl ether
BDE-153	**6**	**2,2',4,4',5,5'-**	**hexabromodiphenyl ether**
BDE-154	**6**	**2,2',4,4',5,6'-**	**hexabromodiphenyl ether**
BDE-155	6	2,2',4,4',6,6'-	hexabromodiphenyl ether
BDE-166	6	2,3,4,4',5,6-	hexabromodiphenyl ether
BDE-172	7	2,2',3,3',4,5,5'-	heptabromodiphenyl ether
BDE-176	7	2,2',3,3',4,6,6'-	heptabromodiphenyl ether

Numbering System	Number of Bromine Atoms	Congener Name	
BDE-181	7	2,2',3,4,4',5,6-	heptabromodiphenyl ether
BDE-183	**7**	**2,2',3,4,4',5',6-**	**heptabromodiphenyl ether**
BDE-185	7	2,2',3,4,5,5',6-	heptabromodiphenyl ether
BDE-189	7	2,3,3',4,4',5,5'-	heptabromodiphenyl ether
BDE-190	7	2,3,3',4,4',5,6-	heptabromodiphenyl ether
BDE-192	7	2,3,3',4,5,5',6-	heptabromodiphenyl ether
BDE-197	8	2,2',3,3',4,4',6,6'-	octabromodiphenyl ether
BDE-203	8	2,2',3,4,4',5,5',6-	octabromodiphenyl ether
BDE-209	**10**	**2,2',3,3',4,4',5,5',6,6'-**	**decabromodiphenyl ether**

Bold type indicates the BDE congeners most commonly found in environmental samples.

Voluntary Children's Chemical Evaluation Program Pilot (VCCEPP)

Tier 1 Assessment Of The Potential Health Risks To Children Associated With Exposure To The Commercial Pentabromodiphenyl Ether Product

Appendix II: Material Safety Data Sheets (MSDS)

MSDS
for
Great Lakes DE-60F Special™

SECTION I - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: **Great Lakes DE-60F Special™**
Manufacturer: Great Lakes Chemical Corporation
Address: P.O. Box 2200 **City:** West Lafayette
State: Indiana **Zip:** 47996-2200
Emergency Telephone Number: **1-800-949-5167**
Information Telephone Number: 1-765-497-6100 **Fax:** 1-765-497-6123
Chemtrec Phone: **1-800-424-9300; Internationally call 703-527-3887**
Effective Date: 02/04/2002 **Supercede Date:** 3/15/99
MSDS Prepared By: Regulatory Affairs Department/Great Lakes Chemical Corporation
Synonyms: None
Product Use: Flame Retardant
Chemical Name: Mixture
Chemical Family: Brominated diphenyl oxide/Aromatic phosphate Blend

Additional Information

No information available

SECTION II - COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT NAME	CAS NO.	%	EXPOSURE LIMITS
*Aromatic phosphates			
Triaryl phosphates, isopropylated	TS	12.8 - 21.6	Y (Hazardous) Not established (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) Not established (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Triphenyl phosphate	115866	5.6 - 10.8	N (Hazardous) 3 ppm (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) 3 ppm (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Hexabromodiphenyl oxide	36483600	Proprietary	Y (Hazardous) 15 mg/m3 (PNOR) (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) 10 mg/m3 (PNOC) (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Pentabromodiphenyl oxide	32534819	Proprietary	Y (Hazardous) 15 mg/m3 (PNOR) (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) 10 mg/m3 (PNOC) (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)

Tetrabromodiphenyl oxide	40088479	Proprietary	Y (Hazardous) Not established (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) Not established (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Tribromodiphenyl oxide	49690940	Proprietary	Y (Hazardous) Not established (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) Not established (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)

*Indented chemicals are components of previous ingredient.

Additional Information

Additional recommended exposure limits:
Triphenyl phosphate:
NIOSH REL = 3 ppm

SECTION III - HAZARDS IDENTIFICATION

Emergency Overview: Clear, amber, dense liquid
Causes eye irritation.
Toxic to aquatic organisms.
Persistent in the environment.

Relevant Routes of Exposure: Ingestion, inhalation and skin absorption

Signs and Symptoms of Overexposure: General reddening and irritation to the skin and eyes, mucous membrane irritation, upper respiratory tract irritation.
Signs and symptoms of cholinesterase inhibition include tremors, tears, salivation, sweating, headache, muscled twitching, abdominal cramps, diarrhea, incoordination, blurred vision, nausea and chest discomfort.

Medical Conditions Generally Aggravated By Exposure: Dermatitis

Potential Health Effects: See Section XI for additional information.

Eyes: Causes eye irritation.

Skin: May cause mild skin irritation.

Ingestion: Not expected to be an acute hazard in normal industrial use. See Chronic Heath Effects.

Inhalation: Not expected to be a hazard in normal industrial use.

Chronic Health Effects: Long term overexposure may result in liver, thyroid, blood and central nervous system effects.

Carcinogenicity:

NTP:	No	**ACGIH:**	No
IARC:	No	**OTHER:**	No
OSHA:	No		

Additional Information

No information available

SECTION IV - FIRST AID MEASURES

Eyes: Flush with large volumes of water for at least 15 minutes. Get medical attention.

SECTION IV - FIRST AID MEASURES

Skin:	Wash with large volumes of soap and water for at least 15 minutes. If irritation develops, get medical attention.
Ingestion:	If conscious, give person 1 to 2 glasses of water. Get medical attention immediately.
Inhalation:	Remove person to fresh air. Get medical attention.
Antidotes:	No information available
Notes to Physicians and/or Protection for First-Aiders:	No information available

Additional Information

No information available

SECTION V - FIRE FIGHTING MEASURES

Flammable Limits in Air (% by Volume):	Not available
Flash Point:	Not available
Autoignition Temperature:	Not available
Extinguishing Media:	All conventional media are suitable.
Fire Fighting Instructions:	Wear a self-contained breathing apparatus and protective clothing to prevent skin and eye contact in fire situations.
Unusual Fire and Explosion Hazards:	Under fire conditions, toxic and irritating fumes may be emitted.
Flammability Classification:	Non-flammable liquid
Known or Anticipated Hazardous Products of Combustion:	Hydrogen bromide and/or bromine Oxides of phosphorus Carbon monoxide and carbon dioxide

Additional Information

No information available

SECTION VI - ACCIDENTAL RELEASE MEASURES

Accidental Release Measures:	Wearing appropriate personal protective equipment, collect spill with the aid of an inert absorbent and place in suitable labeled containers for disposal. Wash spill area after pick-up is complete, collecting all clean up water for appropriate disposal.
Personal Precautions:	See Section VIII.
Environmental Precautions:	Persistent in the environment. Avoid releasing to the environment. Do not allow spills to enter surface waters (streams, rivers, ponds, lakes, etc.).

Additional Information

No information available

SECTION VII - HANDLING AND STORAGE

Handling:	Use appropriate personal protection equipment. Avoid eye, skin and clothing contact. Do not breathe mist or vapor. Avoid repeated and prolonged contact.

SECTION VII - HANDLING AND STORAGE

	For handling purposes, material may be heated from 30 to 50 degrees C. Use of a chemical fume hood is recommended for open handling, where appropriate.
Storage:	Store in a cool, dry, well-ventilated area away from incompatible materials. Keep container tightly closed.
Other Precautions:	No information available

Additional Information

No information available

SECTION VIII - EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls:	No information available
Ventilation Requirements:	Use local exhaust to minimize misting and vapor. Use mechanical ventilation for general area control.
Personal Protective Equipment:	
Eye/Face Protection:	Chemical safety glasses with side shields or chemical safety goggles
Skin Protection:	Combination neoprene is recommended over natural latex. Clothing designed to minimize skin contact
Respiratory Protection:	Wear a NIOSH/MSHA approved organic cartridge respirator if misting or vapor occurs, or there is potential for airborne exposures to exceed established threshold values. Consult the OSHA respiratory protection information located at 29CFR 1910.134 and the American National Standard Institute's Practices of Respiratory Protection Z88.2.
Other Protective Clothing or Equipment:	No information available
Exposure Guidelines:	See Section II.
Work Hygienic Practices:	Wash thoroughly after handling. Wash contaminated clothing before reuse.

Additional Information

No information available

SECTION IX - PHYSICAL & CHEMICAL PROPERTIES

Appearance:	Clear, amber, dense liquid	**Percent Volatile:**	Not available
Boiling Point:	Not available	**pH Value:**	Not available
Bulk Density:	Not available	**pH Concentration:**	Not available
Color:	Amber	**Physical State:**	Liquid
Decomposition Temperature:	Not available	**Reactivity in Water:**	Not water reactive
Evaporation Rate:	Not available	**Saturated Vapor Concentration:**	Not available
Freezing Point:	Not available	**Softening Point:**	Not available
Heat Value:	Not available	**Solubility in Water:**	<0.1 g/100 g at 25 degrees C
Melting Point:	Not available	**Specific Gravity or Density (Water=1):**	1.9 at 25 degrees C
Molecular/Chemical Formula:	Mixture	**Vapor Density:**	Not available
Molecular Weight:	NA	**Vapor Pressure:**	<0.01 mmHg at 95 degrees F
Octanol/Water Partition Coefficient:	Not available	**Viscosity:**	4,470 cps at 20 degrees C

SECTION IX - PHYSICAL & CHEMICAL PROPERTIES

Odor:	No odor	**Volatile Organic Compounds:**	Not available
Odor Threshold:	Not available	**Water/Oil Distribution Coefficient:**	Not available
Particle Size:	Not available	**Weight Per Gallon:**	Not available

Additional Information

No information available

SECTION X - STABILITY AND REACTIVITY

Stability:	Stable under normal conditions of handling and use.
Conditions to Avoid:	None
Incompatibility With Other Materials:	None known
Hazardous Decomposition Products:	Thermal decomposition may produce the following: Hydrogen bromide and/or bromine Oxides of phosphorus Carbon monoxide and carbon dioxide
Hazardous Polymerization:	Will not occur
Conditions to Avoid:	None

Additional Information

No information available

SECTION XI - TOXICOLOGICAL INFORMATION

VALUE (LD50 OR LC50)	ANIMAL	ROUTES	COMPONENTS
>200 mg/L	Rat	Acute Inhalation	Pentabromodiphenyl oxide
5.2 mg/L	Rat	Acute Inhalation	Aromatic phosphates
>2,000 mg/kg	Rabbit	Acute Dermal	Aromatic phosphates
>2,000 mg/kg	Rabbit	Acute Dermal	Pentabromodiphenyl oxide
>3,000 mg/kg	Rat	Acute Oral	Aromatic phosphates
6,200 mg/kg	Rat	Acute Oral	Pentabromodiphenyl oxide

Toxicological Information:
The toxicological properties of this blend have not been determined. Component information is listed below.

Pentabromodiphenyl oxide:
This material has been determined not to be a primary skin irritant in rabbits.
This material has been found to be a slight eye irritant in rabbits.
This material did not cause sensitization in a guinea pig maximization study.

This material was not found to be mutagenic in in vitro microbial assays and negative results were obtained for the induction of structural and numerical chromosome aberrations in human peripheral blood lymphocytes.

Liver cell enlargement and thyroid hyperplasia were observed in a 90-day oral study in rats. Upon compound withdrawal, thyroid hyperplasia was reversible; necrosis was observed in some enlarged liver cells.

In a 30-day oral study in rats, no compound related liver or thyroid effects were observed at 1 mg/kg.

In a 28-day oral diet study in rats, hepatic centrilobular hypertrophy was observed at 100 and 1,000 ppm. Thyroid hyperplasia and increased liver weights were observed at 1,000 ppm. A NOEL was established to be <100 ppm (<~10 mg/kg/day).

In a 28-day gavage study in rats, hepatic hypertrophy and increased liver weight was observed at 250 mg/kg/day.

In a rat developmental study, no developmental effects were seen at the highest dose tested of 200 mg/kg/day. A maternal NOEL was established at 10 mg/kg/day and a fetal NOEL was established at 100 mg/kg/day.

Triaryl phosphate, isopropylated:
Based on a similar product, this material has low acute oral and dermal toxicity. Primary eye and skin irritation studies in rabbits on a similar product did not result in eye or skin irritation. However, eye and skin irritation may be possible. Prolonged or continuous contact with skin will cause irritation. Product may be irritating to the respiratory system and mucous membranes. Breathing or swallowing large quantities may cause neurological effects. Repeated exposure over a prolonged period of time may cause neurological effects.

Other acute and chronic health hazards, as well as target organs, are unknown.

Additional Information

No information available

SECTION XII - ECOLOGICAL INFORMATION

Ecological Information: The following ecological information is offered:

Pentabromodiphenyl oxide:
EC50 in Daphnia magna (48H) = 19 ug/L (nominal); 14 ug/L mean measure concentration; NOEL = 6.5 ug/L

LC50 in rainbow trout (96H) >26 ug/L (nominal); >21 ug/L mean measured concentration; NOEL = 26 ug/L

EC10, EC50, EC90 in freshwater algae (96H) >26 ug/L (nominal); >14 ug/L mean measured concentration

LC50 in earthworms (14 Days) >500 mg/kg of dry soil

In a Carbon Dioxide Evolution Test, minimal degradation of the test substance was observed over a 93 day test period. This material evolved an average of approximately 0.0 and 2.4% TCO on days 29 and 93 respectively.

In a Daphnia magna life cycle study, a NOEC of 5.3 ug/L, LOEC of 9.8 ug/L and a MATC of 7.2 ug/L were established.

In an early life-stage toxicity study in rainbow trout, a NOEC of 8.9 ug/L, LOEC of 16 ug/L and a MATC of 12 ug/L were established.

SECTION XII - ECOLOGICAL INFORMATION

In a bioaccumulation study in carp, this material was found to bioaccumulate.

In prolonged sediment toxicity tests utilizing Chironomus riparius, Lumbriculus variegatus, and Hyalella azteca, the EC 50 (28 Day) for all test organisms was >50 mg/kg.

In seedling emergence tests, the 21 day NOEC in corn, tomato, onion, soybean, ryegrass and cucumber was established to be 16 mg/kg, 125 mg/kg, 1000 mg/kg, 1000 mg/kg, 1000 mg/kg, and 1000 mg/kg, respectively.
Persistent in the environment.

Triaryl phosphate, isopropylated:
LC50 in rainbow trout (96H) = 1.6 (1.2 - 2.2) mg/L
LC50 in fathead minnow (96H) = 10.8 (8.0 - 14.6) mg/L
EC50 in Daphnia magna (48H) = 2.44 (1.93 - 3.08) mg/L

Do not allow spills to enter surface waters (streams, rivers, ponds, lakes, etc.).

Additional Information

No information available

SECTION XIII - DISPOSAL CONSIDERATIONS

Disposal Considerations: Dispose of waste at an approved chemical disposal facility in compliance with all current Local, State/Province, Federal/Canadian laws and regulations.

Additional Information

No information available

SECTION XIV - TRANSPORT INFORMATION

U.S. DOT

Proper Shipping Name:	Environmentally hazardous substance, liquid, n.o.s. (Contains triaryl phosphates, isopropylated and triphenyl phosphate)		
Hazard Class:	9	**ID Number:**	UN3082
Packing Group:	III	**Labels:**	Miscellaneous, Marine Pollutant
Special Provisions:	8, IB3, T4, TP1, TP29	**Packaging Exceptions:**	155
Non-Bulk Packaging:	203	**Bulk Packaging:**	241
Passenger Air/Rail Limit:	None	**Air Cargo Limit:**	None
Vessel Stowage:	A	**Other Stowage:**	N/A
Reportable Quantity:	N/A		

AIR - ICAO OR IATA

Proper Shipping Name:	Environmentally hazardous substance, liquid, n.o.s. (Contains triaryl phosphates, isopropylated and triphenyl phosphate)		
Hazard Class:	9	**ID Number:**	UN3082
Subsidiary Risk:	N/A	**Packing Group:**	III
Hazard Labels:	Miscellaneous, Marine Pollutant	**Packing Instructions:**	914; LQY914

SECTION XIV - TRANSPORT INFORMATION

Air Passenger Limit Per Package:	See Below	**Packing Instruction - Cargo:**	914
Air Cargo Limit Per Package:	No limit	**Special Provisions Code:**	A97

WATER - IMDG

Proper Shipping Name:	Environmentally hazardous substance, liquid, n.o.s. (Contains triaryl phosphates, isopropylated and triphenyl phosphate)		
Hazard Class:	9	**ID Number:**	UN3082
Packing Group:	III	**Subsidiary Risk:**	N/A
Medical First Aid Guide Code:	None		

Additional Information

Air Maximum Net Quantity: No limit; LQ 30 kg G

EmS No. - None

Marine Pollutant

SECTION XV - REGULATORY INFORMATION

U.S. Federal Regulations:

The components of this product are either on the TSCA Inventory or exempt (i.e. impurities, a polymer complying with the exemption rule at 40 CFR 723.250) from the Inventory.

State Regulations:

Triphenyl phosphate:
Massachusetts Substance List
New Jersey Right To Know Hazardous Substance List (1% reporting limit)
Pennsylvania Hazardous Substance List (1% reporting limit)

International Regulations:

This material (or each component) is listed on the following inventories:
Canada - DSL
EU - EINECS
Australia - AICS
Korea - ECL
Japan - ENCS
Philippines - PICCS
China - List I

Canadian Disclosure List (1%) - Triphenyl phosphate
Canadian WHMIS Hazard Class and Division = D.2.b

SARA Hazards:

Acute:	Yes	**Chronic:**	Yes
Reactive:	No	**Fire:**	No
Pressure:	No		

Additional Information

The above regulatory information represents only selected regulations and is not meant to be a complete list.

SECTION XVI - OTHER INFORMATION

NFPA Codes:

Health:	2	**Flammability:**	0
Reactivity:	0	**Other:**	N

SECTION XVI - OTHER INFORMATION

HMIS Codes: * indicates chronic health hazard.

Health:	1*	**Flammability:**	0
Reactivity:	0	**Protection:**	X

Label Statements: Not available

Other Information: Abbreviations:

(L) = Loose bulk density in g/ml
LOEC = Lowest observed effect concentration
MATC = Maximum acceptable toxicant concentration
NA = Not available
N/A = Not applicable
NL = Not limited
NOAEL = No observable adverse effect level
NOEC = No observed effect concentration
NOEL = No observable effect level
NR = Not rated
(P) = Packed bulk density in g/ml
PNOC = Particulates Not Otherwise Classified
PNOR = Particulates Not Otherwise Regulated
REL = Recommended exposure limit
TS = Trade secret

Additional Information

Information on this form is furnished solely for the purpose of compliance with OSHA's Hazard Communication Standard, 29CFR 1910.1200 and The Canadian Environmental Protection Act, Canada Gazette Part II, Vol. 122, No. 2 and shall not be used for any other purpose.

Revision Information:
General review and update.
Section VI Environmental precautions
Section VII - Handling information
Section IX - Physical properties
Section XI - Toxicological information
Section XII- Ecological information
Section XIV - DOT Special provisions
Section XV - International inventories

MSDS
for
Great Lakes DE-61™

SECTION I - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: **Great Lakes DE-61™**
Manufacturer: Great Lakes Chemical Corporation
Address: P.O. Box 2200 **City:** West Lafayette
State: Indiana **Zip:** 47996-2200
Emergency Telephone Number: **1-800-949-5167**
Information Telephone Number: 1-765-497-6100 **Fax:** 1-765-497-6123
Chemtrec Phone: **1-800-424-9300; Internationally call 703-527-3887**
Effective Date: 02/04/2002 **Supercede Date:** 3/15/99
MSDS Prepared By: Regulatory Affairs Department/Great Lakes Chemical Corporation
Synonyms: None
Product Use: Flame Retardant
Chemical Name: Mixture
Chemical Family: Brominated diphenyl oxide/Aromatic phosphate/Surfactant Blend

Additional Information

No information available

SECTION II - COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT NAME	CAS NO.	%	EXPOSURE LIMITS
*Aromatic phosphates			
Triaryl phosphates, isopropylated	TS	12.8 - 21.6	Y (Hazardous) Not established (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) Not established (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Triphenyl phosphate	115866	5.6 - 10.8	N (Hazardous) 3 ppm (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) 3 ppm (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Hexabromodiphenyl oxide	36483600	Proprietary	Y (Hazardous) 15 mg/m3 (PNOR) (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) 10 mg/m3 (PNOC) (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Pentabromodiphenyl oxide	32534819	Proprietary	Y (Hazardous) 15 mg/m3 (PNOR) (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) 10 mg/m3 (PNOC) (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)

Surfactant	TS	Proprietary	Y (Hazardous) Not established (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) Not established (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Tetrabromodiphenyl oxide	40088479	Proprietary	Y (Hazardous) Not established (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) Not established (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Tribromodiphenyl oxide	49690940	Proprietary	Y (Hazardous) Not established (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) Not established (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)

*Indented chemicals are components of previous ingredient.

Additional Information

Additional recommended exposure limits:
Triphenyl phosphate:
NIOSH REL = 3 ppm

SECTION III - HAZARDS IDENTIFICATION

Emergency Overview: Clear, amber, dense liquid
Causes eye irritation.
Toxic to aquatic organisms.
Persistent in the environment.

Relevant Routes of Exposure: Ingestion, inhalation and skin absorption

Signs and Symptoms of Overexposure: General reddening and irritation to the skin and eyes, mucous membrane irritation, upper respiratory tract irritation.
Signs and symptoms of cholinesterase inhibition include tremors, tears, salivation, sweating, headache, muscled twitching, abdominal cramps, diarrhea, incoordination, blurred vision, nausea and chest discomfort.

Medical Conditions Generally Aggravated By Exposure: Dermatitis

Potential Health Effects: See Section XI for additional information.

Eyes: Causes eye irritation.
Skin: May cause mild skin irritation.
Ingestion: Not expected to be an acute hazard in normal industrial use. See Chronic Heath Effects.
Inhalation: Not expected to be a hazard in normal industrial use.
Chronic Health Effects: Long term overexposure may result in liver, thyroid, blood and central nervous system effects.

Carcinogenicity:

NTP: No **ACGIH:** No
IARC: No **OTHER:** No
OSHA: No

SECTION III - HAZARDS IDENTIFICATION

Additional Information

No information available

SECTION IV - FIRST AID MEASURES

Eyes:	Flush with large volumes of water for at least 15 minutes. Get medical attention.
Skin:	Wash with large volumes of soap and water for at least 15 minutes. If irritation develops, get medical attention.
Ingestion:	If conscious, give person 1 to 2 glasses of water. Get medical attention immediately.
Inhalation:	Remove person to fresh air. Get medical attention.
Antidotes:	No information available
Notes to Physicians and/or Protection for First-Aiders:	No information available

Additional Information

No information available

SECTION V - FIRE FIGHTING MEASURES

Flammable Limits in Air (% by Volume):	Not available
Flash Point:	Not available
Autoignition Temperature:	Not available
Extinguishing Media:	All conventional media are suitable.
Fire Fighting Instructions:	Wear a self-contained breathing apparatus and protective clothing to prevent skin and eye contact in fire situations.
Unusual Fire and Explosion Hazards:	Under fire conditions, toxic and irritating fumes may be emitted.
Flammability Classification:	Non-flammable liquid
Known or Anticipated Hazardous Products of Combustion:	Hydrogen bromide and/or bromine Oxides of phosphorus Aldehydes Ketones Carbon monoxide and carbon dioxide

Additional Information

No information available

SECTION VI - ACCIDENTAL RELEASE MEASURES

Accidental Release Measures:	Wearing appropriate personal protective equipment, collect spill with the aid of an inert absorbent and place in suitable labeled containers for disposal. Wash spill area after pick-up is complete, collecting all clean up water for appropriate disposal.
Personal Precautions:	See Section VIII.
Environmental Precautions:	Persistent in the environment. Avoid releasing to the environment. Do not allow spills to enter surface waters (streams, rivers, ponds, lakes, etc.).

SECTION VI - ACCIDENTAL RELEASE MEASURES

Additional Information

No information available

SECTION VII - HANDLING AND STORAGE

Handling: Use appropriate personal protection equipment.
Avoid eye, skin and clothing contact.
Do not breathe mist or vapor.
Avoid repeated and prolonged contact.
For handling purposes, material may be heated from 30 to 50 degrees C.
Use of a chemical fume hood is recommended for open handling, where appropriate.

Storage: Store in a cool, dry, well-ventilated area away from incompatible materials.
Keep container tightly closed.

Other Precautions: No information available

Additional Information

No information available

SECTION VIII - EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls: No information available

Ventilation Requirements: Use local exhaust to minimize misting and vapor.
Use mechanical ventilation for general area control.

Personal Protective Equipment:

Eye/Face Protection: Chemical safety glasses with side shields or chemical safety goggles

Skin Protection: Combination neoprene is recommended over natural latex.
Clothing designed to minimize skin contact

Respiratory Protection: Wear a NIOSH/MSHA approved organic cartridge respirator if misting or vapor occurs, or there is potential for airborne exposures to exceed established threshold values.
Consult the OSHA respiratory protection information located at 29CFR 1910.134 and the American National Standard Institute's Practices of Respiratory Protection Z88.2.

Other Protective Clothing or Equipment: No information available

Exposure Guidelines: See Section II.

Work Hygienic Practices: Wash thoroughly after handling.
Wash contaminated clothing before reuse.

Additional Information

No information available

SECTION IX - PHYSICAL & CHEMICAL PROPERTIES

Appearance:	Clear, amber, dense liquid	**Percent Volatile:**	Not available
Boiling Point:	Approx. 300 degrees F	**pH Value:**	Not available
Bulk Density:	Not available	**pH Concentration:**	Not available
Color:	Amber	**Physical State:**	Liquid
Decomposition Temperature:	Not available	**Reactivity in Water:**	Not water reactive
Evaporation Rate:	Not available	**Saturated Vapor Concentration:**	Not available

SECTION IX - PHYSICAL & CHEMICAL PROPERTIES

Freezing Point:	Not available	**Softening Point:**	Not available
Heat Value:	Not available	**Solubility in Water:**	<0.1 g/100 g at 25 degrees C
Melting Point:	Not available	**Specific Gravity or Density (Water=1):**	1.9 at 25 degrees C
Molecular/Chemical Formula:	Mixture	**Vapor Density:**	Not available
Molecular Weight:	NA	**Vapor Pressure:**	Not available
Octanol/Water Partition Coefficient:	Not available	**Viscosity:**	6,120 cps at 20 degrees C
Odor:	No odor	**Volatile Organic Compounds:**	Not available
Odor Threshold:	Not available	**Water/Oil Distribution Coefficient:**	Not available
Particle Size:	Not available	**Weight Per Gallon:**	Not available

Additional Information

No information available

SECTION X - STABILITY AND REACTIVITY

Stability: Stable under normal conditions of handling and use.

Conditions to Avoid: None

Incompatibility With Other Materials: None known

Hazardous Decomposition Products: Thermal decomposition may produce the following:
Hydrogen bromide and/or bromine
Oxides of phosphorus
Aldehydes
Ketones
Carbon monoxide and carbon dioxide

Hazardous Polymerization: Will not occur

Conditions to Avoid: None

Additional Information

No information available

SECTION XI - TOXICOLOGICAL INFORMATION

VALUE (LD50 OR LC50)	ANIMAL	ROUTES	COMPONENTS
>200 mg/L	Rat	Acute Inhalation	Pentabromodiphenyl oxide
5.2 mg/L	Rat	Acute Inhalation	Aromatic phosphates
>2,000 mg/kg	Rabbit	Acute Dermal	Pentabromodiphenyl oxide
>2.00 g/kg	Rabbit	Acute Dermal	Surfactant
>2,000 mg/kg	Rabbit	Acute Dermal	Aromatic phosphates
>3,000 mg/kg	Rat	Acute Oral	Aromatic phosphates
6,200 mg/kg	Rat	Acute Oral	Pentabromodiphenyl oxide
3.31 g/kg	Rat	Acute Oral	Surfactant

Toxicological Information:
The toxicological properties of this blend have not been determined. Component information is listed below.

Pentabromodiphenyl oxide:
This material has been determined not to be a primary skin irritant in rabbits.
This material has been found to be a slight eye irritant in rabbits.
This material did not cause sensitization in a guinea pig maximization study.

This material was not found to be mutagenic in in vitro microbial assays and negative results were obtained for the induction of structural and numerical chromosome aberrations in human peripheral blood lymphocytes.

Liver cell enlargement and thyroid hyperplasia were observed in a 90-day oral study in rats. Upon compound withdrawal, thyroid hyperplasia was reversible; necrosis was observed in some enlarged liver cells.

In a 30-day oral study in rats, no compound related liver or thyroid effects were observed at 1 mg/kg.

In a 28-day oral diet study in rats, hepatic centrilobular hypertrophy was observed at 100 and 1,000 ppm. Thyroid hyperplasia and increased liver weights were observed at 1,000 ppm. A NOEL was established to be <100 ppm (<~10 mg/kg/day).

In a 28-day gavage study in rats, hepatic hypertrophy and increased liver weight was observed at 250 mg/kg/day.

In a rat developmental study, no developmental effects were seen at the highest dose tested of 200 mg/kg/day. A maternal NOEL was established at 10 mg/kg/day and a fetal NOEL was established at 100 mg/kg/day.

Triaryl phosphate, isopropylated:
Based on a similar product, this material has low acute oral and dermal toxicity. Primary eye and skin irritation studies in rabbits on a similar product did not result in eye or skin irritation. However, eye and skin irritation may be possible. Prolonged or continuous contact with skin will cause irritation. Product may be irritating to the respiratory system and mucous membranes. Breathing or swallowing large quantities may cause neurological effects. Repeated exposure over a prolonged period of time may cause neurological effects.

Surfactant:
The toxicological properties of this material have not been fully investigated. This material has been found to be a slight skin and eye irritant in rabbits, with Draize scores of 1.04/8.0 and 14.4/110, respectively.

Other acute and chronic health hazards, as well as target organs, are unknown.

Additional Information

No information available

SECTION XII - ECOLOGICAL INFORMATION

Ecological Information: The following ecological information is offered:

Pentabromodiphenyl oxide:
EC50 in Daphnia magna (48H) = 19 ug/L (nominal); 14 ug/L mean measure concentration; NOEL = 6.5 ug/L

LC50 in rainbow trout (96H) >26 ug/L (nominal); >21 ug/L mean measured concentration; NOEL = 26 ug/L

SECTION XII - ECOLOGICAL INFORMATION

EC10, EC50, EC90 in freshwater algae (96H) >26 ug/L (nominal); >14 ug/L mean measured concentration

LC50 in earthworms (14 Days) >500 mg/kg of dry soil

In a Carbon Dioxide Evolution Test, minimal degradation of the test substance was observed over a 93 day test period. This material evolved an average of approximately 0.0 and 2.4% TCO on days 29 and 93 respectively.

In a Daphnia magna life cycle study, a NOEC of 5.3 ug/L, LOEC of 9.8 ug/L and a MATC of 7.2 ug/L were established.

In an early life-stage toxicity study in rainbow trout, a NOEC of 8.9 ug/L, LOEC of 16 ug/L and a MATC of 12 ug/L were established.

In a bioaccumulation study in carp, this material was found to bioaccumulate.

In prolonged sediment toxicity tests utilizing Chironomus riparius, Lumbriculus variegatus, and Hyalella azteca, the EC 50 (28 Day) for all test organisms was >50 mg/kg.

In seedling emergence tests, the 21 day NOEC in corn, tomato, onion, soybean, ryegrass and cucumber was established to be 16 mg/kg, 125 mg/kg, 1000 mg/kg, 1000 mg/kg, 1000 mg/kg, and 1000 mg/kg, respectively.
Persistent in the environment.

Triaryl phosphate, isopropylated:
LC50 in rainbow trout (96H) = 1.6 (1.2 - 2.2) mg/L
LC50 in fathead minnow (96H) = 10.8 (8.0 - 14.6) mg/L
EC50 in Daphnia magna (48H) = 2.44 (1.93 - 3.08) mg/L

Do not allow spills to enter surface waters (streams, rivers, ponds, lakes, etc.).

Additional Information

No information available

SECTION XIII - DISPOSAL CONSIDERATIONS

Disposal Considerations: Dispose of waste at an approved chemical disposal facility in compliance with all current Local, State/Province, Federal/Canadian laws and regulations.

Additional Information

No information available

SECTION XIV - TRANSPORT INFORMATION

U.S. DOT

Proper Shipping Name: Environmentally hazardous substance, liquid, n.o.s. (Contains triaryl phosphates, isopropylated and triphenyl phosphate)

SECTION XIV - TRANSPORT INFORMATION

Hazard Class:	9	**ID Number:**	UN3082
Packing Group:	III	**Labels:**	Miscellaneous, Marine Pollutant
Special Provisions:	8, IB3, T4, TP1, TP29	**Packaging Exceptions:**	155
Non-Bulk Packaging:	203	**Bulk Packaging:**	241
Passenger Air/Rail Limit:	None	**Air Cargo Limit:**	None
Vessel Stowage:	A	**Other Stowage:**	N/A
Reportable Quantity:	N/A		

AIR - ICAO OR IATA

Proper Shipping Name:	Environmentally hazardous substance, liquid, n.o.s. (Contains triaryl phosphates, isopropylated and triphenyl phosphate)		
Hazard Class:	9	**ID Number:**	UN3082
Subsidiary Risk:	N/A	**Packing Group:**	III
Hazard Labels:	Miscellaneous, Marine Pollutant	**Packing Instructions:**	914; LQY914
Air Passenger Limit Per Package:	See Below	**Packing Instruction - Cargo:**	914
Air Cargo Limit Per Package:	No limit	**Special Provisions Code:**	A97

WATER - IMDG

Proper Shipping Name:	Environmentally hazardous substance, liquid, n.o.s. (Contains triaryl phosphates, isopropylated and triphenyl phosphate)		
Hazard Class:	9	**ID Number:**	UN3082
Packing Group:	III	**Subsidiary Risk:**	N/A
Medical First Aid Guide Code:	None		

Additional Information

Air Maximum Net Quantity: No limit; LQ 30 kg G

EmS No. - None

Marine Pollutant

SECTION XV - REGULATORY INFORMATION

U.S. Federal Regulations:

The components of this product are either on the TSCA Inventory or exempt (i.e. impurities, a polymer complying with the exemption rule at 40 CFR 723.250) from the Inventory.

State Regulations:

Triphenyl phosphate:
Massachusetts Substance List
New Jersey Right To Know Hazardous Substance List (1% reporting limit)
Pennsylvania Hazardous Substance List (1% reporting limit)

Ethylene oxide (Present as impurity at 0.2 ppm):
Massachusetts Extraordinarily Hazardous Substance (1 ppm reporting limit) - carcinogen
New Jersey Right To Know Hazardous Substance List (1% reporting limit)
New Jersey Special Health Hazard Substance List (0.1% reporting limit)
Pennsylvania Special Hazardous Substance List (0.01% reporting limit)
Pennsylvania Environmental Hazard List
California Proposition 65 - WARNING: This product contains a product known by the State of California to cause cancer and reproductive effects.
The no significant risk level is 2 ug/day and the acceptable intake level is 20 ug/day.

SECTION XV - REGULATORY INFORMATION

International Regulations:
This material (or each component) is listed on the following inventories:
Canada - DSL
EU- EINECS (Monomers Listed)
Australia - AICS
Korea - ECL
Japan - ENCS
Philippines - PICCS
China - List I

Canadian Disclosure List (1%) - Triphenyl phosphate
Canadian WHMIS Hazard Class and Division = D.2.b

SARA Hazards:

Acute:	Yes	**Chronic:**	Yes
Reactive:	No	**Fire:**	No
Pressure:	No		

Additional Information

The above regulatory information represents only selected regulations and is not meant to be a complete list.

SECTION XVI - OTHER INFORMATION

NFPA Codes:

Health:	2	**Flammability:**	0
Reactivity:	0	**Other:**	N

HMIS Codes: * indicates chronic health hazard.

Health:	1*	**Flammability:**	0
Reactivity:	0	**Protection:**	X

Label Statements: Not available

Other Information: Abbreviations:
(L) = Loose bulk density in g/ml
LOEC = Lowest observed effect concentration
MATC = Maximum acceptable toxicant concentration
NA = Not available
N/A = Not applicable
NL = Not limited
NOAEL = No observable adverse effect level
NOEC = No observed effect concentration
NOEL = No observable effect level
NR = Not rated
(P) = Packed bulk density in g/ml
PNOC = Particulates Not Otherwise Classified
PNOR = Particulates Not Otherwise Regulated
REL = Recommended exposure limit
TS = Trade secret

Additional Information

Information on this form is furnished solely for the purpose of compliance with OSHA's Hazard Communication Standard, 29CFR 1910.1200 and The Canadian Environmental Protection Act, Canada Gazette Part II, Vol. 122, No. 2 and shall not be used for any other purpose.

Revision Information:
General review and update.
Section VI Environmental precautions
Section VII - Handling information

SECTION XVI - OTHER INFORMATION

Section IX - Physical properties
Section XI - Toxicological information
Section XII- Ecological information
Section XIV - DOT Special provisions
Section XV - International inventories

MSDS
for
Great Lakes DE-62™

SECTION I - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: **Great Lakes DE-62™**
Manufacturer: Great Lakes Chemical Corporation
Address: P.O. Box 2200 **City:** West Lafayette
State: Indiana **Zip:** 47996-2200
Emergency Telephone Number: **1-800-949-5167**
Information Telephone Number: 1-765-497-6100 **Fax:** 1-765-497-6123
Chemtrec Phone: **1-800-424-9300; Internationally call 703-527-3887**
Effective Date: 02/05/2002 **Supercede Date:** 3/15/99
MSDS Prepared By: Regulatory Affairs Department/Great Lakes Chemical Corporation
Synonyms: None
Product Use: Flame Retardant
Chemical Name: Mixture
Chemical Family: Brominated diphenyl oxide/Aromatic phosphate/Compatibilizer Blend

Additional Information

No information available

SECTION II - COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT NAME	CAS NO.	%	EXPOSURE LIMITS
*Aromatic phosphates			
Triaryl phosphates, isopropylated	TS	12.8 - 21.6	Y (Hazardous) Not established (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) Not established (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Triphenyl phosphate	115866	5.6 - 10.8	N (Hazardous) 3 ppm (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) 3 ppm (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Compatibilizer	TS	Proprietary	Y (Hazardous) Not established (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) Not established (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Hexabromodiphenyl oxide	36483600	Proprietary	Y (Hazardous) 15 mg/m3 (PNOR) (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) 10 mg/m3 (PNOC) (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)

Pentabromodiphenyl oxide	32534819	Proprietary	Y (Hazardous) 15 mg/m3 (PNOR) (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) 10 mg/m3 (PNOC) (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Tetrabromodiphenyl oxide	40088479	Proprietary	Y (Hazardous) Not established (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) Not established (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Tribromodiphenyl oxide	49690940	Proprietary	Y (Hazardous) Not established (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) Not established (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)

*Indented chemicals are components of previous ingredient.

Additional Information

Additional recommended exposure limits:
Triphenyl phosphate:
NIOSH REL = 3 ppm

SECTION III - HAZARDS IDENTIFICATION

Emergency Overview:
Clear, amber, dense liquid
Causes eye irritation.
May cause allergic skin reaction.
Toxic to aquatic organisms.
Persistent in the environment.

Relevant Routes of Exposure: Ingestion, inhalation and skin absorption

Signs and Symptoms of Overexposure:
General reddening and irritation to the skin and eyes, mucous membrane irritation, upper respiratory tract irritation.
Signs and symptoms of cholinesterase inhibition include tremors, tears, salivation, sweating, headache, muscled twitching, abdominal cramps, diarrhea, incoordination, blurred vision, nausea and chest discomfort.

Medical Conditions Generally Aggravated By Exposure: Dermatitis

Potential Health Effects: See Section XI for additional information.

Eyes: Causes eye irritation.

Skin: May cause mild skin irritation.
May cause allergic skin reaction.

Ingestion: Not expected to be an acute hazard in normal industrial use. See Chronic Heath Effects.

Inhalation: Not expected to be a hazard in normal industrial use.

Chronic Health Effects: Long term overexposure may result in liver, thyroid, blood and central nervous system effects.
Repeated contact may cause skin sensitization.
Possible mutagen.

SECTION III - HAZARDS IDENTIFICATION

Carcinogenicity:

NTP:	No	**ACGIH:**	No
IARC:	No	**OTHER:**	No
OSHA:	No		

Additional Information

No information available

SECTION IV - FIRST AID MEASURES

Eyes:	Flush with large volumes of water for at least 15 minutes. Get medical attention.
Skin:	Wash with large volumes of soap and water for at least 15 minutes. If irritation develops, get medical attention.
Ingestion:	If conscious, give person 1 to 2 glasses of water. Get medical attention immediately.
Inhalation:	Remove person to fresh air. Get medical attention.
Antidotes:	No information available
Notes to Physicians and/or Protection for First-Aiders:	No information available

Additional Information

No information available

SECTION V - FIRE FIGHTING MEASURES

Flammable Limits in Air (% by Volume):	Not available
Flash Point:	Not available
Autoignition Temperature:	Not available
Extinguishing Media:	All conventional media are suitable.
Fire Fighting Instructions:	Wear a self-contained breathing apparatus and protective clothing to prevent skin and eye contact in fire situations.
Unusual Fire and Explosion Hazards:	Under fire conditions, toxic and irritating fumes may be emitted.
Flammability Classification:	Non-flammable liquid
Known or Anticipated Hazardous Products of Combustion:	Hydrogen bromide and/or bromine Oxides of phosphorus Carbon monoxide and carbon dioxide

Additional Information

No information available

SECTION VI - ACCIDENTAL RELEASE MEASURES

Accidental Release Measures:	Wearing appropriate personal protective equipment, collect spill with the aid of an inert absorbent and place in suitable labeled containers for disposal. Wash spill area after pick-up is complete, collecting all clean up water for appropriate disposal.
Personal Precautions:	See Section VIII.
Environmental Precautions:	Persistent in the environment. Avoid releasing to the environment.

SECTION VI - ACCIDENTAL RELEASE MEASURES

Do not allow spills to enter surface waters (streams, rivers, ponds, lakes, etc.).

Additional Information

No information available

SECTION VII - HANDLING AND STORAGE

Handling: Use appropriate personal protection equipment.
Avoid eye, skin and clothing contact.
Do not breathe mist or vapor.
Avoid repeated and prolonged contact.
For handling purposes, material may be heated from 30 to 50 degrees C.
Use of a chemical fume hood is recommended for open handling, where appropriate.

Storage: Store in a cool, dry, well-ventilated area away from incompatible materials.
Keep container tightly closed.

Other Precautions: No information available

Additional Information

No information available

SECTION VIII - EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls: No information available

Ventilation Requirements: Use local exhaust to minimize misting and vapor.
Use mechanical ventilation for general area control.

Personal Protective Equipment:

Eye/Face Protection: Chemical safety glasses with side shields or chemical safety goggles

Skin Protection: Combination neoprene is recommended over natural latex.
Clothing designed to minimize skin contact

Respiratory Protection: Wear a NIOSH/MSHA approved organic cartridge respirator if misting or vapor occurs, or there is potential for airborne exposures to exceed established threshold values.
Consult the OSHA respiratory protection information located at 29CFR 1910.134 and the American National Standard Institute's Practices of Respiratory Protection Z88.2.

Other Protective Clothing or Equipment: No information available

Exposure Guidelines: See Section II.

Work Hygienic Practices: Wash thoroughly after handling.
Wash contaminated clothing before reuse.

Additional Information

No information available

SECTION IX - PHYSICAL & CHEMICAL PROPERTIES

Appearance:	Clear, amber, dense liquid	**Percent Volatile:**	Not available
Boiling Point:	Not available	**pH Value:**	Not available
Bulk Density:	Not available	**pH Concentration:**	Not available
Color:	Amber	**Physical State:**	Liquid
Decomposition Temperature:	Not available	**Reactivity in Water:**	Not water reactive

SECTION IX - PHYSICAL & CHEMICAL PROPERTIES

Evaporation Rate:	Not available	**Saturated Vapor Concentration:**	Not available
Freezing Point:	Not available	**Softening Point:**	Not available
Heat Value:	Not available	**Solubility in Water:**	<0.1 g/100 g at 25 degrees C
Melting Point:	Not available	**Specific Gravity or Density (Water=1):**	1.9 at 25 degrees C
Molecular/Chemical Formula:	Mixture	**Vapor Density:**	Not available
Molecular Weight:	NA	**Vapor Pressure:**	Not available
Octanol/Water Partition Coefficient:	Not available	**Viscosity:**	5,120 cps at 20 degrees C
Odor:	No odor	**Volatile Organic Compounds:**	Not available
Odor Threshold:	Not available	**Water/Oil Distribution Coefficient:**	Not available
Particle Size:	Not available	**Weight Per Gallon:**	Not available

Additional Information

No information available

SECTION X - STABILITY AND REACTIVITY

Stability: Stable under normal conditions of handling and use.

Conditions to Avoid: None

Incompatibility With Other Materials:
Strong acids
Strong bases
Amines

Hazardous Decomposition Products:
Thermal decomposition may produce the following:
Hydrogen bromide and/or bromine
Oxides of phosphorus
Carbon monoxide and carbon dioxide

Hazardous Polymerization: Will not occur

Conditions to Avoid: None

Additional Information

No information available

SECTION XI - TOXICOLOGICAL INFORMATION

VALUE (LD50 OR LC50)	ANIMAL	ROUTES	COMPONENTS
>200 mg/L	Rat	Acute Inhalation	Pentabromodiphenyl oxide
5.2 mg/L	Rat	Acute Inhalation	Aromatic phosphates
>2,000 mg/kg	Rabbit	Acute Dermal	Aromatic phosphates
>2,000 mg/kg	Rabbit	Acute Dermal	Pentabromodiphenyl oxide
>3,000 mg/kg	Rat	Acute Oral	Aromatic phosphates
6,200 mg/kg	Rat	Acute Oral	Pentabromodiphenyl oxide

Toxicological Information:
The toxicological properties of this blend have not been determined. Component information is listed below.

Pentabromodiphenyl oxide:
This material has been determined not to be a primary skin irritant in rabbits.
This material has been found to be a slight eye irritant in rabbits.

This material did not cause sensitization in a guinea pig maximization study.

This material was not found to be mutagenic in in vitro microbial assays and negative results were obtained for the induction of structural and numerical chromosome aberrations in human peripheral blood lymphocytes.

Liver cell enlargement and thyroid hyperplasia were observed in a 90-day oral study in rats. Upon compound withdrawal, thyroid hyperplasia was reversible; necrosis was observed in some enlarged liver cells.

In a 30-day oral study in rats, no compound related liver or thyroid effects were observed at 1 mg/kg.

In a 28-day oral diet study in rats, hepatic centrilobular hypertrophy was observed at 100 and 1,000 ppm. Thyroid hyperplasia and increased liver weights were observed at 1,000 ppm. A NOEL was established to be <100 ppm (<~10 mg/kg/day).

In a 28-day gavage study in rats, hepatic hypertrophy and increased liver weight was observed at 250 mg/kg/day.

In a rat developmental study, no developmental effects were seen at the highest dose tested of 200 mg/kg/day. A maternal NOEL was established at 10 mg/kg/day and a fetal NOEL was established at 100 mg/kg/day.

Triaryl phosphate, isopropylated:
Based on a similar product, this material has low acute oral and dermal toxicity. Primary eye and skin irritation studies in rabbits on a similar product did not result in eye or skin irritation. However, eye and skin irritation may be possible. Prolonged or continuous contact with skin will cause irritation. Product may be irritating to the respiratory system and mucous membranes. Breathing or swallowing large quantities may cause neurological effects. Repeated exposure over a prolonged period of time may cause neurological effects.

Compatibilizer:
This material has been found to cause eye irritation and be slightly irritating to the skin. Skin contact may cause skin sensitization in a small proportion of individuals. This material has been found to produce mutagenic activity in several in vitro test systems. carcinogenic potential was not exhibited in lifetime skin-painting studies in mice.

Other acute and chronic health hazards, as well as target organs, are unknown.

Additional Information

No information available

SECTION XII - ECOLOGICAL INFORMATION

Ecological Information: The following ecological information is offered:

Pentabromodiphenyl oxide:
EC50 in Daphnia magna (48H) = 19 ug/L (nominal); 14 ug/L mean measure concentration; NOEL = 6.5 ug/L

LC50 in rainbow trout (96H) >26 ug/L (nominal); >21 ug/L mean measured concentration; NOEL = 26 ug/L

EC10, EC50, EC90 in freshwater algae (96H) >26 ug/L (nominal); >14 ug/L mean measured concentration

SECTION XII - ECOLOGICAL INFORMATION

LC50 in earthworms (14 Days) >500 mg/kg of dry soil

In a Carbon Dioxide Evolution Test, minimal degradation of the test substance was observed over a 93 day test period. This material evolved an average of approximately 0.0 and 2.4% TCO on days 29 and 93 respectively.

In a Daphnia magna life cycle study, a NOEC of 5.3 ug/L, LOEC of 9.8 ug/L and a MATC of 7.2 ug/L were established.

In an early life-stage toxicity study in rainbow trout, a NOEC of 8.9 ug/L, LOEC of 16 ug/L and a MATC of 12 ug/L were established.

In a bioaccumulation study in carp, this material was found to bioaccumulate.

In prolonged sediment toxicity tests utilizing Chironomus riparius, Lumbriculus variegatus, and Hyalella azteca, the EC 50 (28 Day) for all test organisms was >50 mg/kg.

In seedling emergence tests, the 21 day NOEC in corn, tomato, onion, soybean, ryegrass and cucumber was established to be 16 mg/kg, 125 mg/kg, 1000 mg/kg, 1000 mg/kg, 1000 mg/kg, and 1000 mg/kg, respectively.
Persistent in the environment.

Triaryl phosphate, isopropylated:
LC50 in rainbow trout (96H) = 1.6 (1.2 - 2.2) mg/L
LC50 in fathead minnow (96H) = 10.8 (8.0 - 14.6) mg/L
EC50 in Daphnia magna (48H) = 2.44 (1.93 - 3.08) mg/L

Do not allow spills to enter surface waters (streams, rivers, ponds, lakes, etc.).

Additional Information

No information available

SECTION XIII - DISPOSAL CONSIDERATIONS

Disposal Considerations: Dispose of waste at an approved chemical disposal facility in compliance with all current Local, State/Province, Federal/Canadian laws and regulations.

Additional Information

No information available

SECTION XIV - TRANSPORT INFORMATION

U.S. DOT

Proper Shipping Name: Environmentally hazardous substance, liquid, n.o.s. (Contains triaryl phosphates, isopropylated and triphenyl phosphate)

Hazard Class:	9	**ID Number:**	UN3082
Packing Group:	III	**Labels:**	Miscellaneous, Marine Pollutant

SECTION XIV - TRANSPORT INFORMATION

Special Provisions:	8, IB3, T4, TP1, TP29	**Packaging Exceptions:**	155
Non-Bulk Packaging:	203	**Bulk Packaging:**	241
Passenger Air/Rail Limit:	None	**Air Cargo Limit:**	None
Vessel Stowage:	A	**Other Stowage:**	N/A
Reportable Quantity:	N/A		

AIR - ICAO OR IATA

Proper Shipping Name:	Environmentally hazardous substance, liquid, n.o.s. (Contains triaryl phosphates, isopropylated and triphenyl phosphate)		
Hazard Class:	9	**ID Number:**	UN3082
Subsidiary Risk:	N/A	**Packing Group:**	III
Hazard Labels:	Miscellaneous, Marine Pollutant	**Packing Instructions:**	914; LQY914
Air Passenger Limit Per Package:	See Below	**Packing Instruction - Cargo:**	914
Air Cargo Limit Per Package:	No limit	**Special Provisions Code:**	A97

WATER - IMDG

Proper Shipping Name:	Environmentally hazardous substance, liquid, n.o.s. (Contains triaryl phosphates, isopropylated and triphenyl phosphate)		
Hazard Class:	9	**ID Number:**	UN3082
Packing Group:	III	**Subsidiary Risk:**	N/A
Medical First Aid Guide Code:	None		

Additional Information

Air Maximum Net Quantity: No limit; LQ 30 kg G

EmS No. - None

Marine Pollutant

SECTION XV - REGULATORY INFORMATION

U.S. Federal Regulations:

The components of this product are either on the TSCA Inventory or exempt (i.e. impurities, a polymer complying with the exemption rule at 40 CFR 723.250) from the Inventory.

State Regulations:

Triphenyl phosphate:
Massachusetts Substance List
New Jersey Right To Know Hazardous Substance List (1% reporting limit)
Pennsylvania Hazardous Substance List (1% reporting limit)

International Regulations:

This material (or each component) is listed on the following inventories:
Canada - DSL
EU - EINECS
Australia - AICS
Korea - ECL
Japan - ENCS
Philippines - PICCS
China - List I

Canadian Disclosure List (1%) - Triphenyl phosphate
Canadian WHMIS Hazard Class and Division = D.2.b

SECTION XV - REGULATORY INFORMATION

SARA Hazards:

Acute:	Yes	**Chronic:**	Yes
Reactive:	No	**Fire:**	No
Pressure:	No		

Additional Information

The above regulatory information represents only selected regulations and is not meant to be a complete list.

SECTION XVI - OTHER INFORMATION

NFPA Codes:

Health:	2	**Flammability:**	0
Reactivity:	0	**Other:**	N

HMIS Codes: * indicates chronic health hazard.

Health:	2*	**Flammability:**	0
Reactivity:	0	**Protection:**	X

Label Statements: Not available

Other Information: Abbreviations:

(L) = Loose bulk density in g/ml
LOEC = Lowest observed effect concentration
MATC = Maximum acceptable toxicant concentration
NA = Not available
N/A = Not applicable
NL = Not limited
NOAEL = No observable adverse effect level
NOEC = No observed effect concentration
NOEL = No observable effect level
NR = Not rated
(P) = Packed bulk density in g/ml
PNOC = Particulates Not Otherwise Classified
PNOR = Particulates Not Otherwise Regulated
REL = Recommended exposure limit
TS = Trade secret

Additional Information

Information on this form is furnished solely for the purpose of compliance with OSHA's Hazard Communication Standard, 29CFR 1910.1200 and The Canadian Environmental Protection Act, Canada Gazette Part II, Vol. 122, No. 2 and shall not be used for any other purpose.

Revision Information:
General review and update.
Section VI Environmental precautions
Section VII - Handling information
Section IX - Physical properties
Section XI - Toxicological information
Section XII- Ecological information
Section XIV - DOT Special provisions
Section XV - International inventories

MSDS
for
Great Lakes DE-71™

SECTION I - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name:	**Great Lakes DE-71™**		
Manufacturer:	Great Lakes Chemical Corporation		
Address:	P.O. Box 2200	**City:**	West Lafayette
State:	Indiana	**Zip:**	47996-2200
Emergency Telephone Number:	**1-800-949-5167**		
Information Telephone Number:	1-765-497-6100	**Fax:**	1-765-497-6123
Chemtrec Phone:	**1-800-424-9300; Internationally call 703-527-3887**		
Effective Date:	02/01/2002	**Supercede Date:**	12/10/1999
MSDS Prepared By:	Regulatory Affairs Department/Great Lakes Chemical Corporation		
Synonyms:	Pentabromodiphenyl ether; Pentabromodiphenyl oxide; PBDPE		
Product Use:	Flame Retardant		
Chemical Name:	Benzene, 1,1'-oxybis, pentabromo derivative		
Chemical Family:	Brominated diphenyl oxide		

Additional Information

No information available

SECTION II - COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT NAME	CAS NO.	%	EXPOSURE LIMITS
Hexabromodiphenyl oxide	36483600	TS	Y (Hazardous) 15 mg/m3 (PNOR) (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) 10 mg/m3 (PNOC) (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Pentabromodiphenyl oxide	32534819	TS	Y (Hazardous) 15 mg/m3 (PNOR) (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) 10 mg/m3 (PNOC) (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Tetrabromodiphenyl oxide	40088479	TS	Y (Hazardous) Not established (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) Not established (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Tribromodiphenyl oxide	49690940	TS	Y (Hazardous) Not established (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) Not established (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)

*Indented chemicals are components of previous ingredient.

Additional Information

No information available

SECTION III - HAZARDS IDENTIFICATION

Emergency Overview: Clear, amber, dense, viscous liquid
Not acutely hazardous to health by ingestion, inhalation or skin absorption.
Causes eye irritation.
Persistent in the environment.

Relevant Routes of Exposure: Inhalation and ingestion.

Signs and Symptoms of Overexposure: General reddening and irritation to the eyes.

Medical Conditions Generally Aggravated By Exposure: None reported

Potential Health Effects: See Section XI for additional information.

Eyes: Causes eye irritation.

Skin: Not expected to be a hazard in normal industrial use.

Ingestion: Not expected to be a hazard in normal industrial use.

Inhalation: Not expected to be a hazard in normal industrial use.

Chronic Health Effects: Long term overexposure may cause liver effects.
Long term overexposure may cause thyroid effects.

Carcinogenicity:

NTP:	No	**ACGIH:**	No
IARC:	No	**OTHER:**	No
OSHA:	No		

Additional Information

No information available

SECTION IV - FIRST AID MEASURES

Eyes: Flush with large volumes of water for at least 15 minutes. Get medical attention.

Skin: Wash with large volumes of soap and water for at least 15 minutes. If irritation develops, get medical attention.

Ingestion: If conscious, give person 1 to 2 glasses of water. Get medical attention immediately.

Inhalation: Remove person to fresh air. Get medical attention.

Antidotes: No information available

Notes to Physicians and/or Protection for First-Aiders: No information available

Additional Information

No information available

SECTION V - FIRE FIGHTING MEASURES

Flammable Limits in Air (% by Volume): Not available

Flash Point: None

Autoignition Temperature: Not available

Extinguishing Media: All conventional media are suitable.

Fire Fighting Instructions: Wear a self-contained breathing apparatus and protective clothing to prevent skin and eye contact in fire situations.

SECTION V - FIRE FIGHTING MEASURES

Unusual Fire and Explosion Hazards:	Under fire conditions, toxic and irritating fumes may be emitted.
Flammability Classification:	Non-flammable liquid
Known or Anticipated Hazardous Products of Combustion:	Hydrogen bromide and/or bromine Carbon monoxide and carbon dioxide

Additional Information

No information available

SECTION VI - ACCIDENTAL RELEASE MEASURES

Accidental Release Measures:	Wearing appropriate personal protective equipment, collect spill with the aid of an inert absorbent and place in suitable labeled containers for disposal. Wash spill area after pick-up is complete, collecting all clean up water for appropriate disposal.
Personal Precautions:	See Section VIII.
Environmental Precautions:	Persistent in the environment. Avoid releasing to the environment. Do not allow spills to enter surface waters (streams, rivers, ponds, lakes, etc.).

Additional Information

No information available

SECTION VII - HANDLING AND STORAGE

Handling:	Use appropriate personal protection equipment. Avoid eye, skin and clothing contact. Do not breathe mist or vapor. Avoid repeated and prolonged contact. Avoid overheating.
Storage:	Store in a cool, dry, well-ventilated area away from incompatible materials. Keep container tightly closed.
Other Precautions:	No information available

Additional Information

No information available

SECTION VIII - EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls:	No information available
Ventilation Requirements:	Use local exhaust to minimize misting and vapor. Use mechanical ventilation for general area control.
Personal Protective Equipment:	
Eye/Face Protection:	Chemical safety glasses with side shields or chemical safety goggles
Skin Protection:	Rubber or plastic gloves Clothing designed to minimize skin contact
Respiratory Protection:	Wear a NIOSH/MSHA approved organic cartridge respirator if misting or vapor occurs. Consult the OSHA respiratory protection information located at 29CFR 1910.134 and the American National Standard Institute's Practices of Respiratory Protection Z88.2.

SECTION VIII - EXPOSURE CONTROLS/PERSONAL PROTECTION

Other Protective Clothing or Equipment:	No information available
Exposure Guidelines:	See Section II.
Work Hygienic Practices:	Wash thoroughly after handling. Wash contaminated clothing before reuse.

Additional Information

No information available

SECTION IX - PHYSICAL & CHEMICAL PROPERTIES

Appearance:	Clear, amber, dense, very viscous liquid	**Percent Volatile:**	Not available
Boiling Point:	Not available	**pH Value:**	Not available
Bulk Density:	Not available	**pH Concentration:**	Not available
Color:	Amber	**Physical State:**	Liquid
Decomposition Temperature:	Not available	**Reactivity in Water:**	Not water reactive
Evaporation Rate:	Not available	**Saturated Vapor Concentration:**	Not available
Freezing Point:	Not available	**Softening Point:**	Not available
Heat Value:	Not available	**Solubility in Water:**	13.3 ug/L at 25 degrees C
Melting Point:	Not available	**Specific Gravity or Density (Water=1):**	2.3 at 25 degrees C
Molecular/Chemical Formula:	Mixture	**Vapor Density:**	Not available
Molecular Weight:	564.7	**Vapor Pressure:**	4.69E-5 Pa at 21 degrees C
Octanol/Water Partition Coefficient:	LOG KOW = 6.568	**Viscosity:**	>200,000 cps at 25 degrees C
Odor:	No odor	**Volatile Organic Compounds:**	Not available
Odor Threshold:	Not available	**Water/Oil Distribution Coefficient:**	Not available
Particle Size:	Not available	**Weight Per Gallon:**	Not available

Additional Information

No information available

SECTION X - STABILITY AND REACTIVITY

Stability:	Stable under normal conditions of handling and use.
Conditions to Avoid:	None
Incompatibility With Other Materials:	None known
Hazardous Decomposition Products:	Thermal decomposition may produce the following: Hydrogen bromide and/or bromine Carbon monoxide and carbon dioxide
Hazardous Polymerization:	Will not occur
Conditions to Avoid:	None

Additional Information

No information available

SECTION XI - TOXICOLOGICAL INFORMATION

VALUE (LD50 OR LC50)	ANIMAL	ROUTES	COMPONENTS
>200 mg/L	Rat	Acute Inhalation	DE-71
>2,000 mg/kg	Rabbit	Acute Dermal	DE-71
6,200 mg/kg	Rat	Acute Oral	DE-71

Toxicological Information:
This material has been determined not to be a primary skin irritant in rabbits.
This material has been found to be a slight eye irritant in rabbits.
This material did not cause sensitization in a guinea pig maximization study.

This material was not found to be mutagenic in in vitro microbial assays and negative results were obtained for the induction of structural and numerical chromosome aberrations in human peripheral blood lymphocytes.

Liver cell enlargement and thyroid hyperplasia were observed in a 90-day oral study in rats. Upon compound withdrawal, thyroid hyperplasia was reversible; necrosis was observed in some enlarged liver cells.

In a 30-day oral study in rats, no compound related liver or thyroid effects were observed at 1 mg/kg.

In a 28-day oral diet study in rats, hepatic centrilobular hypertrophy was observed at 100 and 1,000 ppm. Thyroid hyperplasia and increased liver weights were observed at 1,000 ppm. A NOEL was established to be <100 ppm (<~10 mg/kg/day).

In a 28-day gavage study in rats, hepatic hypertrophy and increased liver weight was observed at 250 mg/kg/day.

In a rat developmental study, no developmental effects were seen at the highest dose tested of 200 mg/kg/day. A maternal NOEL was established at 10 mg/kg/day and a fetal NOEL was established at 100 mg/kg/day.

Other acute and chronic health hazards, as well as target organs, are unknown.

Additional Information

No information available

SECTION XII - ECOLOGICAL INFORMATION

Ecological Information:

EC50 in Daphnia magna (48H) = 19 ug/L (nominal); 14 ug/L mean measure concentration; NOEL = 6.5 ug/L

LC50 in rainbow trout (96H) >26 ug/L (nominal); >21 ug/L mean measured concentration; NOEL = 26 ug/L

EC10, EC50, EC90 in freshwater algae (96H) >26 ug/L (nominal); >14 ug/L mean measured concentration

LC50 in earthworms (14 Days) >500 mg/kg of dry soil

In a Carbon Dioxide Evolution Test, minimal degradation of the test substance was observed over a 93 day test period. This material evolved an average of approximately 0.0 and 2.4% TCO on days 29 and 93 respectively.

SECTION XII - ECOLOGICAL INFORMATION

In a Daphnia magna life cycle study, a NOEC of 5.3 ug/L, LOEC of 9.8 ug/L and a MATC of 7.2 ug/L were established.

In an early life-stage toxicity study in rainbow trout, a NOEC of 8.9 ug/L, LOEC of 16 ug/L and a MATC of 12 ug/L were established.

In a bioaccumulation study in carp, this material was found to bioaccumulate.

In prolonged sediment toxicity tests utilizing Chironomus riparius, Lumbriculus variegatus, and Hyalella azteca, the EC 50 (28 Day) for all test organisms was >50 mg/kg.

In seedling emergence tests, the 21 day NOEC in corn, tomato, onion, soybean, ryegrass and cucumber was established to be 16 mg/kg, 125 mg/kg, 1000 mg/kg, 1000 mg/kg, 1000 mg/kg, and 1000 mg/kg, respectively.

Persistent in the environment.

Do not allow to enter surface waters (streams, rivers, ponds, lakes, etc.).

Avoid releasing to the environment.

Additional Information

No information available

SECTION XIII - DISPOSAL CONSIDERATIONS

Disposal Considerations: Dispose of waste at an approved chemical disposal facility in compliance with all current Local, State/Province, Federal/Canadian laws and regulations.

Additional Information

No information available

SECTION XIV - TRANSPORT INFORMATION

U.S. DOT

Proper Shipping Name:	Not regulated		
Hazard Class:	N/A	**ID Number:**	N/A
Packing Group:	N/A	**Labels:**	N/A
Special Provisions:	N/A	**Packaging Exceptions:**	N/A
Non-Bulk Packaging:	N/A	**Bulk Packaging:**	N/A
Passenger Air/Rail Limit:	N/A	**Air Cargo Limit:**	N/A
Vessel Stowage:	N/A	**Other Stowage:**	N/A
Reportable Quantity:	N/A		

AIR - ICAO OR IATA

Proper Shipping Name:	Not regulated		
Hazard Class:	N/A	**ID Number:**	N/A
Subsidiary Risk:	N/A	**Packing Group:**	N/A
Hazard Labels:	N/A	**Packing Instructions:**	N/A

SECTION XIV - TRANSPORT INFORMATION

Air Passenger Limit Per Package:	N/A	**Packing Instruction - Cargo:**	N/A
Air Cargo Limit Per Package:	N/A	**Special Provisions Code:**	N/A

WATER - IMDG

Proper Shipping Name:	Not regulated		
Hazard Class:	N/A	**ID Number:**	N/A
Packing Group:	N/A	**Subsidiary Risk:**	N/A
Medical First Aid Guide Code:	N/A		

Additional Information

No information available

SECTION XV - REGULATORY INFORMATION

U.S. Federal Regulations:

The components of this product are either on the TSCA Inventory or exempt (i.e. impurities, a polymer complying with the exemption rule at 40 CFR 723.250) from the Inventory.

The following materials are subject to TSCA Section 12(b) one-time export notification:
Pentabromodiphenyl oxide

State Regulations:

None known

International Regulations:

This material (or each component) is listed on the following inventories:
Canada - DSL
EU - EINECS
Australia - AICS
Japan - ENCS
Korea - ECL
Philippines - PICCS
China - List I

Canadian WHMIS Hazard Class and Division = D.2.b

SARA Hazards:

Acute:	Yes	**Chronic:**	Yes
Reactive:	No	**Fire:**	No
Pressure:	No		

Additional Information

The above regulatory information represents only selected regulations and is not meant to be a complete list.

SECTION XVI - OTHER INFORMATION

NFPA Codes:

Health:	NR	**Flammability:**	NR
Reactivity:	NR	**Other:**	NR

HMIS Codes: * indicates chronic health hazard.

Health:	1*	**Flammability:**	0
Reactivity:	0	**Protection:**	X

Label Statements: Not available

Other Information: Abbreviations:
(L) = Loose bulk density in g/ml

SECTION XVI - OTHER INFORMATION

LOEC = Lowest observed effect concentration
MATC = Maximum acceptable toxicant concentration
NA = Not available
N/A = Not applicable
NL = Not limited
NOAEL = No observable adverse effect level
NOEC = No observed effect concentration
NOEL = No observable effect level
NR = Not rated
(P) = Packed bulk density in g/ml
PNOC = Particulates Not Otherwise Classified
PNOR = Particulates Not Otherwise Regulated
REL = Recommended exposure limit
TS = Trade secret

Additional Information

Information on this form is furnished solely for the purpose of compliance with OSHA's Hazard Communication Standard, 29CFR 1910.1200 and The Canadian Environmental Protection Act, Canada Gazette Part II, Vol. 122, No. 2 and shall not be used for any other purpose.

Revision Information:
Section IX - Physical properties
Section XI - Toxicological information
Section XII - Ecological information

MSDS
for
Great Lakes DE-79™

SECTION I - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name:	**Great Lakes DE-79™**
Manufacturer:	Great Lakes Chemical Corporation
Address:	P.O. Box 2200 **City:** West Lafayette
State:	Indiana **Zip:** 47996-2200
Emergency Telephone Number:	**1-800-949-5167**
Information Telephone Number:	1-765-497-6100 **Fax:** 1-765-497-6123
Chemtrec Phone:	**1-800-424-9300; Internationally call 703-527-3887**
Effective Date:	04/25/2002 **Supercede Date:** 02/02/2001
MSDS Prepared By:	Regulatory Affairs Department/Great Lakes Chemical Corporation
Synonyms:	Octabromodiphenyl ether; Bis(tetrabromophenyl) ether; Octabromodiphenyl oxide
Product Use:	Flame Retardant
Chemical Name:	Benzene, 1,1'-oxybis, octabromo derivative
Chemical Family:	Brominated diphenyl oxide

Additional Information

No information available

SECTION II - COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT NAME	CAS NO.	%	EXPOSURE LIMITS
Heptabromodiphenyl oxide	68928803	TS	Y (Hazardous) 15 mg/m3 (PNOR) (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) 10 mg/m3 (PNOC) (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Hexabromodiphenyl oxide	36483600	TS	Y (Hazardous) 15 mg/m3 (PNOR) (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) 10 mg/m3 (PNOC) (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Nonabromodiphenyl oxide	63936561	TS	Y (Hazardous) 15 mg/m3 (PNOR) (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) 10 mg/m3 (PNOC) (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)
Octabromodiphenyl oxide	32536520	TS	Y (Hazardous) 15 mg/m3 (PNOR) (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) 10 mg/m3 (PNOC) (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)

Pentabromodiphenyl oxide	32534819	TS	Y (Hazardous) 15 mg/m3 (PNOR) (OSHA PEL TWA) Not established (OSHA PEL STEL) Not established (OSHA PEL CEIL) 10 mg/m3 (PNOC) (ACGIH TLV TWA) Not established (ACGIH TLV STEL) Not established (ACGIH TLV CEIL)

*Indented chemicals are components of previous ingredient.

Additional Information

Great Lakes Chemical Corporation internal Worker Exposure Limit = 0.14 mg/m3 (8 hour time weighted average)
5 mg/m3 Respirable Dust Level (OSHA)
3 mg/m3 Respirable Dust Level (ACGIH)
PNOR = Particulates Not Otherwise Regulated
PNOC = Particulates Not Otherwise Classified

SECTION III - HAZARDS IDENTIFICATION

Emergency Overview: Tan powder
No odor
Not acutely hazardous to health by ingestion, inhalation or skin absorption.

Relevant Routes of Exposure: Inhalation and ingestion.

Signs and Symptoms of Overexposure: No known signs and symptoms of exposure.

Medical Conditions Generally Aggravated By Exposure: None reported

Potential Health Effects: See Section XI for additional information.

Eyes: Not expected to be a hazard in normal industrial use.
As with any dust, mechanical irritation is possible to the eye.

Skin: Not expected to be a hazard in normal industrial use.
As with any dust, mechanical irritation is possible to the skin.

Ingestion: Not expected to be a hazard in normal industrial use.

Inhalation: As with any dust, mechanical irritation is possible to mucous membranes and the respiratory tract.

Chronic Health Effects: Long term overexposure may cause liver effects.
Long term overexposure may cause thyroid effects.
Long term overexposure may cause kidney effects.
Long term overexposure may cause developmental effects.
Long term inhalation overexposure may cause lung and female reproductive effects based on animal data.

Carcinogenicity:

NTP:	No	**ACGIH:**	No
IARC:	No	**OTHER:**	No
OSHA:	No		

Additional Information

No information available

SECTION IV - FIRST AID MEASURES

Eyes: Flush with large volumes of water for at least 15 minutes. Get medical attention.

Skin: Wash with large volumes of soap and water for at least 15 minutes. If irritation develops, get medical attention.

SECTION IV - FIRST AID MEASURES

Ingestion:	If conscious, give person 1 to 2 glasses of water. Get medical attention immediately.
Inhalation:	Remove person to fresh air. Get medical attention.
Antidotes:	No information available
Notes to Physicians and/or Protection for First-Aiders:	No information available

Additional Information

No information available

SECTION V - FIRE FIGHTING MEASURES

Flammable Limits in Air (% by Volume):	Not available
Flash Point:	Not applicable
Autoignition Temperature:	Not available
Extinguishing Media:	All conventional media are suitable.
Fire Fighting Instructions:	Wear a self-contained breathing apparatus and protective clothing to prevent skin and eye contact in fire situations.
Unusual Fire and Explosion Hazards:	Under fire conditions, toxic and irritating fumes may be emitted.
Flammability Classification:	Non-flammable solid
Known or Anticipated Hazardous Products of Combustion:	Hydrogen bromide and/or bromine Carbon monoxide and carbon dioxide

Additional Information

No information available

SECTION VI - ACCIDENTAL RELEASE MEASURES

Accidental Release Measures:	Wearing appropriate personal protective equipment, carefully sweep up material and place in suitable labeled containers for disposal. Avoid creating a dusting condition.
Personal Precautions:	See Section VIII.
Environmental Precautions:	Persistent in the environment. Avoid releasing to the environment.

Additional Information

No information available

SECTION VII - HANDLING AND STORAGE

Handling:	Use appropriate personal protection equipment. Avoid eye, skin and clothing contact. Avoid breathing dust. Avoid repeated and prolonged contact. Avoid overheating. Avoid creating a dusting situation.
Storage:	Store in a cool, dry, well-ventilated area away from incompatible materials. Keep container tightly closed.
Other Precautions:	No information available

Additional Information

No information available

SECTION VIII - EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls:	No information available
Ventilation Requirements:	Use local exhaust to minimize dusting. Use mechanical ventilation for general area control.
Personal Protective Equipment:	
Eye/Face Protection:	Chemical safety glasses with side shields or chemical safety goggles
Skin Protection:	Rubber or plastic gloves Clothing designed to minimize skin contact
Respiratory Protection:	Wear a NIOSH/MSHA approved dust respirator if dusting occurs, or there is potential for airborne exposures to exceed established threshold values. Consult the OSHA respiratory protection information located at 29CFR 1910.134 and the American National Standard Institute's Practices of Respiratory Protection Z88.2.
Other Protective Clothing or Equipment:	No information available
Exposure Guidelines:	See Section II.
Work Hygienic Practices:	Wash thoroughly after handling. Wash contaminated clothing before reuse.

Additional Information

No information available

SECTION IX - PHYSICAL & CHEMICAL PROPERTIES

Appearance:	Tan powder	**Percent Volatile:**	Not available
Boiling Point:	Not available	**pH Value:**	Not available
Bulk Density:	1.10 (L); 1.48(P)	**pH Concentration:**	Not available
Color:	Tan	**Physical State:**	Solid
Decomposition Temperature:	Not available	**Reactivity in Water:**	Not water reactive
Evaporation Rate:	Not available	**Saturated Vapor Concentration:**	Not available
Freezing Point:	Not available	**Softening Point:**	Not available
Heat Value:	Not available	**Solubility in Water:**	<1.0 ppb at 25 degrees C
Melting Point:	85 - 89 degrees C	**Specific Gravity or Density (Water=1):**	2.8
Molecular/Chemical Formula:	Mixture	**Vapor Density:**	Not available
Molecular Weight:	801.4	**Vapor Pressure:**	6.59E-6 Pa at 21 degrees C
Octanol/Water Partition Coefficient:	Log Kow = 6.290	**Viscosity:**	Not available
Odor:	No odor	**Volatile Organic Compounds:**	Not available
Odor Threshold:	Not available	**Water/Oil Distribution Coefficient:**	Not available
Particle Size:	Not available	**Weight Per Gallon:**	Not available

Additional Information

Minimum Ignition Energy >10J

SECTION X - STABILITY AND REACTIVITY

Stability:	Stable under normal conditions of handling and use.
Conditions to Avoid:	None

SECTION X - STABILITY AND REACTIVITY

Incompatibility With Other Materials:	None known
Hazardous Decomposition Products:	Thermal decomposition may produce the following: Hydrogen bromide and/or bromine Carbon monoxide and carbon dioxide
Hazardous Polymerization:	Will not occur
Conditions to Avoid:	None

Additional Information

No information available

SECTION XI - TOXICOLOGICAL INFORMATION

VALUE (LD50 OR LC50)	ANIMAL	ROUTES	COMPONENTS
>60 mg/L	Rat	Acute Inhalation	DE-79
>2,000 mg/kg	Rabbit	Acute Dermal	DE-79
>5,000 mg/kg	Rat	Acute Oral	DE-79

Toxicological Information:
This material did not cause sensitization in a guinea pig maximization study.

This material was found not to be mutagenic in a bacterial reverse mutation assay. This material produced negative results in an unscheduled DNA synthesis assay, was negative in an in vitro sister chromatid exchange in Chinese hamster ovary cells with or without metabolic activation, and was negative for induction of structural and numerical chromosome aberrations in an in vitro mammalian chromosome aberration test using human peripheral lymphocytes.

In a 90-day feeding study at 100, 1000, and 10,000 ppm, liver, kidney and thyroid effects were observed. Thyroid hyperplasia was reversible upon compound withdrawal. Hepatocytomegaly declined upon compound withdrawal. Kidney effects were characterized by the occurrence of small to moderate numbers of cortical tubules considered to represent regenerative tubules. Developmental effects have been reported for octabromodiphenyl oxide at 25 mg/kg/day in a teratology study. The NOEL is reported to be 2.5 mg/kg/day.

A range-finding teratology study with DE-79 indicates a potential for fetotoxicity as evidenced by reduced body weight at a dosage level of 50 mg/kg/day. The NOEL is 25 mg/kg/day.

In a 2-week inhalation toxicity range-finding study in albino rats, a no-observed-effect level (NOEL) for systemic toxicity was determined to be 1.0 mg/m3. The no-observed-adverse-effect level under the conditions of this study was 250 mg/m3.

DE-79 is not mutagenic in the Ames test, UDS assay, and in vitro sister chromatid exchange assay.

In an inhalation study in rats at doses of 0, 1, 15 and 200 mg/m3 for six hours per day, five days per week for 13 consecutive weeks, centrilobular hepatocellular hypertrophy was noted in the liver at 15 mg/m3 and 200 mg/m3. At 200 mg/m3, alveolar histiocytosis and chronic active inflammation were noted in the lungs. Based on qualitative evaluation of the ovary, three of ten females in the 200 mg.m3 group had no visible corpora lutea. Under the conditions of this study, the no observable adverse effect level (NOAEL) is 15 mg/m3 and the no observable effect level (NOEL) is 1 mg/m3.

DE-79 was found to be negative for the induction of structural and numerical chromosome aberrations in an in vitro mammalian chromosome aberration test using human peripheral lymphocytes.

Chronic over-exposure may result in liver and kidney effects and a potential for developmental effects.
Other acute and chronic health hazards, as well as target organs, are unknown.
As with all dusts, inhalation of air concentration levels above the PNOR may cause irritation and adverse lung effects.

Additional Information

No information available

SECTION XII - ECOLOGICAL INFORMATION

Ecological Information: The following ecological information is offered:

In a 21 day study the EC50 in Daphnia magna was determined to be >2.0 ug/L nominal (1.7 ug/L, measured), the NOEC = 2.0 ug/L nominal (1.7 ug/L, measured), and the LOEC and the MATC > 2.0 ug/L nominal (1.7 ug/L, measured).

EC10 and EC50 for survival in the earthworm (Eisenia fetida) (28 Day) >1,470 mg/kg dry soil
EC10 and EC50 for reproduction in the earthworm (Eisenia fetida) (56 Day) >1,470 mg/kg dry soil
NOEC for survival and reproduction in the earthworm (Eisenia fetida) = 1,470 mg/kg dry soil

In a prolonged sediment studies with Lumbriculus Variegatus using spiked sediment with either 2% or 5% total organic carbon, a 28 day EC50 was established to be > 1,500 mg/kg dry weight of sediment. The LOEC as established to be >1,500 mg/kg dry weight of sediment. The NOEC was found to be 1,500 mg/kg dry weight of sediment.

In a closed bottle test, this material was found to have 0.0% biodegradation.

Additional Information

NOEC = No observed effect concentration
LOEC = Lowest observed effect concentration
MATC = Maximum acceptable toxicant concentration

SECTION XIII - DISPOSAL CONSIDERATIONS

Disposal Considerations: Dispose of waste at an approved chemical disposal facility in compliance with all current Local, State/Province, Federal/Canadian laws and regulations.

Additional Information

No information available

SECTION XIV - TRANSPORT INFORMATION

U.S. DOT

Proper Shipping Name:	Not regulated		
Hazard Class:	N/A	**ID Number:**	N/A
Packing Group:	N/A	**Labels:**	N/A
Special Provisions:	N/A	**Packaging Exceptions:**	N/A
Non-Bulk Packaging:	N/A	**Bulk Packaging:**	N/A
Passenger Air/Rail Limit:	N/A	**Air Cargo Limit:**	N/A
Vessel Stowage:	N/A	**Other Stowage:**	N/A

SECTION XIV - TRANSPORT INFORMATION

Reportable Quantity: N/A

AIR - ICAO OR IATA

Proper Shipping Name:	Not regulated		
Hazard Class:	N/A	**ID Number:**	N/A
Subsidiary Risk:	N/A	**Packing Group:**	N/A
Hazard Labels:	N/A	**Packing Instructions:**	N/A
Air Passenger Limit Per Package:	N/A	**Packing Instruction - Cargo:**	N/A
Air Cargo Limit Per Package:	N/A	**Special Provisions Code:**	N/A

WATER - IMDG

Proper Shipping Name:	Not regulated		
Hazard Class:	N/A	**ID Number:**	N/A
Packing Group:	N/A	**Subsidiary Risk:**	N/A
Medical First Aid Guide Code:	N/A		

Additional Information

No information available

SECTION XV - REGULATORY INFORMATION

U.S. Federal Regulations:

The components of this product are either on the TSCA Inventory or exempt (i.e. impurities, a polymer complying with the exemption rule at 40 CFR 723.250) from the Inventory.

The following materials are subject to TSCA Section 12(b) one-time export notification:
Octabromodiphenyl oxide

State Regulations:

None known

International Regulations:

This material (or each component) is listed on the following inventories:
Canada - DSL
EU - EINECS
Australia - AICS
Japan - ENCS
Korea - ECL
Philippines - PICCS
China - List I

Canadian WHMIS Hazard Class and Division = D.2.b

SARA Hazards:

Acute:	No	**Chronic:**	Yes
Reactive:	No	**Fire:**	No
Pressure:	No		

Additional Information

The above regulatory information represents only selected regulations and is not meant to be a complete list.

SECTION XVI - OTHER INFORMATION

NFPA Codes:

Health:	NR	**Flammability:**	NR
Reactivity:	NR	**Other:**	NR

SECTION XVI - OTHER INFORMATION

HMIS Codes: * indicates chronic health hazard.

Health:	NR	**Flammability:**	NR
Reactivity:	NR	**Protection:**	NR

Label Statements: Not available

Other Information: Abbreviations:
(L) = Loose bulk density in g/ml
LOEC = Lowest observed effect concentration
MATC = Maximum acceptable toxicant concentration
NA = Not available
N/A = Not applicable
NL = Not limited
NOAEL = No observable adverse effect level
NOEC = No observed effect concentration
NOEL = No observable effect level
NR = Not rated
(P) = Packed bulk density in g/ml
PNOC = Particulates Not Otherwise Classified
PNOR = Particulates Not Otherwise Regulated
REL = Recommended exposure limit
TS = Trade secret

Additional Information

Information on this form is furnished solely for the purpose of compliance with OSHA's Hazard Communication Standard, 29CFR 1910.1200 and The Canadian Environmental Protection Act, Canada Gazette Part II, Vol. 122, No. 2 and shall not be used for any other purpose.

Revision Information:
Section III - Chronic health hazards
Section XI - Toxicological information
Section XII - Ecological information

Voluntary Children's Chemical Evaluation Program Pilot(VCCEPP)

Tier 1 Assessment Of The Potential Health Risks To Children Associated With Exposure To The Commercial Pentabromodiphenyl Ether Product

Appendix III: Robust Summaries of Available Toxicological Studies / IUCLID

I U C L I D

D a t a S e t

Existing Chemical	ID: 32534-81-9
CAS No.	32534-81-9
EINECS No.	251-084-2
EINECS Name	Diphenyl ether, pentabromo derivative

Producer Related Part

Company:	GREAT LAKES CHEMICAL CORPORATION
Creation date:	03-APR-2001

Substance Related Part

Company:	GREAT LAKES CHEMICAL CORPORATION
Creation date:	03-APR-2001

Printing date:	08-APR-2003
Revision date:	
Date of last Update:	**04-NOV-2002**

Number of Pages: **41**

Chapter (profile):	Chapter: 1, 2, 3, 4, 5, 7
Reliability (profile):	Reliability: without reliability, 1, 2, 3, 4
Flags (profile):	Flags: without flag, confidential, non confidential, WGK (DE), TA-Luft (DE), Material Safety Dataset, Risk Assessment, Directive 67/548/EEC, SIDS

1.0.1 OECD and Company Information

Type: lead organisation
Name: Great Lakes Chemical Corp.
Street: One Great Lakes Blvd.
Town: West Lafayette, IN
Country: United States
Phone: 765-

29-JUL-2002

1.0.2 Location of Production Site

Town: El Dorado, AK
Country: United States

29-JUL-2002

1.0.3 Identity of Recipients

-

1.1 General Substance Information

Substance type:
Physical status:
29-JUL-2002

1.1.0 Details on Template

-

1.1.1 Spectra

-

1.2 Synonyms

DE-71
03-APR-2001

Pentabromodiphenyl ether
03-APR-2001

Pentabromodiphenyl oxide
03-APR-2001

1.3 Impurities

CAS-No: 32534-81-9
EINECS-No: 251-084-2
EINECS-Name: diphenyl ether, pentabromo derivative
Contents: = 50 - 62 % w/w
29-JUL-2002

CAS-No: 40088-47-9
EINECS-No: 254-787-2
EINECS-Name: diphenyl ether, tetrabromo derivative
Contents: = 24 - 38 % w/w
29-JUL-2002

CAS-No: 36483-60-0
EINECS-No: 253-058-6
EINECS-Name: diphenyl ether, hexabromo derivative
Contents: = 4 - 12 % w/w
29-JUL-2002

CAS-No: 49690-94-0
EINECS-No: 256-431-1
EINECS-Name: diphenyl ether, tribromo derivative
Contents: = 0 - 1 % w/w
29-JUL-2002

1.4 Additives

-

1.5 Quantity

-

1.6.1 Labelling

-

1.6.2 Classification

-

1.7 Use Pattern

Type: industrial
Category: Polymers industry
Remark: Flame retardant additive to polyurethane foam.
29-JUL-2002

1.7.1 Technology Production/Use

-

1.8 Occupational Exposure Limit Values
-

1.9 Source of Exposure
-

1.10.1 Recommendations/Precautionary Measures
-

1.10.2 Emergency Measures
-

1.11 Packaging
-

1.12 Possib. of Rendering Subst. Harmless
-

1.13 Statements Concerning Waste
-

1.14.1 Water Pollution
-

1.14.2 Major Accident Hazards
-

1.14.3 Air Pollution
-

1.15 Additional Remarks
-

1.16 Last Literature Search
-

1.17 Reviews
-

1.18 Listings e.g. Chemical Inventories

Type: TSCA

29-JUL-2002

Type: EINECS

29-JUL-2002

2.1 Melting Point

Value: = -7 - -3 degree C
Method: other: none reported
GLP: no data
01-AUG-2002

2.2 Boiling Point

Value: > 200 degree C
Decomposition: yes
Method: other: none reported
GLP: no data
01-AUG-2002

2.3 Density

Type: relative density
Value: = 2.25 - 2.28
Method: other: none reported
GLP: no data
Reliability: (1) valid without restriction
01-AUG-2002

2.3.1 Granulometry

-

2.4 Vapour Pressure

Value: = .0000469 hPa at 21 degree C
Method: OECD Guide-line 104 "Vapour Pressure Curve"
Year: 1995
GLP: yes
Testsubstance: other TS: composite of 2 samples of pentabromodiphenyl oxide (from Great Lakes Chemical Corp and Akzo Nobel Chemicals, Inc).
Method: Samples of the test material were warmed at 60 C overnight and mixed equal parts in a blender. The vapor pressure was determined using a spinning rotor gaug
Remark: Sponsor: Chemical Manufacturers Association's Brominated Flame Retardant Industry Panel
Study also complied with EPA OPPTS No. 830.7950 Vapor Pressure, 1996.
Result: The vapor pressure of Pentabromodiphenyl oxide was determined to be 4.69 x 10(-5) Pa at 21 C using a spinning rotor gaug
Reliability: (1) valid without restriction
06-AUG-2002

(31)

2.5 Partition Coefficient

log Pow: = 6.568 at 25 degree C
Method: other (calculated): OPPTS 830.7560 Partition Coefficient (n-Octanol/Water), Generator Column Method
Year: 1996
GLP: yes
Testsubstance: other TS: composite of 2 samples of pentabromodiphenyl oxide (from Great Lakes Chemical Corp and Akzo Nobel Chemicals, Inc).
Method: Samples of test material were warmed at 60 C overnight and mixed equal parts in a blender. The octanol/water partition coefficient was determined using the generator column metho
Remark: Sponsor: Chemical Manufacturers Association's Brominated Flame Retardant Industry Panel
Result: The log(10) octanol/water partition coefficient (Kow) of Pentabromodiphenyl Oxide was determined to be 6.568 at 25 +/- 0.05 C using the generator column metho
Reliability: (1) valid without restriction
06-AUG-2002

(30)

2.6.1 Water Solubility

Value: = 13.3 other: ug/L at 25 degree C
Method: OECD Guide-line 105 "Water Solubility"
Year: 1981
GLP: yes
Testsubstance: other TS: composite of 2 samples of pentabromodiphenyl oxide (from Great Lakes Chemical Corp and Akzo Nobel Chemicals, Inc).
Method: Samples of test material were warmed at 60 C overnight and mixed equal parts in a blender. The water solubility was determined using a column elution metho
Remark: Sponsor: Chemical Manufacturers Association's Brominated Flame Retardant Industry Panel
Study also compliant with US EPA 40 CFR Ch. 1 796.1860 Water Solubility (Generator Column Method), 1991.
Result: The solubility of Pentabromodiphenyl oxide in water at 25 C was determined to be 13.3 ug/L (ppb) using a column elution method. The solubility was calculated based on the sum of the solubilities of its two major components, pentabromodiphenyl oxide (2.4 ug/L) and tetrabromodiphenyl oxide (10.9 ug/L
Reliability: (1) valid without restriction
06-AUG-2002

2.6.2 Surface Tension

-

2.7 Flash Point

-

2.8 Auto Flammability

-

2.9 Flammability

-

2.10 Explosive Properties

-

2.11 Oxidizing Properties

-

2.12 Additional Remarks

Memo: Not auto-flammable; not flammable; not explosive; not oxidizing.

29-JUL-2002

3.1.1 Photodegradation

-

3.1.2 Stability in Water

-

3.1.3 Stability in Soil

-

3.2 Monitoring Data (Environment)

-

3.3.1 Transport between Environmental Compartments

-

3.3.2 Distribution

-

3.4 Mode of Degradation in Actual Use

-

3.5 Biodegradation

Type: aerobic
Inoculum: activated sludge, domestic
Contact time: 92 day
Degradation: ca. 2.4 % after 93 day
Result: under test conditions no biodegradation observed
Controlsubstance: Benzoic acid, sodium salt
Method: OECD Guide-line 301 B "Ready Biodegradability: Modified Sturm Test (CO2 evolution)"
Year: 1992 **GLP:** yes
Test substance: other TS: composite of samples of pentabromodiphenyl oxide from Great Lakes Chemical Corp, and Akzo Nobel Chemicals, Inc.
Method: The ready biodegradability of pentabromodiphenyl oxide was determined by the Carbon Dioxide Evolution Test method (OECD Guideline 301B
Remark: Sponsor: Chemical Manufacturers Association's Brominated Flame Retardant Industry Panel.
Result: Minimal degradation of the test substance was observed over a 93-day test period. The standard 28-day test period was extended so that sufficient opportunity for biodegradation would be provided. The amount of CO2 produced is expressed as a percentage of the theoretical amount of CO2 (TCO2) that could have been produced if complete biodegrdation had occurred.

Pentabromodiphenyl oxide evolved an average of approx. 0.0 and 2.4% TCO2 on days 29 and 93, respectivel

Reliability: (1) valid without restriction
29-JUL-2002

(33)

3.6 BOD5, COD or BOD5/COD Ratio

-

3.7 Bioaccumulation

Species: Cyprinus carpio (Fish, fresh water)
Exposure period: at 25 degree C
Concentration: 100 µg/l
BCF: = 14000
Elimination:
Method: other: none reported
Year:
GLP: no data
Test substance: other TS: Pentabromobiphenyl ether (sample #S-512).
Method: Carp were exposed to pentabromobiphenyl ether at 100 or 10 ppb in a continuous flow through system at 25 degrees C. Exposure and recovery times are not given in the report
Remark: Sponsor: Miki & Co., Ltd.
Result: Calculated Bioconcentration factors:

	# Br	Peak	2 wk	4 wk	6 wk	8 wk
100 ppb	5	B	1650	2880	4830	5380
			2020	2980	4310	5260
	5	C	73	<0.3	35	39
			24	<0.3	24	14
10 ppb	5	B	4600	8610	9120	11700
			4480	7580	10100	10200
	5	C	<3.4	<3.4	5	<3.4
			<3.4	<3.4	5	<3

Reliability: (2) valid with restrictions
Study performed in Japan, no indication of GLP compliance.
01-AUG-2002

(4)

3.8 Additional Remarks

Memo: Analytical Method Verification for Determination of Pentabromodiphenyl Oxide in Well Water
Method: Well water samples were fortified to reflect concentrations of 1.00, 5.00, 10.0 and 25.0 ug/l of PeBDPO. The recovery samples were extracted and the extracts analyzed using gradient elution high performance liquid chromatography and diode array detectio
Remark: Sponsor: Chemical Manufacturers Association's Brominated

Result:

Flame Retardant Industry Panel.

Sample recoveries ranged from 103 to 112% of nominal concentrations with a mean percent recovery of 107%. No interferences at or above the limit of quantitation of 0.500 ug/l were observed during the sample analyses. Based on these recoveries, the methodology was considered suitable to analyze PeBDPO in well water.

Additional well water samples were fortified at 100 and 250 ug/l using a solvent concentration of 0.10 ml/l. Aliquots from these samples were analyzed prior and subsequent to centrifugation. Uncentrifuged samples fortified at 100 and 250 ug/l PeBDPO yielded mean percent recoveries of 89.6 and 91.8%, respectively. Well water samples fortified at 100 and 250 ug/l PeBDPO, which were subsequently centrifuged, yielded mean percent recoveries of 65.4 and 63.6%, respectivel

Reliability: (1) valid without restriction
06-AUG-2002

(32)

AQUATIC ORGANISMS

4.1 Acute/Prolonged Toxicity to Fish

Type: flow through
Species: Oncorhynchus mykiss (Fish, fresh water)
Exposure period: 96 hour(s)
Unit: µg/l **Analytical monitoring:** yes
NOEC: m = 26
LC50: m > 26
Method: EPA OTS 797.1400
Year: 1994 **GLP:** yes
Test substance: other TS: composite of 2 samples of pentabromodiphenyl oxide from Great Lakes Chemical Corp and Akzo Nobel Chemicals, Inc.

Method: Samples of test material were warmed at 60 C overnight and mixed equal parts in a blender. The blend was used to determine the acute toxicity of pentabromodiphenyl oxide to rainbow trout (Oncorhynchus mykiss) during a 96 hour exposure period under flow-through test conditions. During the test the pH ranged from 8.3 at initiation to 8.2 at 96 hours and dissolved oxygen ranges were 9.7-10.0 mg/L at initiation and 8.8-9.2 mg/L at 96 hour

Remark: Also compliant with OECD Guideline 203, 1984.
Sponsor: Chemical Manufacturers Association's Brominated Flame Retardant Industry Panel

Result: Nominal Test Conc: 1.6, 3.3, 6.5, 13 and 26 ug/L
Measured Test Conc: 1.1, 2.3, 3.9, 7.8 and 21 ug/L
Solubility in well water at 25 C: 13.3 ug/L

96 hour toxicity, Rainbow trout
EC50: >26 ug, nominal (>21 ug, measured)
No Mortality Conc: >26 ug, nominal (>21 ug, measured)
NOEC: 26 ug, nominal (21 ug, measure

Reliability: (1) valid without restriction
02-AUG-2002

(28)

Type: flow through
Species: Oryzias latipes (Fish, fresh water)
Exposure period: 48 hour(s)
Unit: mg/l **Analytical monitoring:** no data
TLm : > 500
Method:
Year:
GLP: no data
Test substance: other TS: Pentabromobiphenyl ether (sample #S-512).

Method: The acute toxicity of Pentabromobiphenyl ether (sample #S-512) was tested in Oryzias latipe

Remark: Sponsor Miki & Co., Ltd.
Result: The 48 hour TLm value was greater than 500 ppm (w/v
Reliability: (2) valid with restrictions
Study performed in Japan, no indication of GLP compliance.
29-JUL-2002

(4)

4.2 Acute Toxicity to Aquatic Invertebrates

Type: flow through
Species: Daphnia magna (Crustacea)
Exposure period: 48 hour(s)
Unit: µg/l **Analytical monitoring:** yes
NOEC: m = 6.5
EC50: m = 19
Method: EPA OTS 797.1300
Year: 1994 **GLP:** yes
Test substance: other TS: composite of 2 samples of pentabromodiphenyl oxide from Great Lakes Chemical Corp and Akzo Nobel Chemicals, Inc.

Method: Samples of test material were warmed at 60 C overnight and mixed equal parts in a blender. The blend was used to determine the acute toxicity of pentabromodiphenyl oxide to Daphnia magna during a 48 hour exposure period under flow-through test conditions. The pH of the water ranged from 8.0 to 8.5, and dissolved oxygen ranged from 8.2 to 9.0 mg

Remark: Sponsor: Chemical Manufacturers Association's Brominated Flame Retardant Industry Panel.

Result: Nominal Test Conc: 1.6, 3.3, 6.5, 13 and 26 ug/L
Measured Test Conc: 1.2, 2.4, 4.9, 9.1 and 20 ug/L
Solubility in well water at 25 C: 13.3 ug/L

48 Hour Toxicity, Daphnia magna
EC50: 19 ug, nominal (14 ug, measured)
95% Conf Int.: 15 and 25 ug, nominal (11 and 19 ug, measured)
No Mortality/immobility Conc: 6.5 ug, nominal (4.9 ug, measured)
NOEC: 6.5 ug, nominal (4.9 ug, measure

Reliability: (1) valid without restriction
29-JUL-2002

(27)

4.3 Toxicity to Aquatic Plants e.g. Algae

Species: Selenastrum capricornutum (Algae)
Endpoint: growth rate
Exposure period: 96 hour(s)
Unit: µg/l **Analytical monitoring:** yes
NOEC: m = 26
EC10: m > 26
EC50: m > 26
EC90 : m > 26
Method: EPA OTS 797.1050
Year: 1988 **GLP:** yes
Test substance: other TS: composite of 2 samples of Pentabromodiphenyl oxide samples from Great Lakes Chemical Corp and Akzo Nobel Chemicals, Inc.

Method: Samples of test material were warmed at 60 C overnight and mixed equal parts in a blender. The blend was used to determine the acute toxicity of pentabromodiphenyl oxide to the freshwater alga, Selenastrum capricornutum, during a 96 hour exposure period under static test conditions. The pH of the water ranged from 8.1 to 8.4 and dissolved oxygen ranged from 8.8 to 10.0 mg/

Remark: Also compliant with OECD Guideline 201, 1984.
Sponsor: Chemical Manufacturers Association's Brominated Flame Retardant Industry Panel

Result: Nominal Test Conc: 1.6, 3.3, 6.5, 13 and 26 ug/L
Measured Test Conc: 1.1, 1.8, 3.3, 6.6 and 14 ug/L
Solubility in well water at 25 C: 13.3 ug/L

96 hour toxicity (cell density) Selenastrum capricornutum
EC10: >26 ug, nominal (>14 ug, measured)
EC50: >26 ug, nominal (>14 ug, measured)
EC90: >26 ug, nominal (>14 ug, measured)
NOEC: 26 ug, nominal (>14 ug, measured)

96 hour toxicity (area under growth curve) Selenastrum capricornutum
EC10: >26 ug, nominal (>14 ug, measured)
EC50: >26 ug, nominal (>14 ug, measured)
EC90: >26 ug, nominal (>14 ug, measured)
NOEC: 26 ug, nominal (>14 ug, measure

Reliability: (1) valid without restriction
29-JUL-2002

(26)

4.4 Toxicity to Microorganisms e.g. Bacteria

-

4.5 Chronic Toxicity to Aquatic Organisms

4.5.1 Chronic Toxicity to Fish

Species: Oncorhynchus mykiss (Fish, fresh water)
Endpoint: weight of young fish
Exposure period: 87 day
Unit: µg/l **Analytical monitoring:** no data
NOEC: m = 8.9
LOEC: m = 16
MATC : c = 12
Method: OECD Guide-line draft "Early Life Stage Test (ELS-Test)"
Year: 1992 **GLP:** yes
Test substance: other TS: Lot No. 8550OI01A, purity 99.93%, expiration 25 May, 2000.

Method: Rainbow trout (Oncorhynchus mykiss) were exposed to Pentabromodiphenyl Oxide at concentrations </= 8.9 ug/L for 60 days post-hatch to determine the chronic toxicity. The effects on hatching success, time to swim-up, larval survival, fry survival and growth were documente

Remark: Study also conducted to OECD Guideline 210: Fish, Early-Life Stage Toxicity Test, 1992; ASTM Standard E1241-88a, Standard Guide for Conducting Early Life-Stage Toxicity Tests with Fish.

Result: The most sensitive endpoints measured during this study were total length, wet weight and dry weight at test termination.

Rainbow trout (Oncorhynchus mykiss) exposed to Pentabromodiphenyl Oxide at concentrations </= 8.9 ug/L for 60 days post-hatch showed no effects on hatching success, time to swim-up, larval survival, fry survival or growth. Rainbow trout exposed to 16 ug/L showed significant reductions in total length, wet weight and dry weight.

The LOEC for this study, based on total length, wet weight and dry weight, was 16 ug/L. The NOEC was 8.9 ug/L and the MATC was calculated to be 12 ug/

Reliability: (1) valid without restriction
06-AUG-2002

(22)

4.5.2 Chronic Toxicity to Aquatic Invertebrates

Species: Daphnia magna (Crustacea)
Endpoint: mortality
Exposure period: 21 day
Unit: µg/l **Analytical monitoring:** yes
NOEC: m = 5.3
LOEC: m = 9.8
EC50: m = 14
MATC : c = 7.2
Method: OECD Guide-line 202, part 2 "Daphnia sp., Reproduction Test"
Year: 1984 **GLP:** yes
Test substance: other TS: a composite of 2 samples of Pentabromodipehnyl oxide from Great Lakes Chemical Corp, lot 55500J18A, and Akzo Nobel Chemicals Inc., lot ANCR-DF T #37.

Method: Daphnia magna were exposed to PeBDPO at concentrations up to 5.3 ug/L for 21 days. The pH of the test solutions ranged from 7.9 to 8.3 and dissolved oxygen was equal to or greater than 76

Result: Daphnia magna exposed to PeBDPO at concentrations up to 5.3 ug/L for 21 days showed no significant reductions in survival, reproduction or growth. Daphnia magna exposed to 9.8 and 20 ug/L showed significant reductions in length and survival, respectively. Consequently the LOEC, based on slight length reduction, was 9.8 ug/L. The NOEC was 5.3 ug/L and the MATC was calculated to be 7.2 ug/L. The 21-day EC50 values based on mortality/immobility and reproduction were both 14 ug/

Reliability: (1) valid without restriction
06-AUG-2002

(29)

TERRESTRIAL ORGANISMS

4.6.1 Toxicity to Soil Dwelling Organisms

Type: artificial soil
Species: Eisenia fetida (Worm (Annelida), soil dwelling)
Endpoint: mortality
Exposure period: 14 day
Unit: mg/kg soil dw
NOEC: c = 500
LC50: c > 500
Method: OECD Guide-line 207 "Earthworm, Acute Toxcity Test"
Year: 1984 **GLP:** yes
Test substance: other TS: Lot No. 8550OI01A, purity 99.93%, expiration May 25, 2000.

Method: The effects of pentabromodiphenyl oxide on earthworms during a 14-day exposure period in an artificial soil substrate were determined. The study was conducted in two phases. In the first, concentrations tested were 3.1, 6.3, 13, 25, and 50 mg/kg soil; and in the second, concentrations tested were 100, 300 and 500 mg/kg. Earthworms (10 worms/replicate) were places on the substrate. Body weight and survival were determined on Days 0, 7 and 1

Remark: Sponsor: Great Lakes Chemical Corp.

Result: Soil pH ranged from 6.6 to 7.6 on Day 0 and from 7.7 to 8.7 on Day 14; temperatures ranged from 20 to 22 C; and moisture content ranged from 31.6 to 32.8 on Day 0 and from 26.5 to 31.4 on Day 14.

At test termination, mortality in the 3.1, 6.3, 13, 25, 50, 100, 300 and 500 mg/kg treatment groups was 2.5, 0, 0, 2.5, 5, 7.5, 12.5 and 10%, respectively. The numbers of mortalities that occurred in the treatment groups were comparable to the control groups and did not occur in a concentration responsive manner. Mortalities were not considered treatment related. There was a slight loss in body weight over the test period (worms were not fed during the study), which was not statistically significant at any concentration when compared to the control groups.

The 14-day LC50 for earthworms exposed to pentabromodiphenyl oxide in artificial soil substrate was >500 mg/kg dry soil, the highest concentration tested. The NOEC was 500 mg/kg dry soil (no treatment related differences in survival or behavioral/pathological observations at any concentration) and no statistically significant effects on body weight chang

Reliability: (1) valid without restriction
06-AUG-2002

(20)

Type: artificial soil
Species: Lumbricus sp. (Worm (Annelida), soil dwelling)
Endpoint: mortality
Exposure period: 28 day
Unit: mg/kg soil dw
NOEC: c = 1.3
LOEC : c = 6.3
Method: OECD Guide-line 207 "Earthworm, Acute Toxcity Test"
Year: 1984 **GLP:** yes
Test substance: other TS: Lot no. 8550OI01A
Method: The 28-day EC50 for oligochaetes (Lumbriculus variegatus) exposed to pentabromodiphenyl oxide (PeBDPO) in sediment was determined. The highest nominal concentration tested was 50 mg/kg dry weight of sediment. Determinations of the lowest-observed-effect-concentration (LOEC) and the no-observed-effect-concentration (NOEC) were based on an evaluation of the survival/reproduction and dry weight dat
Remark: Study also complied with EPA OPPTS No. 850.1735: Whole Sediment Acute Toxicity Intertebrates, Freshwater and ASTM E 1706-95b, 1995, Standard Test methods for measuring the Toxicity of Sediment Associated Contaminants with Fresh Water Invertebrates.
Result: The most sensitive parameter in this study was survival/reproduction. The 28-day EC50 value for oligochaetes (Lumbriculus variegatus) exposed to pentabromodiphenyl oxide (PeBDPO) in sediment was >50 mg/kg dry weight of sediment, the highest nominal concentration tested.

Based on the statistically significant reduction in the number of worms (survival and reproduction) in the 6.3 mg/kg treatment group in comparison to the solvent control group, the LOEC was 6.3 mg/kg dry sediment and the NOEC was 1.3 mg/kg dry sedimen

06-AUG-2002

(23)

Type: artificial soil
Species: other: Amphipod (Hyalella azteca)
Endpoint: mortality
Exposure period: 28 day
Unit: mg/kg soil dw
NOEC: m = 6.3
LOEC : m = 13
Method: OECD Guide-line 207 "Earthworm, Acute Toxcity Test"
Year: **GLP:** yes
Test substance: other TS: Lot no. 8550OI01A, purity 99.93%, expiration 25 May, 2000.

Method: The 28-day EC50 for amphipods (Hyalella azteca) exposed to pentabromodiphenyl oxide (PePDBO) in sediment was determined. Determinations of the LOEC and the NOEC were based on an evaluation of the survival and dry weight dat

Result: The 28-day EC50 value for amphipods (Hyalella azteca) exposed to pentabromodiphenyl oxide (PePDBO) in sediment was >50 mg/kg dry weight of sediment, the highest nominal concentration tested.

There were no significant reductions in weight at any concentration tested. Therefore, based on the general increase in mortality at concentrations >/=13 mg/kg dry sediment, the LOEC was 13 mg/kg dry sediment and the NOEC was 6.3 mg/kg dry sedimen

Reliability: (1) valid without restriction
06-AUG-2002

(25)

Type: other: artificial sediment
Species: other: Midge (Chironomus riparius) larvae
Endpoint: mortality
Exposure period: 28 day
Unit: mg/kg soil dw
NOEC: c = 25
LOEC : c = 50
Method: OECD Guide-line 207 "Earthworm, Acute Toxcity Test"
Year: 1984 **GLP:** yes
Test substance: other TS: Lot no. 8550OI01A, purity 99.93%, expiration 25 May, 2000.

Method: The 28-day EC50 was determined for midges (Chironomus riparius) exposed to pentabromodiphenyl oxide (PePDBO) in artificial sediment. The highest nominal concentration tested was 50 mg/kg. Determinations of the LOEC and the NOEC were based on an evaluation of the mean development times, emergence rates and development rate

Result: The most sensitive parameter in this study was development rate.

Based on the statistically significant reduction in development rate in the 50 mg/Kg treatment group, the LOEC was 50 mg/Kg dry sediment and the NOEC was 25 mg/Kg dry sediment.

Based on mortality, the 28-day EC50 for midges (Chironomus riparius) exposed to pentabromodiphenyl oxide (PePDBO) in sediment was >50 mg/Kg dry weight of sedimen

06-AUG-2002

(24)

4.6.2 Toxicity to Terrestrial Plants

Species: other terrestrial plant: Tomato (Lycopersicon esculentum)
Endpoint: emergence
Expos. period: 21 day
Unit: mg/kg soil dw
NOEC: c = 125
LC25 (emergence) : c > 1000
EC25 (height) : c = 369
Method: EPA OPPTS 850.4100
Year: 1996 **GLP:** yes
Test substance: other TS: Lot no. 8550OI01A, purity 99.93%, expiration 25 May, 2000.
Method: Toxicity to tomato plants was evaluated. The most sensitive endpoint for tomatoes was seedling weigh
Remark: Study also met EPA OPPTS No 850.4225: Terrestrial Plant Toxicity, Tier II (Seedling Emergence); OECD Guideline 208, 1984.
Result: Based on seedling weight, which was the most sensitive endpoint, the NOEC for tomatoes was 125 mg/kg; the LOEC was 250 mg/kg; and the EC25 was 136 mg/k
Reliability: (1) valid without restriction
06-AUG-2002

(21)

Species: other terrestrial plant: Corn (Zea mays)
Endpoint: other: emergence, growth and condition.
Expos. period: 21 day
Unit: mg/kg soil dw
NOEC: c = 16
LC25 (emergence) : c > 1000
EC25 (height) : c > 1000
Method: EPA OPPTS 850.4100
Year: 1996 **GLP:** yes
Test substance:
Method: Toxicity of Pentabromodiphenyl oxide to corn seedlings was determine
Remark: Study also met EPA Series 850 - Ecological Effects Test Guidelines OPPTS No. 850.4225; OECD Guideline for Testing of chemicals: Proposal for Revision of Guideline 208: "Terrestrial Non-target Plant Tests".
Result: Treatment related effects on seedling growth were observed in corn. The most sensitive endpoint was seedling weight. The LOEC was 62.5 mg/kg and the EC25 was 154 mg/kg, based on seedling weight. The NOEC was based on weight and was estimated by the calculation of the EC05 to be 16.0 mg/k
Reliability: (1) valid without restriction
06-AUG-2002

(21)

Species: other terrestrial plant: Cucumber (Cucumis sativa), Onion (Allium cepa), Ryegrass (lolium perenne), Soybean (Glycene max),
Endpoint: emergence
Expos. period: 21 day
Unit: mg/kg soil dw
NOEC: c = 1000
LC25 (emergence) : c > 1000
EC25 (height) : c > 1000
Method: EPA OPPTS 850.4100
Year: 1996 **GLP:** yes
Test substance:
Method: Toxicity of Pentabromodiphenyl oxide to seedlings of cucumber, onion, ryegrass and soybean was determine
Remark: Study also complied with EPA OPPTS No. 850.4225: Terrestrial Plant Toxicity, Tier II (Seedling Emergence); OECD Guideline 208, 1984, Guideline for Testing of Chemicals, Terrestrial Plants, Growth Test.
Result: There were no treatment-related effects on seedling growth resulting from soil incorporated pentabromodiphenyl oxide observed on cucumber, onion, ryegrass or soybean seedlings. Therefore, the highest concentration tested, 1000 mg/kg, was determined to be the NOEC for these species and the LOEC was not determine
Reliability: (1) valid without restriction
06-AUG-2002

(21)

4.6.3 Toxicity to other Non-Mamm. Terrestrial Species

-

4.7 Biological Effects Monitoring

-

4.8 Biotransformation and Kinetics

-

4.9 Additional Remarks

Memo: Soil Microorganisms, Nitrogen Transformation Test (EC50, 28 Days, OECD Guidelines for the Testing of Chemicals, Document 216).
Method: The objective of this study was to investigate the effects of pentabromodiphenyl oxide on the nitrogen transformation (nitrification and mineralisation) of soil microflora under aerobic conditions. The test material was incorporated into a sandy loam soil at 0.00, 0.01, 0.03, 0.10, 0.33, and 1.00 mg/kg oven dry soil equivalen
Remark: Sponsor: Great Lakes Chemical Corp.

Result: The EC(50) for inhibition of nitrate production was greater than the highest concentration tested (1.00 mg/kg) and increasing concentrations of test material had no apparent effect on nitrogen transformati

Reliability: (1) valid without restriction
06-AUG-2002

(8)

5.1 Acute Toxicity

5.1.1 Acute Oral Toxicity

Type: other: toxicity
Species: rat
Strain: other: Charles River CD
Sex: male
Number of Animals: 15
Vehicle: other: corn oil
Value: = 500 - 5000 mg/kg bw
Method: other: none reported
Year: **GLP:** no data
Test substance: other TS: Pentabromodiphenyl Ether, 345-76A
Method: Pentabromodiphenyl Ether, 345-76A, was evaluated for oral toxicity in rats. The test material was suspended in corn oil at concentrations enabling the administration of 10 mg/kg at all dosage levels and administered by gavage at dosage levels of 50, 500 and 5000 mg/kg to groups of 5 male rats. Rats were observed over the following 14 days for mortalit
Result: None of the rats at either the 50 or 500 mg/kg dosage levels died during the 14 day observation period. All rats at these levels exhibited normal body weight gains during the observation period. Four of five rats at the 5000 mg/kg died. One was dead at 3 days and 3 additional rats were dead at 5 days. The remaining rat survived the 14 day observation period and exhibited a normal body weight gai
Reliability: (2) valid with restrictions
Study performed in 1970's, no indication of GLP compliance.
01-AUG-2002 (7)

Type: LD50
Species: rat
Strain: Wistar
Sex: male/female
Number of Animals: 50
Vehicle: other: maize oil
Value: = 6200 mg/kg bw
Method: other: none reported
Year: **GLP:** no data
Test substance: other TS: Pentabromodiphenyl Ether, DE-71, 25.10.76 (date), ref. # 2564.
Method: Groups (5 males and 5 females/group) of fasted Wistar rats were used at each dose level. The test material was diluted to 80% w/v in maize oil and administered by oral intubation. Doses administered were 2400, 4000, 6048, 7621 and 9600 mg/kg body weight and a control of maize oil only. Rats were observed for a 44 day observation perio
Remark: Sponsor: Lunevale Products, Ltd.
Result: Mortality:

Dose (mg/kg)	Number Dead/Total Males	Females
2400	0/5	0/5
4800	0/5	1/5
6048	1/5	4/5
7621	3/5	5/5
9600	5/5	5/5

All animals given 4800 mg/kg and above had slight diarrhea within 24 hours of dosing, followed by 2-3 days when less feces than controls were produced. Females at 4800 and animals at higher doses showed piloerection and reduced activity within a few hours of dosing, these signs were followed by clonic persistent tremors of the fore limbs together with a red staining around the nose and eyes. Also, a continual chewing movement of the jaws was seen. In those animals which died, these signs increased in severity up to the time of death. All remaining rats appeared to be normal by six days after treatment.

There was a significantly lower body weight gain during the first week after dosing with all dose levels. Recovery of body weight gain generally took longer with increasing dose level, however, by 32 days the body weight gains of the male rats given the two lowest doses were simliar to those of the controls. The females were more severely affected such that at the end of 44 days, the cumulative body weights at all dose levels were significantly lower than those of the controls.

Post mortem examination of animals that died during the study revealed pale enlarged necrotic livers in all cases. The majority also showed multiple small ulcerations of the gastric mucosa. There was evidence of hemorrhage from these since the stomach contents contained blood.

Post mortem examination of the survivors showed slightly mottled livers, the incidence of which increased with dose level.

The acute oral LD50 values (95% Confidence Limits) of pentabromodiphenylether were:

male rats: 7400 (6802 - 8051) mg/kg
female rats: 5800 (5370 - 6264) mg/kg
combined: 6200 (5391 - 7130) mg/

Reliability: (2) valid with restrictions
Study performed in 1970's, prior to GLP.

01-AUG-2002

(2)

5.1.2 Acute Inhalation Toxicity

Type: other: toxicity
Species: rat
Strain: other: Charles River CD
Sex: male/female
Number of Animals: 20
Vehicle: other: none
Exposure time: 1 hour(s)
Value: > 200 mg/l
Method: other: none reported
Year: **GLP:** no data
Test substance: other TS: Pentabromodiphenyl Ether, 345-76A
Method: Pentabromodiphenyl Ether, 345-76A, was evaluated for inhalation toxicity in rats. Each of two groups of 5 male and 5 female rats were placed in a sealed 59.1 l glass chamber and exposed for 1 hour to a dynamic atmosphere containing the mist of the test material. Addition of the test compound, which had been mixed with corn oil, to the test chamber atmosphere was controlled by a Harvard Infusion Pump at the 2.0 mg/l level and by a Dow Dual Syringe Feeder at the 200 mg/L level. The calculated atmospheric concentrations administered were approximately 2.0 and 100 mg/l. [There is no indication in the report of particle/droplet size

Result: All rats at each dose level survived the 14 day observation period. Signs observed during the 1 hour exposure included increased, followed by decreased, motor activity; eye squint; erythema; lacrimation; salivation; and tachypnea. Signs at termination of exposure were identical to those observed during exposure. At 24 and 48 hours two rats exhibited nasal congestion and at 72 hours one rat exhibited respiratory congestion. From 4 through 14 days, all rats appeared normal and exhibited normal body weight gains.

Pentabromodiphenyl Ether, 345-76A, would not be considered a toxic substance by the inhalation route of administratio

Reliability: (2) valid with restrictions
Study performed in 1970's prior to GLP.

01-AUG-2002

(7)

5.1.3 Acute Dermal Toxicity

Type: other: toxicity
Species: rabbit
Strain: New Zealand white
Sex: male/female
Number of Animals: 4
Vehicle: other: none
Value: > 2000 mg/kg bw
Method: other: none reported
Year:
GLP: no data
Test substance: other TS: Pentabromodiphenyl Ether, 345-76A
Method: Pentabromodiphenyl Ether, 345-76A, was evaluated for dermal toxicity in rabbits. The test material was warmed gently to produce a viscous liquid. The test material was applied at two dose levels (200 and 2000 mg/kg body weight) to sites on the clipped backs of 2 male and 2 female rabbits. The skin of one male and one female was abraded, that of one male and one female was not. Sites were wrapped with gauze and occluded with Saran Wrap. 24 hours later the bandages were removed, the area washed with water and the animals observed for mortality for 14 day

Result: None of the rabbits at either dosage level died during the 14 day study. At 200 mg/kg, one male exhibited a slight body weight loss of 88 grams. The other male exhibited a body weight loss of 710 grams which was attributable to an injury sustained in stock confinement. At 2000 mg/kg three of four rabbits exhibited body weight gains. One female exhibited a body weight loss of 135 g.
Pentabromodiphenyl Ether, 345-76A, would not be considered a toxic material by the dermal route of administratio

Reliability: (2) valid with restrictions
Study performed in 1970's prior to GLP.

01-AUG-2002

(7)

5.1.4 Acute Toxicity, other Routes

Type: other: tissue irritation
Species: rabbit
Strain: New Zealand white
Sex: male/female
Number of Animals: 12
Vehicle: other: sesame oil
Route of admin.: other: intracutaneous injection
Value:
Method: other: none reported
Year:
GLP: yes
Test substance: other TS: extracts of foam blocks.
Method: The objective of the study was to determine if an extract of the test material causes increased reaction to

intracutaneous injection in rabbits. The test materials were three foam blocks. Four pieces (5 x 2.5 x 0.4 cm) of each block were extracted with 20 ml sesame oil, heated in an autoclave to 121 C for 60 min, and cooled to room temperature. Each of the three extracts was administered as 0.2 ml intracutaneous injections to 10 sites on the left sides of three rabbits. The blank (sesame oil) was injected intracutaneously to 5 sites on the right side of each rabbit. Sites were examined at 24, 48, and 72 hours after injection and evaluated by the method of Draiz

Result: None of the rabbits died and there were no significant body weight changes. Mean dermal observation scores of the test material extracts did not exceed the blank group mean scores. Therefore, the test materials were not considered to cause reactions when their extracts were administered by intracutaneous injections in comparison to vehicle control

Reliability: (1) valid without restriction
06-AUG-2002

(19)

5.2 Corrosiveness and Irritation

5.2.1 Skin Irritation

Species: rabbit
Concentration: undiluted

Exposure: Occlusive
Exposure Time: 24 hour(s)
Number of Animals: 6
PDII: .3
Result: not irritating
EC classificat.: not irritating
Method: other: none reported
Year:
GLP: no data
Test substance: other TS: Pentabromodiphenyl Ether, 345-76A

Method: Pentabromodiphenyl Ether, 345-76A, was evaluated for dermal irritation in rabbits. The test material was warmed gently to produce a viscous liquid which was applied (0.5 ml) to the clipped backs of each of 3 male and 3 female rabbits. The skin of three rabbits was abraded, that of three was not. Sites were wrapped with gauze and occluded with Saran Wrap. 24 hours later the bandages were removed, the area washed with water and scored for irritation over the following 72 hour

Result: The primary irritation score was 0.3. Pentabromodiphenyl Ether, 345-76A, would not be considered a primary skin irritan

Reliability: (2) valid with restrictions
Study performed in 1970's prior to GLP.
01-AUG-2002

(7)

5.2.2 Eye Irritation

Species: rabbit
Concentration: undiluted
Dose: .1 ml
Exposure Time:
Comment: not rinsed
Number of Animals: 6
Result: irritating
EC classificat.: irritating
Method: other: none reported
Year: **GLP:** no data
Test substance: other TS: Pentabromodiphenyl Ether, 345-76A.
Method: Pentabromodiphenyl Ether, 345-76A, was evaluated for eye irritation in rabbits. The test material was warmed gently to produce a viscous liquid which was instilled (0.1 ml) into the right conjunctival sac of each of 3 male and 3 female rabbits. Eyes were not rinsed, but were scored for irritation over the following 7 day
Result: Examination at 72 hours revealed slight evidence of corneal damage in 1 of the 6 treated eyes. The average irritation scores for each examination period were: 6.8, 3.8, 3.2 and 3.0 for 24, 48 and 72 hours and 7 days, respectively. Pentabromodiphenyl Ether, 345-76A, would be considered a possible eye irritan
Reliability: (2) valid with restrictions
Study performed in 1970's prior to GLP.

01-AUG-2002

(7)

5.3 Sensitization

Type: Guinea pig maximization test
Species: guinea pig
Concentration:

Induction	5	%	other: intradermal
Induction		undiluted	open epicutaneous
Challenge		undiluted	open epicutaneous

Number of Animals: 30
Vehicle: other: corn oil
Result: not sensitizing
Classification: not sensitizing
Method: other: none reported
Year: **GLP:** yes
Test substance: other TS: Pentabromodiphenyl Oxide
Method: Pentabromodiphenyl Oxide was evaluated in the guinea pig maximization test. The first induction doses were administered to the interscapular region as intradermal injections (3 pairs of injections of Freund's adjuvant and corn oil, test article at 5% in corn oil and 50:50 test article in corn oil and Freund's adjuvant). After 7 days the treated animals (test material) received topical

applications of neat test article on the previously treated interscapular sites. Following a two week rest period, the challenge doses were administered. Each animal received a topical application of neat test article on the left flank and an empty Hilltop Chamber on the right flan

Result: Examination of the test sites indicated the test article produced no erythema or edema in any animal at 24, 48, 72, 96, or 120 hours after the challenge dose. Based on the percentage of animals responding (0%), Pentabromodiphenyl Oxide was considered a non-sensitize

Reliability: (1) valid without restriction
06-AUG-2002

(12)

5.4 Repeated Dose Toxicity

Species: rat **Sex:** female
Strain: Long-Evans
Route of admin.: oral unspecified
Exposure period: 4 consecutive daily doses, starting at age 28 days
Frequency of treatment: daily
Post. obs. period: none
Doses: 0.3, 1.0, 3, 10, 30, 100 and 300 mg/kg/day
Control Group: yes
Method: other: none reported
Year: **GLP:** no
Test substance: other TS: DE-71, lot #7550OK20A (58.1% penta-BDE) Great Lakes Chem. Co.

Method: Female Long Evans rats, 28 days old, were orally administered DE-71 at doses of 0.3, 1, 3, 10, 30, 100 and 300 mg/kg/day for 4 consecutive days. A control group was also included in the study. Eight females were in each treatment group except 0.3 mg/kg which had four females.

Twenty-four hours after the last dose serum and liver samples were collected and analyzed for serum total thyroxine (T4), triiodothyronine (T3), thyroid-stimulating hormone (TSH), hepatic microsomal ethoxy- and pentoxy-resorufin-O-deethylase (EROD and PROD), and uridine diphosphate-glucuronosyltransferase (UDPGT) activitie

Result: The treated groups did not exhibit significant changes in body weight; however, increased liver weights, as well as 10- to 20-fold induction in EROD and 30- to 40-fold induction of PROD were found in the DE-71 treated animals. DE-71 caused dose dependent depletion of T4, accompanied by up to 3- to 4-fold induction in UDPGT activities. Serum total T4 was decreased a maximum of 80% for DE-71 at 300 mg/kg, with benchmark doses of approximately 12.74 mg/kg/day. Dose related effects in serum T3 levels were less apparent, with maximal reductions of 25-30% for DE-71 at 300 mg/kg. There was no effect on serum TSH level. Benchmark dose analysis revealed DE-71 and DE-79 were

comparable in altering thyroid hormone levels and hepatic enzyme activit

Reliability: (2) valid with restrictions
Study performed at University of North Carolina, no indication of GLP compliance, not clear how controls were dosed.

04-NOV-2002

(13)

Species: rat **Sex:** male/female
Strain: other: Charles River CD
Route of admin.: oral feed
Exposure period: 28 days
Frequency of treatment: daily
Post. obs. period: none
Doses: 100 and 1000 ppm in diet
Control Group: yes, concurrent no treatment
NOAEL: < 100 ppm
LOAEL: = 100 ppm
Method: other: none reported
Year:
GLP: no data
Test substance: other TS: Pentabromodiphenyl Ether, 345-76A.

Method: Pentabromodiphenyl Ether, 345-76A, was evaluated in a 28 day diet study in rats. The test material was dissolved in corn oil and then mixed into basal diet at two dose levels, 100 and 1000 ppm. Diets were mixed fresh weekly. Treatment groups consisted of 10 male and 10 female Charles River CD rats at each of two dose levels of test material and a control group which received basal diet. Treatment was continued for 28 day

Result: No treatment related changes were seen in general behavior or appearance, body weight or food consumption. No rats died during the study.

Absolute and relative liver weights were significantly increased for male and female rats at 1000 ppm. (Absolute liver weights for males were 16.22, 16.40 and 23.98** and for females were 8.90, 9.70 and 13.61**; liver weights relative to body weights for males were 3.81%, 3.93% and 5.93** and for females were 3.66%, 4.03% and 5.82%** at 0, 100 and 1000 ppm, respectively.) The effects on liver weights were considered treatment related.

No treatment related gross pathologic lesions were observed at necropsy in any rats. Microscopically, treatment related changes occurred in the livers of rats at 100 and 1000 ppm. The lesions were characterized by enlargement of centrolobular and midzonal parenchymal cells with large areas of finely granular 'ground glass' appearing cytoplasm present. Intracytoplasmic eosinophilic bodies were frequently seen in affected cells. Occurrence of slight to moderate thyroid hyperplasia in several rats at the 100 and 1000 ppm levels had a questionable compound relationshi

Reliability: (2) valid with restrictions
Study performed in 1970's prior to GLP.

04-NOV-2002

(6)

Species: rat **Sex:** male/female
Strain: other: Charles River COBS CD
Route of admin.: oral feed
Exposure period: 30 day
Frequency of treatment: daily
Post. obs. period: 6, 12 and 24 weeks
Doses: 0.01, 0.05, 0.10, 0.50 and 1.00 mg/kg/day
Control Group: yes, concurrent vehicle
NOAEL: = 1 mg/kg
LOAEL: > 1 mg/kg
Method: other: none reported
Year:
GLP: yes
Test substance: other TS: Pentabromodiphenyl Oxide, DE-71.

Method: Potential toxic effects of Pentabromodiphenyl Oxide were evaluated in rats in a 30-day dietary study with recovery periods of 6, 12 and 24 weeks. Test compound was blended in the basal laboratory diet and supplied fresh weekly for a minimum of 30 days at dosage levels of 0.01, 0.05, 0.10, 0.50 and 1.00 mg/kg/day. A concurrent vehicle control group received the basal diet with corn oil on a comparable regimen. Treatment groups consisted of 20 male and 20 female Charles River COBS CD rat

Result: No compound related effects were noted during the treatment or recovery periods in survival, clinical observations, body weights, food consumption, clinical laboratory parameters, macroscopic or microscopic evaluations. After the treatment period, bromine levels were increased in the thyroid gland and liver at 0.5 and 1.0 mg/kg. In general, bromine levels in these organs were comparable with control values after a 6-week recovery period.

There were no compound related effects noted in the study except for the elevated bromine levels after 4 weeks of treatmen

Reliability: (1) valid without restriction
01-AUG-2002

(18)

Species: rat
Sex: male/female
Strain: Sprague-Dawley
Route of admin.: oral feed
Exposure period: 90 days
Frequency of treatment: daily
Post. obs. period: 24 weeks
Doses: 2, 10 and 100 mg/kg/day
Control Group: yes, concurrent vehicle
NOAEL: < 2 mg/kg
LOAEL: = 2 mg/kg
Method:
Year:
GLP: yes
Test substance: other TS: Pentabromodiphenyl Oxide (DE-71), sample #830-185A, Ref. #PP307, 1/12/83.

Method:

Potential toxic effects of pentabromodiphenyl oxide when administered 90 days to rats were evaluated. Test material was prepared as a premix in corn oil by adding test material to heated corn oil and stirring until a homogeneous suspension was obtained. Rodent meal was added in small increments to the premix until all the premix was absorbed. This mixture was added to the remaining portion of basal laboratory diet and supplied fresh weekly. Diets were administered to groups of 30 male and 30 female rats at 2, 10 and 100 mg/kg/day. A control group received corn oil in basal diet. Ten rats/sex/group were sacrificed at 4 weeks and at 90 days (13 weeks). Five animals per sex per group were retained for a 6-week recovery period and the remaining animals were sacrificed after a 24 week recovery perio

Result:

No compound related effects were noted for mortality or clinical observations. Compound related decreases were noted in body weights for males and females at 100 mg/kg and in food consumption for females at 100 mg/kg.

There were no toxic effects noted in hematology parameters. Cholesterol levels were increased for males and females at 100 mg/kg. Decreases were noted in T4 levels with corresponding increases in serum bromide levels for rats at 10 and 100 mg/kg.

Compound related increases were observed in liver and urine porphyrins for rats at 100 mg/kg. Tissue bromine levels were elevated throughout the dosing period. Although these levels decreased during the recovery period, elevated bromine levels were present in the tissues 24 weeks after compound withdrawal.

Compound related increases were noted in absolute liver weight and liver weight relative to body weight during the dosing period for rats at 10 and 100 mg/kg. The differences were statistically significant for mid dose males at week 4 and high dose males and females at weeks 4 and 13. (Week 13 mean liver weight (g), males: 15.38, 16.14, 17.07, 25.86**; females: 8.41, 8.45, 9.32 and 12.62** for 0, 2, 10 and 100 mg/kg dose groups.) Liver weights returned to

normal ranges following the 24 week recovery period.
Microscopic examination of the tissues revealed compound related changes at all dosage levels in the liver (hepatocytomegaly) and thyroid gland (hyperplasia). The thyroid hyperplasia was a reversible effect and was not present after the 24 week recovery. The liver effects were not completely reversible - hepatocytomegaly was noted in males at 10 mg/kg and males and females at 100 mg/kg after 24 weeks of withdrawal. No hepatocytomegaly was noted in females at 10 mg/kg or in the rats at 2 mg/kg after 24 weeks of withdrawal. After 24 weeks of withdrawal, degeneration and necrosis of liver parenchymal cells were noted for the females at all dosage levels.
The no effect level for pentabromodiphenyl oxide is less than 2 mg/kg/da

Reliability: (1) valid without restriction
01-AUG-2002

(17)

5.5 Genetic Toxicity 'in Vitro'

Type: Ames test
System of testing: Plate incorporation
Concentration: 0.5, 1.0, 10,0, 100, 500, 1000, 2500 and 5000 ug/plate
Cytotoxic Conc.:
Metabolic activation: with and without
Result: negative
Method:
Year:
GLP: yes
Test substance: other TS: 534-111
Method: The test material, 534-111, was evaluated in the Ames assay for mutagenic activity. The compound was tested directly and in the presence of liver microsomal enzyme preparations from Aroclor-induced rats over a series of concentraions from 0.5 ug to 5000 ug per plat
Result: The results of the tests conducted on the compound in the absence and in the presence of a metabolic activation system were all negative. The test compound, 534-111, did not demonstrate genetic activity in any of the assays conducted and was considered not mutageni
Reliability: (1) valid without restriction
29-JUL-2002

(10)

Type: Salmonella typhimurium reverse mutation assay
System of testing: Plate incorporation
Concentration: 0.005, 0.01, 0.1, and 1.0 ul/plate
Cytotoxic Conc.:
Metabolic activation: with and without
Result: negative
Method:
Year:
GLP: no data
Test substance: other TS: 345-76A
Method: The test compound, 345-76A, was evaluated for genetic activity in microbial assays with and without the addition of mammalian metabolic activation preparations. The compound was tested in 5 strains of Salmonella typhimurium and one yeast strain (Saccharomyces cerevisiae, strain D4) at 0.005, 0.01, 0.1 and 1.0 ul per plat
Result: The test compound, 345-76A, did not demonstrate mutagenic activity in any of the assays conducted and was considered not mutagenic under the test condition
Reliability: (2) valid with restrictions
Study performed in 1970's prior to GLP.
29-JUL-2002
(9)

Type: Chromosomal aberration test
System of testing: Human peripheral blood lymphocytes
Concentration: 0.75, 2.5, 7.5, 25, 75, 250, 750, 2500 ug/ml
Cytotoxic Conc.:
Metabolic activation: with and without
Result: negative
Method:
Year:
GLP: yes
Test substance: other TS: Pentabromodiphenyl Oxide
Method: Pentabromodiphenyl Oxide was tested in the in vitro mammalian cytogenetic test using human peripheral blood lymphocytes both in the absence and presence of metabolic activation. The test material was dissolved in DMSO at approximately 100 mg/ml. Visible precipitate was observed in treatment medium at dose levels of 750 and 2500 ug/ml; the test article was soluble but cloudy at 250 ug/ml. Toxicity (mitotic inhibition) of approx. 47% was observed at 250 ug/ml in the non-activated study. In the activated study, no toxicity was observed at the highest dose level (2500 ug/ml). the non-activated assay was repeate
Result: A weak positive response was observed in the initial assay at 2500 ug/ml in the presence of S9. The response of 4% aberrant cells was barely outside the range of the historical solvent control (0-3%) and within the criteria for the determination of a valid test. The 1% increase over the historical solvent control range is considered to have no biological significance and was not reproducible in an

independent repeat assay. Pentabromodiphenyl Oxide was negative for the induction of structural and numerical chromosome aberrations in human peripheral blood lymphocyte

Reliability: (1) valid without restriction
01-AUG-2002

(11)

5.6 Genetic Toxicity 'in Vivo'

-

5.7 Carcinogenicity

-

5.8 Toxicity to Reproduction

-

5.9 Developmental Toxicity/Teratogenicity

Species: rat **Sex:** female
Strain: Long-Evans
Route of admin.: gavage
Exposure period: Gestation Day 6 through post-natal Day 21.
Frequency of treatment: daily
Duration of test: Through post-natal Day 21.
Doses: 0, 1, 10 and 30 mg/kg/day
Control Group: yes, concurrent vehicle
Method: other: none reported
Year: **GLP:** no data
Test substance: other TS: DE-71, pentabromodiphenyl ether, lot 7550OK20A, Great Lakes Chemical Corp.

Method: Timed pregnant rats were allocated to four groups (47, 47, 55, 55) and administered DE-71 by gavage once daily at 0, 1, 10, or 30 mg/kg/day on gestation days 6 through post-natal day 22, except for the day of parturition. The numbers of dams with litters on post-natal day 1 were 38, 39, 48 and 45, respectively. Some (undefined number) dams from each group were decapitated for tissue collection on gestation day 20 and postnatal day 22. Some (undefined number) offspring from each group were decapitated for tissue collection on gestation day 20 and postnatal days 4, 14, 36 and 90. Body weights and organ weights were collected. Serum and liver samples from dams, fetuses and offspring were analyzed for circulating total serum thyroxine and triiodothyronine and hepatic microsomal ethoxy- and pentoxy-resorufin-O-deethylase (EROD and PROD) and uridine diphosphoglucuronosyl transferase (UDPGT) activit

Result: There were no significant effects of treatment on maternal body weight gain, litter size or sex ratio, nor were there any effects on any measures of offspring viability or

growth. Serum T4 was reduced in a dose-dependent manner in fetuses on GD 20 (at least 15%) and offspring on PND 4 and PND 14 (50 and 64% maximal in the 10 and 30 mg/kg groups, respectivey), but recovered to control levels by PND 36. Reduction in serum T4 was also noted in GD 20 dams (48% at highest dose), as well as PND 22 dams (44% at highest dose). There was no significant effect of DE-71 on T3 concentrations at any time in the dams or the offspring. Increased liver to body weight ratios in offspring were consistent with induction of EROD (maximal 95-fold), PROD (maximal 26-fold) or UDPGT (maximal 4.7-fold). Induction of PROD was similar in both dams and offspring; however, EROD and UDPGT inductions were much greater in offspring compared to dams (EROD = 3.8-fold; UDPGT = 0.5-fold

Reliability: (2) valid with restrictions
Study performed at University of North Carolina, no indication of GLP, not clear how many animals sacrificed at each time point.

04-NOV-2002

(14)

Species: mouse **Sex:** female
Strain: CD-1
Route of admin.: gavage
Exposure period: Gestation day 6 to postnatal day 120.
Frequency of treatment: daily
Duration of test: Postnatal day 21
Doses: 0.6, 6 and 30 mg/kg/day
Control Group: other: concurrent vehicle control and concurrent positive control
Method: other:European Communities Council Directive (86/609/EEC)
Year: 1986 **GLP:** no data
Test substance: other TS: PBDE 99 (Promochem, Wesel, Germany)
Method: Mated female CD-1 mice (4 females/group) were administered PBDE 99 dissolved in corn oil at 0.6, 6 or 30 mg/kg/day. Pups were weaned on PND 21. Dams were assessed for effects on pregnancy and pups were assessed for somatic and neurobehavioral development (PND 2-20), ultrasonic vocalisations (PMD 4, 8 and 12), homing (PND 11), and open field activity (22, 34, 60 and 120)

Result: Pregnancy: Two females, one control and one mid-dose of PBDE99, had pregnancy failures; therefore, the number of pregnant females was 3, 4, 3, and 4 for the 0, 0.6, 6 and 30 mg/kg groups, respectively. The mean number of pups at birth for dams administered 6 mg PBDE 99/kg was significantly lower than that of controls. However, since the number of pups was evaluated on PND 1, it is possible that some of the pups may have been cannibalised by the mothers.

Somatic and Neurobehavioural Development: PBDE 99 groups did not differ from controls with regard to body weight. The main effect of treatment on sensori-motor development was evidenced in the screen climbing response. The PBDE 99

high dose group showed about 2 days delayed maturation of this response.

Ultrasonic Vocalisations and Homing Test: No significant differences between control and treated groups were observed.

Open-Field Test: On PND 34 PBDE 99 mid-dose animals locomoted more only during the second part of the test compared to controls. The low and mid-dose groups displayed more rearing than controls. On PND 60 PBDE 99 treated animals continued to show high levels of locomotor activity. The low and mid-dose groups displayed more locomotion compared to controls. On PND 120 PBDE 99 low and mid-dose groups displayed a significantly lower level of locomotion than controls during the second part of the 60 minute test sessio

Reliability: (1) valid without restriction
Study performed in a research laboratory and only minimal details are available. Results are based on the progeny of 3 or 4 females in each treatment group.

04-NOV-2002

(1)

5.10 Other Relevant Information

Type: Immunotoxicity

Method: These studies investigated the acute and subchronic immunotoxicity and endocrine effects of a commercial pentabromodiphenyl ether mixture, DE-71, in female C57BL/6 mice. Mice were orally (gavage) exposed to acute single doses of DE-71 at 0, 0.8, 4.0, 20, 100 or 500 mg/kg (6 mice/group), or to subchronic (14) daily doses at 0, 18, 36 or 72 mg/kg/day (6-8 mice/group; total doses of 0, 250, 500, or 1000 mg/kg). Immunotoxicity was assessed by measuring the plaque-forming cell response to sheep erythrocytes (SRBC) and natural killer cell (NKC) activity (basal and poly I:C stimulated) to YAC-1 target cells. Liver cytochrome P450 content and activities (ethoxyresorufin-o-deethylase (EROD) and pentoxyresorufin-o-deethylase (PROD)) as well as corticosterone (CS) and thyroxine (T4) concentrations were also measure

Result: EROD activity and total microsomal cytochrome P450 content were significantly induced only in mice treated subchronically with DE-71; maximum induction of EROD was 3.3-fold. Total serum T4 concentrations were significantly lower in mice treated acutely with DE-71 at all doses except the 100 mg/kg dose. Total and free T4 concentrations were dose dependently decreased in DE-71 treated mice following subchronic exposure. Plasma CS levels were elevated following subchronic exposure to DE-71. The elevation of CS was correlated with order of capture at necropsy, suggesting an interactive effect of DE-71 and stress. In regard to immunotoxicity, significant suppression of the anti-SRBC

response was seen only in mice exposed subchronically to 1000 mg DE-71/kg, an exposure that also resulted in decreased thymus weight. NKC activity was not altered by exposure to DE-7

Reliability: (2) valid with restrictions
Study was performed at Oregon State University, no indication of GLP compliance.

07-MAR-2002

(15)

Type: other: bioavailability and bioaccumulation in rats.

Method: Groups of 8 Sprague-Dawley male rats consumed feed containing either a commercial penta-brominated diphenyl ether in peanut oil at a dose of 32 ng/day/rat or peanut oil. Rats were trained to consume the treated feed in 1 hour and were fed daily for 21 days. The rats were housed individually in metabolism cages and urine and feces collected. Carcasses, livers and feces from controls were pooled for processing. All samples were spiked with 13-C-labelled recovery standard

Result: At this time, only 4 of the dosed animals and the control composites have been fully analyzed by GC-MS. On average 0.3 - 1.2% of the dosed congeners remained in the liver, and 17.9 - 42.7% remained in the carcass. The BDE congeners with the highest bioaccumulation in the liver and carcass were BDE-99 and BDE-153 with totals of 46.2% and 45.3%, respectively. Excretion in the feces was similarly low for all congeners, except BDE-85, and showed that at least 80% of the dose was bioavailable to rats. High amounts of BDE-85 in the feces (56% of dose) may indicate that this congener was poorly absorbed. Overall, only 40 - 88% of the dosed congeners were accounted for, suggesting that significant metabolism occurred for some of the ocngeners.
Results of this long-term dosing experiment in rats do not show any obvious differences between the bioavailability or accumulation of lower brominated congeners, especially BDE-47 and 99, which could be used to explain the elevated amounts of BDE-47 in biota. The congener distribution pattern in the rat carcasses and livers was the same as in the dosing formulatio

Test substance: A commercial penta-BDE mixture (DE-71) from Great Lakes Chemical.

Reliability: (2) valid with restrictions
Study performed in research laboratory with minimal details in unpublished report.

04-NOV-2002

(5)

Type: other: induction of xenobiotic metabolism in rats.

Result: Commercial preparations of fire retardant brominated diphenyl ethers were tested along with bis(p-bromophenyl) ether and diphenyl ether for their ability to alter xenobiotic metabolism. The materials, 0.1 mmol/kg/day, were administered orally to male rats for 14 days.
Pentabromodiphenyl and octabromodiphenyl ether preparations

increased O-ethyl O-p-nitrophenyl phenylphosphonothioate (EPN) detoxification, p-nitroanisole demethylation, NADPH-cytochrome c reductase, cytochrome P-450, liver weight, UDP-glucuronyltransferase and benzo[a]pyrene hydroxylase. Diphenyl ether increased only EPN detoxification and decabromodiphenyl ether only liver weight. Bis(p-bromophenyl) ether increased liver weight, cytochrome c reductase and cytochrome P-450. The data indicate these materials are inducers of xenobiotic metabolism with activity dependent on degree of brominatio

Reliability: (2) valid with restrictions
Study conducted in university laboratory, not under GLP.

04-NOV-2002

(16)

Type: other: induction of xenobiotic metabolism in rats.

Method: Pentabromodiphenyl ether was dissolved in corn oil and administered p.o. to male Sprague Dawley rats for 90 days. When the original doses of 6.25, 12.5 and 25 umol/kg/day revealed extensive induction even at the lowest dose, the experiment was repeated at doses of 0.78, 1.56 and 3.13 umol/kg/day.

1, 30 or 60 days after the last dose, the animals were anesthetized lightly and portions of the liver removed for histological evaluation, and for determination of EPN detoxification and p-nitroanisol demethylation. Protein, NADPH cytochrome c reductase and cytochrome P-450 were measure

Result: Initial 90-day studies revealed that the administration of 6.25, 12.5 or 25 umol/kg/day resulted in statistically significant increases in EPN detoxification, p-nitroanisol demethylation and cytochrome P-450, but no significant increases in NADPH cytochrome c reductase.

In the second study, administration of 0.78, 1.56 and 3.13 umol/kg/day resulted in statistically significant increases in EPN detoxification, p-nitroanisole demethylation, NADPH cytochrome c reductase and cytoshrome P-450. Measurements made at 30 and 60 days after the last dose showed that these indicators of induced xenobiotic metabolism slowly returned on control level

Test substance: Pentabromodiphenyl ether (lot 345-146A) from Great lakes Chemical Corp.

04-NOV-2002

(3)

5.11 Experience with Human Exposure

-

(1) Branchi, I., E. Alleva, L. G. Costa. Effects of perinatal exposure to a polybrominated diphenyl ether (PBDE 99) on mouse neurobehavioural development. NeuroToxicology 23:375-384 (2002).

(2) British Industrial Biological Research Association, #193/1/77.

(3) Carlson, Gary P. Induction of xenobiotic metabolism in rats by brominated diphenyl ethers administered for 90 days. Toxicology Letters, 6:207-212 (1980).

(4) Chemical Biotesting Center, Japan.

(5) Hakk, Heldur, J. Huwe and M. Lorentzsen. A mass balance study of a commercial pentabromodiphenyl ether mixture in male Sprague-Dawley rats. USDA, ARS, Biosciences Research Laboratory, Fargo, ND.

(6) International Research and Development Corp., 274-023, Jan. 24, 1976.

(7) International Research and Development Corp., 274-025, Oct. 31, 1975.

(8) Inveresk Research report #17982, Dec. 7, 1999.

(9) Litton Bionetics, Inc., LBI project #2547, May 25, 1976.

(10) Litton Bionetics, Inc., LBI project 20988, Feb. 1980.

(11) Microbiological Associates, Inc., study #G96AO63.342, Dec. 12, 1996.

(12) Microbiological Associates, Inc., study #M96AO63.1X64, Nov. 8, 1996.

(13) Toxicological Sciences 61:76-82 (2001). T.Zhou, D.G. Ross, M.J. DeVito, and K.M. Crofton, Effects of Short-Term in Vivo Exposure to Polybrominated Diphenyl Ethers on Thyroid Hromones and Hepatic Enzyme Activities in Weanling Rats.

(14) Toxicological Sciences 66:105-116 (2002), T. Zhou, M.M. Taylor, M.J. DeVito and K.M. Crofton, Developmental Exposure to Brominated Diphenyl Ethers Results in Thyroid Hormone Disruption.

(15) Toxicology 86:49-61 (1994). J.R. Fowles, A. Fairbrother. L. Baecher-Steppan, N.I. Kerkvliet, Immunologic and endocrine effects of the flame-retardant pentabromodiphenyl ether (DE-71) in C57BL/6J mice.

(16) Toxicology Letters 5:19-25 (1980), G. P. Carlson

(17) WIL Research Laboratories, Inc., project #WIL-12011, Oct. 8, 1984.

(18) WIL Research Laboratories, Inc., project #WIL-12042, Dec. 4, 1985.

(19) WIL Research Laboratories, Inc., project #WIL-12122, Oct. 1, 1990.

(20) Wildlife International, Ltd., project #298-101.

(21) Wildlife International, Ltd., Project #298-102, Apr. 27, 2000.

(22) Wildlife International, Ltd., project #298A-108.

(23) Wildlife International, Ltd., project #298A-109, Apr. 20, 2000.

(24) Wildlife International, Ltd., project #298A-110, Apr. 20, 2000.

(25) Wildlife International, Ltd., project #298A-111.

(26) Wildlife International, Ltd., project #439A-105, Oct. 1, 1997.

(27) Wildlife International, Ltd., project #439A-106, Oct. 3, 1997.

(28) Wildlife International, Ltd., project #439A-107, Oct. 3, 1997.

(29) Wildlife International, Ltd., project #439A-109, Sept. 23, 1998.

(30) Wildlife International, Ltd., project #439C-108, Sept. 12, 1997.

(31) Wildlife International, Ltd., project #439C-116, July 31, 1997.

(32) Wildlife International, Ltd., project #439C-118, June 10, 1997.

(33) Wildlife International, Ltd., project #439E-103A, Aug. 25, 1997.

7.1 End Point Summary

-

7.2 Hazard Summary

-

7.3 Risk Assessment

-

Voluntary Children's Chemical Evaluation Program Pilot (VCCEPP)

Tier 1 Assessment Of The Potential Health Risks To Children Associated With Exposure To The Commercial Pentabromodiphenyl Ether Product

Appendix IV: USEPA IRIS Reference Dose (RfD)

Pentabromodiphenyl ether (CASRN 32534-81-9)

view QuickView

MAIN CONTENTS

Reference Dose for Chronic Oral Exposure (RfD)

0184

Pentabromodiphenyl ether; CASRN 32534-81-9

Health assessment information on a chemical substance is included in IRIS only after a comprehensive review of chronic toxicity data by U.S. EPA health scientists from several Program Offices and the Office of Research and Development. The summaries presented in Sections I and II represent a consensus reached in the review process. Background information and explanations of the methods used to derive the values given in IRIS are provided in the Background Documents.

STATUS OF DATA FOR Pentabromodiphenyl ether

File First On-Line 03/31/1987

Category (section)	Status	Last Revised
Oral RfD Assessment (I.A.)	on-line	08/01/1990
Inhalation RfC Assessment (I.B.)	no data	
Carcinogenicity Assessment (II.)	on-line	08/01/1990

_I. Chronic Health Hazard Assessments for Noncarcinogenic Effects

_I.A. Reference Dose for Chronic Oral Exposure (RfD)

Substance Name -- Pentabromodiphenyl ether
CASRN -- 32534-81-9
Last Revised -- 08/01/1990

The oral Reference Dose (RfD) is based on the assumption that thresholds exist for certain toxic

effects such as cellular necrosis. It is expressed in units of mg/kg-day. In general, the RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. Please refer to the Background Document for an elaboration of these concepts. RfDs can also be derived for the noncarcinogenic health effects of substances that are also carcinogens. Therefore, it is essential to refer to other sources of information concerning the carcinogenicity of this substance. If the U.S. EPA has evaluated this substance for potential human carcinogenicity, a summary of that evaluation will be contained in Section II of this file.

__I.A.1. Oral RfD Summary

Critical Effect	Experimental Doses*	UF	MF	RfD
		1000	1	2E-3 mg/kg/day
Induction of hepatic enzymes	NOAEL: 3.13 umol/kg/day (1.77 mg/kg/day)			
Subchronic, Rat, Oral (gavage)	LOAEL: 6.25 umol/kg/day (3.52 mg/kgday			
Carlson, 1980				

*Conversion Factors: 1 umol = 0.5647 mg

__I.A.2. Principal and Supporting Studies (Oral RfD)

Carlson, G.P. 1980. Induction of xenobiotic metabolism in rats by brominated diphenyl ethers administered for 90 days. Toxicol. Lett. 6: 207-212.

Carlson (1980) administered pentabromodiphenyl ether (commercial grade) in corn oil by gavage to groups of six male Sprague-Dawley rats weighing 200 to 250 g for 90 days. Two dosing regimens were used: a high-dose series of 0, 6.25, 12.5, or 25 umol/kg/day (equivalent to 0, 3.53, 7.06, or 14.12 mg/kg/day, respectively) and a low-dose series of 0, 0.78, 1.56, or 3.13 umol/kg/day (equivalent to 0, 0.44, 0.88, or 1.77 mg/kg/day, respectively). Liver enzyme induction occurred at all dose levels, and some of these changes were persistent, lasting for 30-60 days after the cessation of treatment. No histologic liver abnormalities were observed in rats administered the low-dose series. Histologic evaluation was not performed on the high-dose rats; thus, these dose levels should be considered as possible AELs (adverse-effect levels). Since the relevance of hepatic enzyme induction to health effects is not established, this endpoint, in the absence of a histopathology evaluation, is considered adverse. Thus, the highest NOAEL for pentabromodiphenyl ether is considered to be 1.77 mg/kg/day, the highest dose for which liver enzyme induction occurred, but no histologic liver abnormalities were found.

__I.A.3. Uncertainty and Modifying Factors (Oral RfD)

UF -- The uncertainty of 1000 reflects 10 for both intraspecies and interspecies variability to the toxicity of this chemical in lieu of specific data, and 10 for extrapolation of a subchronic effect level to its chronic equivalent.

MF -- None

__I.A.4. Additional Studies/Comments (Oral RfD)

None.

__I.A.5. Confidence in the Oral RfD

Study -- Low
Database -- Low

RfD -- Low

Although six dose levels were used in the critical study, the study was of short duration, only one sex and one species were exposed, there were only six animals/group, and few toxic endpoints were examined. The study also did not establish a definitive LOAEL or NOAEL; thus, confidence in the study is low. Supporting evidence is limited; therefore, a low confidence rating is given to the data base. Low confidence in the RfD follows.

__I.A.6. EPA Documentation and Review of the Oral RfD

Source Document -- U.S. EPA, 1983

This document has received an Agency review with the help of two external scientists.

Other EPA Documentation -- None

Agency Work Group Review -- 10/09/1985, 05/15/1986

Verification Date -- 05/15/1986

Screening-Level Literature Review Findings -- A screening-level review conducted by an EPA contractor of the more recent toxicology literature pertinent to the RfD for Pentabromodiphenyl ether conducted in September 2002 did not identify any critical new studies. IRIS users who know of important new studies may provide that information to the IRIS Hotline at hotline.iris@epa.gov or 301-345-2870.

__I.A.7. EPA Contacts (Oral RfD)

Please contact the IRIS Hotline for all questions concerning this assessment or IRIS, in general, at (301)345-2870 (phone), (301)345-2876 (FAX) or hotline.iris@epa.gov (internet address).

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_I.B. Reference Concentration for Chronic Inhalation Exposure (RfC)

Substance Name -- Pentabromodiphenyl ether
CASRN -- 32534-81-9

Not available at this time.

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_II. Carcinogenicity Assessment for Lifetime Exposure

Substance Name -- Pentabromodiphenyl ether
CASRN -- 32534-81-9
Last Revised -- 08/01/1990

Section II provides information on three aspects of the carcinogenic assessment for the substance in question; the weight-of-evidence judgment of the likelihood that the substance is a human carcinogen, and quantitative estimates of risk from oral exposure and from inhalation exposure. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. The rationale and methods used to develop the carcinogenicity information in IRIS are described in

The Risk Assessment Guidelines of 1986 (EPA/600/8-87/045) and in the IRIS Background Document. IRIS summaries developed since the publication of EPA's more recent Proposed Guidelines for Carcinogen Risk Assessment also utilize those Guidelines where indicated (Federal Register 61(79):17960-18011, April 23, 1996). Users are referred to Section I of this IRIS file for information on long-term toxic effects other than carcinogenicity.

_II.A. Evidence for Human Carcinogenicity

__II.A.1. Weight-of-Evidence Characterization

Classification -- D; not classifiable as to human carcinogenicity

Basis -- No human data and animal data available.

__II.A.2. Human Carcinogenicity Data

None.

__II.A.3. Animal Carcinogenicity Data

None.

__II.A.4. Supporting Data for Carcinogenicity

Pentabromodiphenyl ether (purity unknown) was not mutagenic in a Salmonella typhimurium assay, in which four strains were utilized both with and without metabolic activation (Zeiger et al., 1987).

Pentabromodiphenyl ether is structurally-related to decabromodiphenyl ether, a possible human carcinogen. Decabromodiphenyl ether is also not mutagenic for S. typhimurium.

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_II.B. Quantitative Estimate of Carcinogenic Risk from Oral Exposure

None.

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_II.C. Quantitative Estimate of Carcinogenic Risk from Inhalation Exposure

None.

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_II.D. EPA Documentation, Review, and Contacts (Carcinogenicity Assessment)

__II.D.1. EPA Documentation

Source Document -- U.S. EPA, 1984 . Health and Environmental Effects Profile for Brominated Diphenyl Ethers. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response, Washington, DC.

The 1984 Health and Environmental Effects Profile for Brominated Diphenyl Ethers has received

Agency review.

__II.D.2. EPA Review (Carcinogenicity Assessment)

Agency Work Group Review -- 06/15/1990

Verification Date -- 06/15/1990

Screening-Level Literature Review Findings -- A screening-level review conducted by an EPA contractor of the more recent toxicology literature pertinent to the cancer assessment for Pentabromodiphenyl ether conducted in September 2002 did not identify any critical new studies. IRIS users who know of important new studies may provide that information to the IRIS Hotline at hotline.iris@epa.gov or 301-345-2870.

__II.D.3. EPA Contacts (Carcinogenicity Assessment)

Please contact the IRIS Hotline for all questions concerning this assessment or IRIS, in general, at (301)345-2870 (phone), (301)345-2876 (FAX) or hotline.iris@epa.gov (internet address).

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_III. [reserved]
_IV. [reserved]
_V. [reserved]

_VI. Bibliography

Substance Name -- Pentabromodiphenyl ether
CASRN -- 32534-81-9
Last Revised -- 08/01/1990

_VI.A. Oral RfD References

Carlson, G.P. 1980. Induction of xenobiotic metabolism in rats by bromi- nated diphenyl ethers administered for 90 days. Toxicol. Lett. 6: 207-212.

U.S. EPA. 1983. Health and Environmental Effects Profile for Brominated Diphenyl Ethers. Prepared by the Office of Health and Environmental Assess- ment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste, Washington, DC.

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_VI.B. Inhalation RfC References

None

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_VI.C. Carcinogenicity Assessment References

U.S. EPA. 1984. Health and Environmental Effects Profile for Brominated Diphenyl Ethers. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response, Washington, DC.

Zeiger, E., B. Anderson, S. Haworth, T. Lawlor, K. Mortelmans and W. Speck. 1987. Salmonella mutagenicity tests: III. Results from the testing of 255 chemicals. Environ. Mutag. 9(Suppl. (9): 1-110.

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_VII. Revision History

Substance Name -- Pentabromodiphenyl ether
CASRN -- 32534-81-9

Date	Section	Description
09/01/1989	VI.	Bibliography on-line
07/01/1990	II.	Carcinogen assessment now under review
08/01/1990	I.A.	Text edited
08/01/1990	II.	Carcinogen assessment on-line
08/01/1990	VI.C.	Carcinogen references added
01/01/1992	I.A.7.	Secondary contact changed
01/01/1992	IV.	Regulatory Action section on-line
04/01/1997	III., IV., V.	Drinking Water Health Advisories, EPA Regulatory Actions, and Supplementary Data were removed from IRIS on or before April 1997. IRIS users were directed to the appropriate EPA Program Offices for this information.
12/03/2002	I.A.6., II.D.2.	Screening-Level Literature Review Findings message has been added.

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_VIII. Synonyms

Substance Name -- Pentabromodiphenyl ether
CASRN -- 32534-81-9
Last Revised -- 03/31/1987

32534-81-9
Benzene, 1,1'-oxybis-, pentabromo deriv.
DE 71
Pentabromodiphenyl ether

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Last updated on Wednesday, December 11th, 2002
URL:
file:///Y:/GreatLakes-BFR/DRAFT%20PENTA%20REPORT/Appendices/Apx4(IRIS)/Pentabromodiphenyl%20ether%20(CASRN%2032534-81-9),

Voluntary Children's Chemical Evaluation Program Pilot (VCCEPP)

Tier 1 Assessment Of The Potential Health Risks To Children Associated With Exposure To The Commercial Pentabromodiphenyl Ether Product

Appendix V: Environmental Data Summaries / Environmental Levels

Environmental Levels in Air

Levels in Air				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Chicago, USA	BDE-47	33 pg/m^3	Strandberg et al. (2001)	Values averaged over a three year period (1997, 1998, and 1999) - Urban location
	BDE-99	16 pg/m^3		
	BDE-100	2.0 pg/m^3		
	BDE-153	0.53 pg/m^3		
	BDE-154	0.41 pg/m^3		
	BDE-209	0.30 pg/m^3		
	Total PBDE	52 pg/m^3		
Eagle Harbor, USA	BDE-47	2.9 pg/m^3	Strandberg et al. (2001)	Values averaged over a three year period (1997, 1998, and 1999) - Rural location near the Great Lakes
	BDE-99	2.1 pg/m^3		
	BDE-100	0.29 pg/m^3		
	BDE-153	0.13 pg/m^3		
	BDE-154	0.088 pg/m^3		
	BDE-209	<0.10 pg/m^3		
	Total PBDE	5.5 pg/m^3		
Sturgeon Point, USA	BDE-47	3.8 pg/m^3	Strandberg et al. (2001)	Values averaged over a three year period (1997, 1998, and 1999) - Rural location near the Great Lakes
	BDE-99	2.8 pg/m^3		
	BDE-100	0.39 pg/m^3		
	BDE-153	0.19 pg/m^3		
	BDE-154	0.11 pg/m^3		
	BDE-209	<0.10 pg/m^3		
	Total PBDE	7.2 pg/m^3		
Sleeping Bear Dunes, USA	BDE-47	8.4 pg/m^3	Strandberg et al. (2001)	Values averaged over a three year period (1997, 1998, and 1999) - Rural location near the Great Lakes
	BDE-99	5.3 pg/m^3		
	BDE-100	0.80 pg/m^3		
	BDE-153	0.25 pg/m^3		
	BDE-154	0.15 pg/m^3		
	BDE-209	<0.10 pg/m^3		
	Total PBDE	15 pg/m^3		
Virginia, USA		**% of Total PBDEs**	Hale et al. (2001)	Values were extracted and approximated from a graph
rural air	BDE-47	53		
	BDE-49	0		
	BDE-99	38		
	BDE-100	4		
	BDE-153	3		
	BDE-154	2		

Levels in Air				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Sweden	BDE-47	<0.10 ng/m^3	Sjodin (2001a)	Total air concentration of particle-associated and semivolatile BFR; Only two samples collected (n=2)
	BDE-85	<0.006 ng/m^3		
	BDE-99	<0.06 ng/m^3		
	BDE-100	<0.009 ng/m^3		
	BDE-153	<0.004 ng/m^3		
	BDE-154	<0.002 ng/m^3		
	BDE-183	<0.0007 ng/m3		
	BDE-209	<0.04 ng/m^3		
Sweden	**Levels**	**(pmol/m^3)**	Bergman et al. (1999)	Ambient Outdoor Air where n=2; Limit of quantification was determined as 10 times the blank sample amount
	BDE-47	<0.2		
	BDE-99	<0.1		
	BDE-153	<0.006		
	BDE-183	<0.0009		
	BDE-209	<0.04		
		(pg/m^3)		
Japan & Taiwan	Sum PBDE	7.1-53 (tri-hexa)	Watanabe, et al. (1992) as cited in Palm et al. (2002)	
Osaka, Japan	BDE-209	83-3060		
Ammarnos, Sweden	BDE-47	6.3	Bergander et al. (1995) as cited in Palm et al. (2002)	
	BDE-99	1.6		
	BDE-100	0.4		
	BDE-209	nd		
Hoburgen, Sweden	BDE-47	0.7		
	BDE-99	0.35		
	BDE-100	0.07		
	BDE-209	nd		
Dunai, Russia	Sum PBDE	5	Alaee et al. (1999) as cited in Palm et al. (2002)	
Tagish, Yukon	BDE-47	<10-210		
	BDE-99	<10-490		
	Sum PBDE	2000		
Alert, Canada	Sum PBDE	1.0-28.0		
Stoke Ferry, UK	BDE-47	4.0-50.0	Peters et al. (1999) as cited in Palm et al. (2002)	
	BDE-99	5.5-13		
	BDE-100	1.1-3.9		
Hazelrigg, UK	BDE-47	3.2-61.0		
	BDE-99	3.1-22.0		
	BDE-100	0.62-5.4		
Bobcaygeon, Ontario	BDE-47	47-650	Gouin et al. (in review) as cited in Palm, A et al. (2002)	
	BDE-99	<10-330		
	Sum PBDE	88-1300		

Environmental Levels in Sediments

Levels in Sediments				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Mid-Atlantic region, USA	BDE-47	6.37µg/kg dry	Hale et al. (2002)	Sediment from stream leaving foam plant, Sample 1
	BDE-99	9.47µg/kg dry		
	BDE-100	1.34µg/kg dry		
	Total BDEs	17.2µg/kg dry		
	Total BDEs	22,300µg/kg lipid		
	BDE-47	<0.10µg/kg dry	Hale et al. (2002)	Sediment from stream leaving foam plant, Sample 2
	BDE-99	<0.10µg/kg dry		
	BDE-100	<0.10µg/kg dry		
	Total BDEs	Non-detectable		
	Total BDEs	Non-detectable		
	BDE-47	36.2µg/kg dry	Hale et al. (2002)	Sediment from stream leaving foam plant, Sample 3
	BDE-99	86.3µg/kg dry		
	BDE-100	9.01µg/kg dry		
	Total BDEs	132µg/kg dry		
	Total BDEs	20,500µg/kg lipid		
	BDE-47	0.50µg/kg dry	Hale et al. (2002)	Pond Sediment, Sample 1
	BDE-99	<0.10µg/kg dry		
	BDE-100	<0.10µg/kg dry		
	Total BDEs	0.50µg/kg dry		
	Total BDEs	63.1µg/kg lipid		
	BDE-47	<0.10µg/kg dry	Hale et al. (2002)	Pond Sediment, Sample 2
	BDE-99	<0.10µg/kg dry		
	BDE-100	<0.10µg/kg dry		
	Total BDEs	Non-detectable		
	Total BDEs	Non-detectable		
Virginia, USA		**% of total PBDEs**	Hale et al. (2001)	Values were extracted and approximated from a graph
sediment	BDE-47	55		
	BDE-49	0		
	BDE-99	35		
	BDE-100	7		
	BDE-153	2		
	BDE-154	1		

Levels in Sediments				
Country	**Compound**	**Concentration**	**Reference**	**Note**
USA		**(ng/g dry)**		Samples were taken from the West, Middle, and East Sections of Hadley Lake
West	BDE-47	4.7	Dodder et al. (2002)	
	BDE-99	22		
	BDE-100	2.5		
	BDE-153	4.2		
	BDE 154	4.2		
	BDE -190	<0.02		
	BDE-209	33		
	Total PBDE	71		
Middle	BDE-47	0.85	Dodder et al. (2002)	
	BDE-99	1.6		
	BDE-100	0.32		
	BDE-153	1.4		
	BDE 154	1		
	BDE -190	<0.03		
	BDE-209	36		
	Total PBDE	41		
Middle	BDE-47	1.1	Dodder et al. (2002)	
	BDE-99	2.8		
	BDE-100	0.53		
	BDE-153	1.5		
	BDE 154	1.2		
	BDE -190	<0.03		
	BDE-209	27		
	Total PBDE	34		
East	BDE-47	0.8	Dodder et al. (2002)	
	BDE-99	1.9		
	BDE-100	0.36		
	BDE-153	1.1		
	BDE 154	1.3		
	BDE -190	<0.03		
	BDE-209	19		
	Total PBDE	24		

Levels in Sediments				
Country	Compound	Concentration	Reference	Note
Sweden - Core Depth (date)			Nylund, K. et al (1992)	Sediment core from the Baltic Proper
0-5 (1987)	BDE-47	1.6		
5-10 (1986)		0.76		
10-15 (1984)		0.68		
15-20 (1982)		0.5		
20-25 (1980)		0.35		
25-30 (1978)		0.28		
30-35 (1976)		0.24		
35-40 (1974)		ND		
40-45 (1971		0.13		
45-50 (1967)		ND		
50-60 (1961)		0.21		
60-70 (1953)		0.15		
70-80 (1946)		0.12		
80-90 (1939		0.06		
0-5 (1987)	BDE-99	0.98	Nylund, K. et al (1992)	Sediment core from the Baltic Proper
5-10 (1986)		0.2		
10-15 (1984)		0.36		
15-20 (1982)		0.13		
20-25 (1980)		0.09		
25-30 (1978)		0.1		
30-35 (1976)		0.07		
35-40 (1974)		0.05		
40-45 (1971		0.06		
45-50 (1967)		0.03		
50-60 (1961)		ND		
60-70 (1953)		0.07		
70-80 (1946)		ND		
80-90 (1939		ND		
Baltic Sea		**(ng/g dry)**	Nylund et al. (1992) as cited in Manchester-Neesvig et al. (2001)	
surface sediment	Total PBDE	0.5		
Osaka, Japan			Watanabe et al. (1987) as cited in Manchester-Neesvig et al. (2001)	
surface sediment	Total PBDE	57.2		

Levels in Sediments				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Great Britain			Allchin et al. (1999) as cited in de Wit (2002)	
River Tweed	BDE-47	<0.3-0.4		
	BDE-99	<0.6		
	DE-71	<0.38		
	DE-79	<0.44		
	DE-83	<0.6		
River Tees, upstream a suspected source/manufacturing plant	BDE-47	<0.3	Allchin et al. (1999) as cited in de Wit (2002)	
	BDE-99	<0.6		
	DE-71	<0.38		
	DE-79	<0.44		
	DE-83	<0.6		
River Tees/Skerne, downstream of confluence	BDE-47	8.0-51.0	Allchin et al. (1999) as cited in de Wit (2002)	
	BDE-99	11.0-85.0		
	DE-71	34.0-35.0		
	DE-79	25.0-129.0		
	DE-83	<0.6-7		
River Skerne, Newton Ayecliffe	BDE-47	239	Allchin et al. (1999) as cited in de Wit (2002)	
	BDE-99	319		
	DE-71	130		
	DE-79	397		
	DE-83	64		
River Skerne, downstream Newton Ayecliffe	BDE-47	68-112	Allchin et al. (1999) as cited in de Wit (2002)	
	BDE-99	111-159		
	DE-71	45-68		
	DE-79	264-1405		
	DE-83	23-294		
Tees estuary	BDE-47	8.9-368	Allchin et al. (1999) as cited in de Wit (2002)	
	BDE-99	16-898		
	DE-71	19-366		
	DE-79	29-1348		
	DE-83	<0.6-9		
River Calder, upstream of sewage plant	BDE-47	2.3-7.6	Allchin et al. (1999) as cited in de Wit (2002)	
	BDE-99	0.6-16		
	DE-71	<0.38-6.1		
	DE-79	3.0-9.0		
	DE-83	<0.6-399		

Levels in Sediments				
Country	**Compound**	**Concentration**	**Reference**	**Note**
River Calder, downstream of	BDE-47	24	Allchin et al. (1999) as cited in de Wit (2002)	
sewage plant	BDE-99	46		
	DE-71	18		
	DE-79	17		
	DE-83	3190		
River Ribble	BDE-47	1.2	Allchin et al. (1999) as cited in de Wit (2002)	
	BDE-99	1.7		
	DE-71	<0.38		
	DE-79	4.4		
	DE-83	111		
River Nith	BDE-47	<0.3-1.7	Allchin et al. (1999) as cited in de Wit (2002)	
	BDE-99	<0.6-3.5		
	DE-71	<0.38-0.6		
	DE-79	<0.44-2		
	DE-83	<0.6		
Avonmouth	BDE-47	2.4-3.6	Allchin et al. (1999) as cited in de Wit (2002)	
	BDE-99	2.9-4.7		
	DE-71	0.6-1.0		
	DE-79	<0.44		
	DE-83	<0.6-7		
Great Ouse and Elstow Landfill	BDE-47	0.4-4.2	Allchin et al. (1999) as cited in de Wit (2002)	
	BDE-99	<0.6-5.7		
	DE-71	<0.38-1.5		
	DE-79	<0.44-13		
	DE-83	<0.6		
River Humber	BDE-47	21	Allchin et al. (1999) as cited in de Wit (2002)	
	BDE-99	36		
	DE-71	6.6		
	DE-79	29		
	DE-83	17		
Sweden		**(ng/g ignition loss)**	Sellstrom and Jansson (1995) as cited in de Wit (2002)	
Upstream a plastics industry	BDE-47	3.7		Ignition loss % = 67
	BDE-99	8.8		
	BDE-100	1.6		
	Sum of three PBDE	14.1		
Downstream a plastics industry	BDE-47	780		Ignition loss % = 62.5
	BDE-99	1200		
	BDE-100	270		
	Sum of three PBDE	2250		

Environmental Levels in Water

Levels in Water				
Country	**Compound**	**Concentration (ug/l)**	**Reference**	**Note**
Japan, 1977	BDE-209	<0.2-<2.5	EU (2000) as cited in Palm et al. (2002)	
Japan, 1987	Hexa-BDE	<0.04	Watanabe and Tatsukawa (1989) as cited in Palm et al. (2002)	
	BDE-209	<0.1		
Japan, Kino River	BDE-209	<0.1	EU (2000) as cited in Palm et al. (2002)	
Japan, 1988	BDE-209	<0.06	EU 2000 as cited in Palm et al. (2002)	
Japan, 1984	di-BDE	<0.01	Watanabe and Tatsukawa (1989) as cited in Palmet al. (2002)	
USA, Industrial Rivers	mono-BDE	0-202700	WHO/IPCS (1994) as cited in Palm et al. (2002)	

Environmental Levels in Soil

Levels in Soil				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Mid-Atlantic region, USA	BDE-47	31.6µg/kg dry	Hale et al. (2002)	Soil near foam production building
	BDE-99	41.2µg/kg dry		
	BDE-100	3.15µg/kg dry		
	Total BDEs	76.0µg/kg dry		
	Total BDEs	33,600µg/kg TOC		
	BDE-47	8.11µg/kg dry		Soil downwind of foam plant, Sample 1
	BDE-99	4.75µg/kg dry		
	BDE-100	0.77µg/kg dry		
	Total BDEs	13.6µg/kg dry		
	Total BDEs	2160µg/kg TOC		
	BDE-47	<0.10µg/kg dry		Soil downwind of foam plant, Sample 2
	BDE-99	<0.10µg/kg dry		
	BDE-100	<0.10µg/kg dry		
	Total BDEs	Non-detectable		
	Total BDEs	Non-detectable		

Environmental Levels in Sewage Sludge

Levels in Sewage Sludge				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Mid-Atlantic region, USA		**(µg/kg dry)**	Hale et al. (2002)	
	BDE-47	544		
	BDE-99	725		
	BDE-100	266		
	Total BDEs	1540		
	Total BDEs	6620		
USA	DE-71	1100-2290	Hale et al. (2001)	secondary source for this information; DE-71 is the penta-product
Sweden		**(ng/g dry)**	Nylund et al. (1992) as cited in Manchester-	
	Total PBDE	25		
Sickla	BDE-47	78	Sellstrom (1999) and Sellstrom et al. (1999) as cited in de Wit (2002)	
	BDE-99	98		
	BDE-100	24		
	BDE-209	220		
Bromma	BDE-47	80	Sellstrom (1999) and Sellstrom et al. (1999) as cited in de Wit (2002)	
	BDE-99	100		
	BDE-100	25		
	BDE-209	270		
Loudden	BDE-47	36	Sellstrom (1999) and Sellstrom et al. (1999) as cited in de Wit (2002)	
	BDE-99	56		
	BDE-100	13		
	BDE-209	170		

Environmental Levels in Fish

Levels in Fish				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Laurentian Great Lakes, USA		**(ng/g wet)**	Luross et al. (2002)	values are mean concentrations in freshwater fish and all samples were whole fish and ground
Lake Ontario lake trout	BDE-47	58 ± 15		
	BDE-66	1.3 ± 0.38		
	BDE-99	14 ± 3.5		
	BDE-100	5.7 ± 1.1		
	BDE-153	4.9 ± 1.6		
Lake Erie lake trout	BDE-47	16 ± 4.2	Luross et al. (2002)	values are mean concentrations in freshwater fish and all samples were whole fish and ground
	BDE-66	0.18 ± 0.12		
	BDE-99	2.0 ± 0.48		
	BDE-100	2.5 ± 0.89		
	BDE-153	0.89 ± 0.14		
Lake Huron lake trout	BDE-47	27 ± 8.6	Luross et al. (2002)	values are mean concentrations in freshwater fish and all samples were whole fish and ground
	BDE-66	0.82 ± 0.38		
	BDE-99	7.7 ± 3.8		
	BDE-100	3.8 ± 1.8		
	BDE-153	2.3 ± 0.98		
Lake Superior lake trout	BDE-47	29 ± 9.8	Luross et al. (2002)	values are mean concentrations in freshwater fish and all samples were whole fish and ground
	BDE-66	0.89 ± 0.31		
	BDE-99	12 ± 5.9		
	BDE-100	4.1 ± 1.3		
	BDE-153	1.5 ± 0.54		
Lake Michigan, USA		**Range (ng/g wet)**	Manchester-Neesvig et al. (2001)	A sample number of 21 coho and chinook salmon were used. The average % lipid was 3.89 with a range b/w 1.83-7.19. A 100g "steak" was tested which included skin, muscle, bone, and organ tissues and then blended - the steak was extracted from in front of the dorsal fin
Salmon	BDE-47	26.0-95.1		
	BDE-66	1.2-2.5		
	BDE-99	5.9-18.9		
	BDE-100	5.2-18.8		
	BDE-153	1.8-4.8		
	BDE-154	2.8-8.5		
	Total PBDE	44.6-148.0		
	Total PBDE	773.0-8120.0 ng/g lipid		
		Mean (ng/g wet)	Manchester-Neesvig et al. (2001)	A sample number of 21 coho and chinook salmon were used. The average % lipid was 3.89 with a range b/w 1.83-7.19. A 100g "steak" was tested which included skin, muscle, bone, and organ tissues and then blended - the steak was extracted from in front of the dorsal fin
	BDE-47	52.1		
	BDE-66	1.7		
	BDE-99	9.3		
	BDE-100	9.7		
	BDE-153	2.7		
	BDE-154	4.5		
	Total PBDE	80.1		
	Total PBDE	2440 ng/g lipid		

Levels in Fish				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Virginia, USA		**Range (% of total PBDEs)**	Hale et al. (2001)	Values were extracted and approximated from a graph. Five species of fish were analyzed (channel catfish, flathead catfish, carp, striped bass, and white bass. Values were ranged across species - there had similar distribution within each species despite large cariations in total PBDEs in fish b/w sampling sites. Number of samples: Catfish n=15; flathead n=20; carp n=5; stiped
	BDE-47	45-74		
	BDE-49	2-12.0		
	BDE-99	0-27		
	BDE-100	16-24		
	BDE-153	0-7		
	BDE-154	3.0-5.0		
Washington State, USA		**(µg/kg wet)**	Johnson and Olson (2001)	Quantitation limit was approx. 5ug/kg unless indicated values were on a lipid basis Samples were collected at different times between 9/94 - 7/99 - RI= Rock Island Creek; DC= Douglas Creek; SR=Spokane River; SoR= Soleduck River; SnR= Snake River; YR= Yakima River; CR= Columbia River; Total PBDEs can be broken down into TBDEs, PeBDEs, and HxBDEs
RI - Rainbow trout (whole)	Total PBDE	Non-detectable		
RI - Rainbow trout (whole)	Total PBDE	Non-detectable		
SR - Rainbow trout (whole)	Total PBDE	297.0		
DC - Rainbow trout (whole)	Total PBDE	1.4		
DC - Rainbow trout (split)	Total PBDE	1.5		
DC - Rainbow trout (split)	Total PBDE	1.4		
SR - Raibow trout (fillet)	Total PBDE	20.0		
SR - Raibow trout (fillet)	Total PBDE	119.0		
SR - Raibow trout (fillet)	Total PBDE	166.0		
SR - Raibow trout (fillet)	Total PBDE	174.0		
SoR - Moutain whitefish (fillet)	Total PBDE	Non-detectable		
SR - Mountain whitefish (whole)	Total PBDE	1250.0		
SR - Largescale sucker (fillet)	Total PBDE	120.0		
SR - Largescale sucker (whole)	Total PBDE	105.0		
YR - Largescale sucker (whole)	Total PBDE	64.0		
YR - Carp (fillet)	Total PBDE	22.0		
SnR - Channel catfish (fillet)	Total PBDE	8.0		
CR - Starry flounder (whole)	Total PBDE	30.0		
USA		**(ng/g wet)**	Dodder et al. (2002)	This lake is in close proximity(1.3 km) to a suspected PBDE manufacturing facility
Hadley Lake - white crappie and	BDE-47	13 ± 2		
bluegill	BDE-99	16 ± 2		
	BDE-100	7.4 ± 1		
	BDE-153	15 ± 2		
	BDE 154	13 ± 1		
	BDE -190	<0.007		
	BDE-209	<1.4		
	Total PBDE	65 ± 8		
	Total PBDE	2400 ± 600 ng/g lipid		

Levels in Fish				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Carp	BDE-47	3.20	Dodder et al. (2002)	This lake is in close proximity(1.3 km) to a suspected PBDE manufacturing facility
	BDE-99	0.07		
	BDE-100	0.89		
	BDE-153	0.10		
	BDE 154	2.10		
	BDE -190	<0.007		
	BDE-209	<1.4		
	Total PBDE	6.2		
	Total PBDE	760 ng/g lipid		
Carp	BDE-47	9.80	Dodder et al. (2002)	This lake is in close proximity(1.3 km) to a suspected PBDE manufacturing facility
	BDE-99	0.12		
	BDE-100	3.60		
	BDE-153	0.04		
	BDE 154	6.90		
	BDE -190	<0.006		
	BDE-209	<1.3		
	Total PBDE	20.0		
	Total PBDE	2500 ng/g lipid		
Lake of the Ozarks - white	BDE-47	3.5 ± 0.7	Dodder et al. (2002)	This lake is in close proximity(1.3 km) to a suspected PBDE manufacturing facility
crappie and bluegill	BDE-99	1.9 ± 0.4		
	BDE-100	1.1 ± 0.2		
	BDE-153	0.27 ± 0.11		
	BDE 154	0.2 ± 0.05		
	BDE -190	<0.007		
	BDE-209	<1.4		
	Total PBDE	6.9 ± 1.4		
	Total PBDE	300 ± 80 ng/g lipid		
Lake Superior - Smelt	BDE-47	5.7 ± 0.3	Dodder et al. (2002)	This lake is in close proximity(1.3 km) to a suspected PBDE manufacturing facility
	BDE-99	1.8 ± 0.2		
	BDE-100	0.98 ± 0.09		
	BDE-153	0.2 ± 0.02		
	BDE 154	0.45 ± 0.03		
	BDE -190	<0.007		
	BDE-209	<1.5		
	Total PBDE	9.1 ± 0.6		
	Total PBDE	150 ± 9 ng/g lipid		

Levels in Fish				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Lake Ontario - Smelt	BDE-47	10 ± 1	Dodder et al. (2002)	This lake is in close proximity(1.3 km) to a suspected PBDE manufacturing facility
	BDE-99	5.3 ± 0.7		
	BDE-100	1.6 ± 0.1		
	BDE-153	0.49 ± 0.02		
	BDE 154	0.9 ± 0.05		
	BDE -190	<0.007		
	BDE-209	<1.6		
	Total PBDE	18 ± 1		
	Total PBDE	240 ± 30 ng/g lipid		
Michigan, USA - Detroit River		**Mean (ng/g wet)**	Rice et al. (2002)	n=12; composite subsamples of whole fish
Large mouth bass	BDE-47	2.80		
	BDE-99	0.48		
	BDE-100	0.45		
	BDE-153	0.44		
	BDE 154	0.43		
	BDE -181	0.26		
	BDE-183	0.26		
	Total PBDE	5.25		
	Total PBDE	163 ng/g lipid		
Carp	BDE-47	3.00	Rice et al. (2002)	n=10; composite subsamples of whole fish
	BDE-99	0.50		
	BDE-100	0.48		
	BDE-153	0.47		
	BDE 154	0.45		
	BDE -181	0.24		
	BDE-183	0.25		
	BDE-190	n/a		
	Total PBDE	5.39		
	Total PBDE	40.70		
Illinois, USA - Des Plaines River (lower)		**Mean (ng/g wet)**	Rice et al. (2002)	It is speculated that these numbers are due to the manufactur. Discharges that use products containing these substances are from waste facilities along the river; n=10; composite subsamples of whole fish
Carp	BDE-47	2.54		
	BDE-99	0.50		
	BDE-100	0.44		
	BDE-153	1.01		
	BDE 154	1.89		
	BDE -181	3.28		
	BDE-183	2.99		
	BDE-190	1.75		
	Total PBDE	14.40		
	Total PBDE	281.00		

Levels in Fish				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Illinois, USA - Des Plaines River (upper)		**Mean (ng/g wet)**	Rice et al. (2002)	It is speculated that these numbers are due to the manufactur. Discharges that use products containing these substances are from waste facilities along the river; n=4; composite subsamples of whole fish
Carp	BDE-47	1.34		
	BDE-99	0.50		
	BDE-100	0.49		
	BDE-153	0.66		
	BDE 154	0.98		
	BDE -181	1.44		
	BDE-183	1.31		
	BDE-190	0.97		
	Total PBDE	7.68		
	Total PBDE	78.3		
Buffalo, New York			Loganathan et al. (1995) as cited in Manchester-	
Carp Muscle	Total PBDE	18.7		
Klosterfjorden, Sweden			Andersson et al. (1981) as cited in Manchester-	
Sea Trout	Total PBDE	15.0		
Viskan River, Sweden			Andersson et al. (1981) as cited in Manchester-Neesvig et al. (2001)	
pike muscle	Total PBDE	124.0		
pike liver	Total PBDE	9680.0		
Baltic Sea			Asplund et al. (1999) as cited in Manchester-Neesvig et al. (2001)	
Salmon muscle	Total PBDE	14.0		
Salmon egg	Total PBDE	9.0		
Salmon blood	Total PBDE	6.0		
Wakayama, Japan			Watanabe et al. (1987) as cited in Manchester-	
Sardine	Total PBDE	0.8		
North Sea			de Boer (1989) as cited in Manchester-Neesvig et al. (2001)	
North - cod liver	Total PBDE	26.0		
Central - cod liver	Total PBDE	54.0		
South - cod liver	Total PBDE	170.0		
Canada		**(pg/g wet)**	Easton et al. (2002)	2 samples were taken at different locations. Both are listed; For individual concentrations of congeners (41 cong. were detected), see Table 6 in article; NDR = Peak detected, but did not meet quantification criteria; ND = Not detected
Salmon feed	BDE-27/33	61.0; 67.0		
	BDE-47	840; 1100		
	BDE-49	190; 170		
	BDE-99	130; 180		
	BDE-100	170; 230		
	BDE-153	65; 38		
	BDE-154	170; 48		
	BDE-155	140; 19		
	Total PBDE	1875.2; 1902.4		

Levels in Fish				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Farmed Salmon	BDE-27/33	36; 110	Easton et al. (2002)	2 samples were taken at different locations. Both are listed; For individual concentrations of congeners (41 cong. were detected), see Table 6 in article; NDR = Peak detected, but did not meet quantification criteria; ND = Not detected
	BDE-47	690; 2600		
	BDE-49	110; 210		
	BDE-99	140; 390		
	BDE-100	130; 470		
	BDE-153	NDR; 80		
	BDE-154	41; 130		
	BDE-155	16; 67		
	Total PBDE	1187.9; 4147.4		
Wild Salmon	BDE-27/33	NDR-19.0	Easton et al. (2002)	4 samples were taken at different locations. Ranges are listed; For individual concentrations of congeners (41 cong. were detected), see Table 6 in article; NDR = Peak detected, but did not meet quantification criteria; ND = Not detected
	BDE-47	29-280		
	BDE-49	NDR-29.0		
	BDE-99	NDR-97.0		
	BDE-100	4.2-43		
	BDE-153	ND-3.0		
	BDE-154	ND-5.2		
	BDE-155	NDR-3.2		
	Total PBDE	38.7-485.2		
Baltic Sea		**(ng/g lipid)**	Bergman et al., Cambridge Isotope Labs (no date)	Concentrations were found in Salmon muscle
Salmon muscle	BDE-47	200.0		
	BDE-99	54.0		
	BDE-100	47.0		
Sweden - Baltic Sea		**Mean (pmol/g lipid)**	Bergman et al. (1999)	
Salmon	BDE-47	410		
	BDE-99	96		
		Range (pmol/g lipid)		
	BDE-47	210-840		
	BDE-99	46-130		
		Homogenate (pmol.g lipid)		
Herring	BDE-47	170		
	BDE-99	48		
Great Britain			Allchin et al. (1999) as cited in de Wit (2002)	
Tees Bay - plaice, flounder	BDE-47	520-9500		
and dab	BDE-99	83-370		
	DE-71	920-1200		
	DE-79	500-1200		
Lune/Wyre (off River Calder) -	BDE-47	400	Allchin et al. (1999) as cited in de Wit (2002)	
flounder	BDE-99	54		
	DE-71	100		
	DE-79	120		

Levels in Fish				
Country	Compound	Concentration	Reference	Note
Nith estuary - flounder	BDE-47	73-120	Allchin et al. (1999) as cited in de Wit (2002)	
	BDE-99	nd-19		
	DE-71	47-120		
	DE-79	nd-83		
Bideford Bay (off Avonmouth) -	BDE-47	nd-370	Allchin et al. (1999) as cited in de Wit (2002)	
paice, flounder, and dab	BDE-99	nd-100		
	DE-71	94-120		
	DE-79	nd-970		
The Wash (off Great Ouse) - dab	BDE-47	380	Allchin et al. (1999) as cited in de Wit (2002)	
	BDE-99	74		
	DE-71	110		
	DE-79	58		
Off River Humber	BDE-47	1600	Allchin et al. (1999) as cited in de Wit (2002)	
	BDE-99	160		
	DE-71	110		
	DE-79	900		
Sweden			Sellstrom et al. (1993)	Approximations based on graphed data
Herring Muscle	BDE-47	82		Bothnian Sea Nov. 1986
	BDE-47	450		Baltic Proper June 1987
	BDE-47	59		Skagerrak April 1987
	BDE-47	12		Fladen Nov. 1987
	BDE-47	38		Utlangan Sept. 1987
	BDE-47	35		Landsort Oct. 1987
	BDE-47	27		Angskarsklubb Sept.-Oct 1987
	BDE-47	19		Harufjarden Oct 1987
Bream muscle	BDE-47	250		River Viskan Spring 1987
Bream muscle	BDE-47	750		River Viskan Spring 1987
Pike muscle	BDE-47	6500		River Haggen Spring 1987
Pike muscle	BDE-47	2000		River Viskan Spring 1987
Perch muscle	BDE-47	24000		River Viskan Spring 1987
Perch muscle	BDE-47	2200		River Viskan Spring 1987
Trout muscle	BDE-47	460		Kesnacksalven Fall 1988
Trout muscle	BDE-47	120		Bengtsbroholjen Fall 1988
Trout muscle	BDE-47	140		Kesnacksalven Fall 1988
Trout muscle	BDE-47	250		Bengtsbroholjen Fall 1988
Trout muscle	BDE-47	190		Skifors Fall 1988
Pike muscle	BDE-47	98		Kesnacksalven Fall 1988
Pike muscle	BDE-47	94		Bengtsfors Fall 1988
Arctic char muscle	BDE-47	400		Lake Vattern May 1987
Whitefish muscle	BDE-47	15		Lake Storvindeln Nov. 1986

Levels in Fish				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Sweden				Approximations based on graphed data
Herring Muscle	BDE-99	27	Sellstrom et al. (1993)	Bothnian Sea Nov. 1986
	BDE-99	46		Baltic Proper June 1987
	BDE-99	9.8		Skagerrak April 1987
	BDE-99	3.4		Fladen Nov. 1987
	BDE-99	17		Utlangan Sept. 1987
	BDE-99	9.2		Landsort Oct. 1987
	BDE-99	17		Angskarsklubb Sept.-Oct 1987
	BDE-99	7.8		Harufjarden Oct 1987
Bream muscle	BDE-99	2.3		River Viskan Spring 1987
Bream muscle	BDE-99	2.4		River Viskan Spring 1987
Pike muscle	BDE-99	1100		River Haggen Spring 1987
Pike muscle	BDE-99	78		River Viskan Spring 1987
Perch muscle	BDE-99	9400		River Viskan Spring 1987
Perch muscle	BDE-99	380		River Viskan Spring 1987
Trout muscle	BDE-99	590		Kesnacksalven Fall 1988
Trout muscle	BDE-99	130		Bengtsbroholjen Fall 1988
Trout muscle	BDE-99	130		Kesnacksalven Fall 1988
Trout muscle	BDE-99	220		Bengtsbroholjen Fall 1988
Trout muscle	BDE-99	64		Skifors Fall 1988
Pike muscle	BDE-99	79		Kesnacksalven Fall 1988
Pike muscle	BDE-99	60		Bengtsfors Fall 1988
Arctic char muscle	BDE-99	64		Lake Vattern May 1987
Whitefish muscle	BDE-99	7.2		Lake Storvindeln Nov. 1986
North Sea		**ng/g lipid weight**	Boon et al. (2002)	
Herring filet - Mean	BDE-28	1.9		
	BDE-47	37		
	BDE-99	12		
	BDE-100	9.2		
	BDE-153	0.9		
	BDE-154	1.5		
Range	BDE-28	1.2-2.4		
	BDE-47	23-47		
	BDE-99	9.9-17		
	BDE-100	6.3-12		
	BDE-153	0.6-1.3		
	BDE-154	1.3-1.9		

Levels in Fish				
Country	Compound	Concentration	Reference	Note
Cod filet - Mean	BDE-28	2.7	Boon et al. (2002)	
	BDE-47	43		
	BDE-99	6.3		
	BDE-100	13		
	BDE-153	<LOD		
	BDE-154	3.9		
Range	BDE-28	1.5-4.5		
	BDE-47	26-74		
	BDE-99	3.1-16		
	BDE-100	5.9-21		
	BDE-153	<LOD		
	BDE-154	3.9-3.9		
Whiting filet - Mean	BDE-28	1.8	Boon et al. (2002)	
	BDE-47	26		
	BDE-99	9		
	BDE-100	8.6		
	BDE-153	<LOD		
	BDE-154	3.3		
Range	BDE-28	1.3-2.4		
	BDE-47	7.1-40		
	BDE-99	5.3-14		
	BDE-100	4.2-12		
	BDE-153	<LOD		
	BDE-154	2.2-4.4		
Herring liver - Mean	BDE-28	2.1	Boon et al. (2002)	
	BDE-47	30		
	BDE-99	13		
	BDE-100	9.1		
	BDE-153	2.1		
	BDE-154	2.6		
Range	BDE-28	1.6-2.5		
	BDE-47	19-52		
	BDE-99	8.0-21		
	BDE-100	5.6-17		
	BDE-153	1.1-3.9		
	BDE-154	1.5-4.4		

Levels in Fish				
Country	Compound	Concentration	Reference	Note
Cod liver - Mean	BDE-28	6.7	Boon et al. (2002)	
	BDE-47	133		
	BDE-99	15		
	BDE-100	40		
	BDE-153	0.7		
	BDE-154	6.4		
Range	BDE-28	2.0-12		
	BDE-47	63-307		
	BDE-99	1.4-53		
	BDE-100	18-93		
	BDE-153	0.5-1.3		
	BDE-154	4.3-12		
Whiting liver - Mean	BDE-28	3.6	Boon et al. (2002)	
	BDE-47	70		
	BDE-99	15		
	BDE-100	16		
	BDE-153	1.4		
	BDE-154	4.5		
Range	BDE-28	0.7-6.3		
	BDE-47	7.6-132		
	BDE-99	1.9-34		
	BDE-100	1.7-31		
	BDE-153	0.3-3.1		
	BDE-154	0.6-11		

Environmental Levels in Food

Levels in Food				
Country	**Compound**	**Concentration**	**Reference**	**Note**
USA			Huwe et al. (2002a)	13 chickens from the southern United States and a composite sample of chickens from North Dakota were analyzed
(North Dakota)	Total PBDE	1.7 ppb whole weight (ww)		
(Arkansas)	Total PBDE	39.4 ppb ww		
Japan		**(pg/g fresh weight)**	Ohta et al. (2002)	These are approximations based on graphed data
Spinach	BDE-154	2		
	BDE-153	10		
	BDE-100	3		
	BDE-99	12		
	BDE-47	40		
	BDE-28	23		
	Total PBDE	134		
Potato	BDE-154	3	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-153	30		
	BDE-100	1		
	BDE-99	4		
	BDE-47	6		
	BDE-28	4		
	Total PBDE	47.6		
Carrot	BDE-154	2	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-153	12		
	BDE-100	2		
	BDE-99	5		
	BDE-47	12		
	BDE-28	6		
	Total PBDE	38.4		
Pork	BDE-154	2	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-153	3		
	BDE-100	6		
	BDE-99	25		
	BDE-47	25		
	BDE-28	2		
	Total PBDE	63.6		
Beef	BDE-154	1	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-153	Non-detectable		
	BDE-100	2		
	BDE-99	2		
	BDE-47	6		
	BDE-28	2		
	Total PBDE	16.2		

Levels in Food				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Chicken	BDE-154	0.5	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-153	Non-detectable		
	BDE-100	2		
	BDE-99	2		
	BDE-47	2		
	BDE-28	Non-detectable		
	Total PBDE	6.25		
Sweden		**(ng/g whole weight)**	Darnerud et al. (2000) *(unpublished)*	Congeners consisted of BDE-47, 99, 100, 153, 154
Fish	Total PBDE	0.634		
Meat	Total PBDE	0.0458		
Dairy	Total PBDE	0.0182		
Egg	Total PBDE	0.0425		
Fat/Oil	Total PBDE	0.158		
Pastry	Total PBDE	0.0925		

Environmental Levels in Biota

Levels in Biota				
Country	**Compound**	**Concentration**	**Reference**	**Note**
British Columbia, Canada		**(ng/g lipid)**	Ikonomou et al. (2002)	Samples were collected b/w 1992-2000; Total PBDE consists of congen. BDE-15,17,28/33,47,49,66,75,99,100,119,153,154,155, and other (BDE-25,30,32,77,140); Crab ranged from 4.2-480 ng/g lipid; Sole ranged from 12-340 ng/g lipid; Porpoise ranged from 350-2300 ng/g lipid
Crab (Vancouver)	Total PBDE	350		
Crab (Cowichan)	Total PBDE	320		
Crab (Gardener)	Total PBDE	4.2		
Crab (Sechelt)	Total PBDE	320		
Crab (Prince Rupert)	Total PBDE	480		
Crab (Victoria)	Total PBDE	200		
Sole (Bamfield)	Total PBDE	22		
Sole (Crofton)	Total PBDE	82		
Sole (Crofton)	Total PBDE	67		
Sole (Crofton)	Total PBDE	60		
Sole (Crofton)	Total PBDE	12		
Sole (Howe Sound)	Total PBDE	140		
Sole (Kitimat)	Total PBDE	66		
Sole (Kitimat)	Total PBDE	70		
Sole (Kitimat)	Total PBDE	64		
Sole (Mill Bay)	Total PBDE	37		
Sole (Trincomali)	Total PBDE	110		
Sole (Trincomali)	Total PBDE	110		
Sole (Vancouver)	Total PBDE	340		
Sole (Vancouver)	Total PBDE	280		
Porpoise (Esquimalt)	Total PBDE	530		
Porpoise (Esquimalt)	Total PBDE	350		
Porpoise (Parksville)	Total PBDE	420		
Porpoise (Tsawwassen)	Total PBDE	2300		
Porpoise (Victoria)	Total PBDE	740		
Swedish Area		**(ng/g lipid)**	Jansson et al. (1993)	% lipid
Rabbit	BDE-47	<2		1.1
	BDE-99	<0.3		
Moose	BDE-47	0.82		2
	BDE-99	0.64		
Reindeer	BDE-47	0.17		56
	BDE-99	0.26		
Whitefish	BDE-47	15		0.66
	BDE-99	7.2		
Artic Char	BDE-47	400		5.3
	BDE-99	64		
Herring	BDE-47	82		5.4
	BDE-99	27		

Levels in Biota				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Herring	BDE-47	450	Jansson et al. (1993)	4.4
	BDE-99	46		
Herring	BDE-47	59		3.2
	BDE-99	9.8		
Ringed Seal	BDE-47	47		88
	BDE-99	1.7		
Grey Seal	BDE-47	650		74
	BDE-99	40		
Osprey	BDE-47	1800		4
	BDE-99	140		
Sweden		**(ng/g lipid)**	Haglund et al. (1997)	
Grey Seal Liver	BDE-47	16		% lipid= .03
	BDE-85	0.8		
	BDE-99	1.3		
	BDE-153	ND		
Grey Seal Blubber	BDE-47	308		% lipid= .90
	BDE-85	57		
	BDE-99	54		
	BDE-153	11		
Ringed Seal Liver	BDE-47	33		% lipid= .08
	BDE-85	2.9		
	BDE-99	3		
	BDE-153	2.5		
Ringed Seal Blubber	BDE-47	256		% lipid= .91
	BDE-85	61		
	BDE-99	33		
	BDE-153	9.6		
Sweden			Sellstrom et al. (1993)	% lipid not reported
Rabbit muscle	BDE-47	<1.8		Revingehed Sept. 1986
Moose muscle	BDE-47	0.82		Grimso Oct. 1985-86
Reindeer suet (fatty tissue around organs)	BDE-47	0.17		Ottsjo Oct. 1986
Ringed Seal blubber	BDE-47	47		Svalbard 1981
Grey Seal muscle	BDE-47	650		Baltic Sea 1979-85
Osprey muscle	BDE-47	1800		Sweden 1982-86
Starling muscle	BDE-47	4.5	Sellstrom et al. (1993)	Tyresta 1988
Starling muscle	BDE-47	3.2		Fleringe 1988
Starling muscle	BDE-47	7.8		Krankesjon 1988
Starling muscle	BDE-47	2.7		Svartedalen 1988

Levels in Biota				
Country	Compound	Concentration	Reference	Note
Guillemot Egg	BDE-47	130	Sellstrom et al. (1993)	Stora Karlso 1970
Guillemot Egg	BDE-47	130		Stora Karlso 1975
Guillemot Egg	BDE-47	640		Stora Karlso 1979
Guillemot Egg	BDE-47	880		Stora Karlso 1983
Guillemot Egg	BDE-47	1200		Stora Karlso 1986
Guillemot Egg	BDE-47	1500		Stora Karlso 1989
Guillemot Egg	BDE-47	170		Stora Karlso 1974
Guillemot Egg	BDE-47	260		Stora Karlso 1978
Guillemot Egg	BDE-47	820		Stora Karlso 1982
Guillemot Egg	BDE-47	650		Stora Karlso 1987
Guillemot Egg	BDE-47	600		Stora Karlso 1976
Guillemot Egg	BDE-47	910		Stora Karlso 1989
Rabbit muscle	BDE-99	<.34	Sellstrom et al. (1993)	Revingehed Sept. 1986
Moose muscle	BDE-99	0.64		Grimso Oct. 1985-86
Reindeer suet (fatty tissue around organs)	BDE-99	0.26		Ottsjo Oct. 1986
Ringed Seal blubber	BDE-99	1.7		Svalbard 1981
Grey Seal muscle	BDE-99	40		Baltic Sea 1979-85
Osprey muscle	BDE-99	140		Sweden 1982-86
Starling muscle	BDE-99	4.2	Sellstrom et al. (1993)	Tyresta 1988
Starling muscle	BDE-99	2.3		Fleringe 1988
Starling muscle	BDE-99	4.2		Krankesjon 1988
Starling muscle	BDE-99	2.3		Svartedalen 1988
Guillemot Egg	BDE-99	24	Sellstrom et al. (1993)	Stora Karlso 1970
Guillemot Egg	BDE-99	33		Stora Karlso 1975
Guillemot Egg	BDE-99	130		Stora Karlso 1979
Guillemot Egg	BDE-99	210		Stora Karlso 1983
Guillemot Egg	BDE-99	260		Stora Karlso 1986
Guillemot Egg	BDE-99	330		Stora Karlso 1989
Guillemot Egg	BDE-99	48		Stora Karlso 1974
Guillemot Egg	BDE-99	70		Stora Karlso 1978
Guillemot Egg	BDE-99	200		Stora Karlso 1982
Guillemot Egg	BDE-99	160		Stora Karlso 1987
Guillemot Egg	BDE-99	130		Stora Karlso 1976
Guillemot Egg	BDE-99	240		Stora Karlso 1989

Levels in Biota				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Japan		**(pg/g fresh wt.)**	Ohta et al. (2002)	These are approximations based on graphed data
Wakayama prefecture	BDE-153	30		
(Young Yellowtail)	BDE-154	190		
	BDE-99	125		
	BDE-100	240		
	BDE-47	1000		
	244'/2'34			
	Total	1650		
Ehime prefecture	BDE-153	30	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-154	170		
	BDE-99	110		
	BDE-100	240		
	BDE-47	925		
	244'/2'34			
	Total	1580		
Iwate prefecture	BDE-153	70	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-154	170		
	BDE-99	190		
	BDE-100	260		
	BDE-47	1000		
	244'/2'34			
	Total	1720		
China Sea	BDE-153	50	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-154	140		
	BDE-99	190		
	BDE-100	250		
	BDE-47	925		
	244'/2'34			
	Total	1620		
Iwate prefecture	BDE-153	60	Ohta et al. (2002)	These are approximations based on graphed data
(Mackerel)	BDE-154	220		
	BDE-99	140		
	BDE-100	230		
	BDE-47	750		
	244'/2'34			
	Total	1550		

Levels in Biota				
Country	Compound	Concentration	Reference	Note
Chiba prefecture	BDE-153	80	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-154	60		
	BDE-99	140		
	BDE-100	220		
	BDE-47	700		
	244'/2'34			
	Total	1400		
Shizuoka prefecture	BDE-153	30	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-154	60		
	BDE-99	350		
	BDE-100	230		
	BDE-47	825		
	244'/2'34			
	Total	1540		
Barents Sea (Northern Europe)	BDE-153	30	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-154	125		
	BDE-99	310		
	BDE-100	190		
	BDE-47	700		
	244'/2'34			
	Total	1280		
Iwate prefecture	BDE-153	60	Ohta et al. (2002)	These are approximations based on graphed data
(Yellowtail)	BDE-154	40		
	BDE-99	190		
	BDE-100	190		
	BDE-47	740		
	244'/2'34			
	Total	1320		
Shizuoka prefecture	BDE-153	40	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-154	125		
	BDE-99	125		
	BDE-100	190		
	BDE-47	600		
	244'/2'34			
	Total	985		

Levels in Biota				
Country	Compound	Concentration	Reference	Note
Miyagi prefecture	BDE-153	40	Ohta et al. (2002)	These are approximations based on graphed data
(Salmon)	BDE-154	125		
	BDE-99	70		
	BDE-100	125		
	BDE-47	600		
	244'/2'34			
	Total	1040		
Hokkaido prefecture	BDE-153	50	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-154	125		
	BDE-99	70		
	BDE-100	125		
	BDE-47	500		
	244'/2'34			
	Total	897		
Iwate prefecture	BDE-153	50	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-154	90		
	BDE-99	125		
	BDE-100	110		
	BDE-47	375		
	244'/2'34			
	Total	813		
Hokkaido prefecture	BDE-153	30	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-154	90		
	BDE-99	70		
	BDE-100	60		
	BDE-47	250		
	244'/2'34			
	Total	593		
Indian Ocean	BDE-153	unreadable	Ohta et al. (2002)	These are approximations based on graphed data
(Yellow Tuna)	BDE-154	unreadable		
	BDE-99	unreadable		
	BDE-100	unreadable		
	BDE-47	unreadable		
	244'/2'34	unreadable		
	Total	18.5		

Levels in Biota				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Western Pacific Ocean	BDE-153	unreadable	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-154	unreadable		
	BDE-99	unreadable		
	BDE-100	unreadable		
	BDE-47	unreadable		
	244'/2'34	unreadable		
	Total	17.7		
Shizuoka prefecture	BDE-153	unreadable	Ohta et al. (2002)	These are approximations based on graphed data
(Short-necked clam)	BDE-154	unreadable		
	BDE-99	unreadable		
	BDE-100	unreadable		
	BDE-47	unreadable		
	244'/2'34	unreadable		
	Total	61.3		
Shimane prefecture	BDE-153	unreadable	Ohta et al. (2002)	These are approximations based on graphed data
	BDE-154	unreadable		
	BDE-99	unreadable		
	BDE-100	unreadable		
	BDE-47	unreadable		
	244'/2'34	unreadable		
	Total	43.5		
North Atlantic Ocean		**(ng/g wet)**	de Boer et al. (1998) as cited in Manchester-Neesvig et al. (2001)	
sperm whale blubber	Total PBDE	99		
sperm whale liver	Total PBDE	4		
minke whale blubber	Total PBDE	122		
North and Wadden Seas			de Boer et al. (1998) as cited in Manchester-Neesvig et al. (2001)	
dolphin blubber	Total PBDE	7700		
dolphin liver	Total PBDE	31		
harbor seal blubber	Total PBDE	1083		
harbor seal liver	Total PBDE	20		
Virginia, Atlantic coast, USA			Kuehl et al. (1991) as cited in Manchester-	These values are normalized to lipid content
dolphin blubber	Total PBDE	200		
Viskan River, Sweden			Andersson et al. (1981) as cited in Manchester-	
eel muscle	Total PBDE	215		
Osaka, Japan			Wantanabe et al. (1987) as cited in Manchester-	
mussel	Total PBDE	17.4		

Environmental Levels in Oil

Levels in Oil				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Sweden		()	Haglund et al. (1997)	
Bio-Marin commercial fish oil	BDE-47	3.9		
	BDE-85	2.3		
	BDE-99	2.8		
	BDE-153	ND		
Eskimo-3 commercial fish oil	BDE-47	0.7		
	BDE-85	0.1		
	BDE-99	0.1		
	BDE-153	ND		
Pikasol commercial fish oil	BDE-47	0.1		
	BDE-85	ND		
	BDE-99	0.1		
	BDE-153	ND		
Cod Liver Oil	BDE-47	23		
	BDE-85	3.8		
	BDE-99	1.3		
	BDE-153	ND		

Environmental Levels in the Workplace

Levels in the Workplace					
Country	Compound	Concentration	Range	Reference	Note
Sweden					
In a dismantling hall	BDE-47	1.2 ng/m3	0.35-2.1 ng/m3	Sjodin (2001a)	Total air concentration of particle-associated and semivolatile BFR
	BDE-85	0.17 ng/m3	0.10-0.24 ng/m3		
	BDE-99	2.6 ng/m3	0.54-5.5 ng/m3		
	BDE-100	0.25 ng/m3	0.063-0.52 ng/m3		
	BDE-153	3.9 ng/m3	0.88-11 ng/m3		
	BDE-154	0.57 ng/m3	0.13-1.0 ng/m3		
	BDE-183	19 ng/m3	6.3-44 ng/m3		
	BDE-209	36 ng/m3	12-70 ng/m3		
Around a shredder	BDE-47	2.0;2.1 ng/m3		Sjodin (2001a)	Total air concentration of particle-associated and semivolatile BFR; Only two samples collected (n=2) - both concentrations are listed
	BDE-85	0.42;0.52 ng/m3			
	BDE-99	4.0;4.5 ng/m3			
	BDE-100	0.56;0.61 ng/m3			
	BDE-153	14;15 ng/m3			
	BDE-154	2.4;2.4ng/m3			
	BDE-183	84;87 ng/m3			
	BDE-209	150;200 ng/m3			
During the assembly of circuit boards	BDE-47	0.35 ng/m3	<0.1-0.39 ng/m3	Sjodin (2001a)	Total air concentration of particle-associated and semivolatile BFR
	BDE-85		<0.006 ng/m3		
	BDE-99	0.15 ng/m3	<0.06-0.15 ng/m3		
	BDE-100	0.041 ng/m3	<0.009-0.058 ng/m3		
	BDE-153	0.019 ng/m3	<0.004-0.033 ng/m3		
	BDE-154	0.0069 ng/m3	<0.002-0.013 ng/m3		
	BDE-183	0.053 ng/m3	0.014-0.11 ng/m3		
	BDE-209	0.22 ng/m3	<0.04-0.32 ng/m3		
In a computer repair facility	BDE-47	<0.10 ng/m3		Sjodin (2001a)	Total air concentration of particle-associated and semivolatile BFR; Only two samples collected (n=2)
	BDE-85	<0.006 ng/m3			
	BDE-99	<0.06 ng/m3			
	BDE-100	<0.009 ng/m3			
	BDE-153	<0.004;0.014 ng/m3			
	BDE-154	<0.002;0.0043 ng/m3			
	BDE-183	0.048;0.063 ng/m3			
	BDE-209	<0.04;0.093 ng/m3			

Levels in the Workplace					
Country	**Compound**	**Concentration**	**Range**	**Reference**	**Note**
Sweden		**Mean (pmol/m^3)**	**Range (pmol/m^3)**	Bergman et al. (1999)	There were 12 samples (n=12); Limit of quantification was determined as 10 times the blank sample amount
Dismantling of Electronics	BDE-47	2.5	0.73-4.3		
	BDE-99	4.6	1.0-9.8		
	BDE-153	6.1	1.4-17		
	BDE-183	26	8.7-60		
	BDE-209	38	12.0-73		
Office with Computers	BDE-47	<0.2	----	Bergman et al. (1999)	There were 4 samples (n=4); Limit of quantification was determined as 10 times the blank sample amount
	BDE-99	<0.1	----		
	BDE-153	<0.006	----		
	BDE-183	0.011	0.0063-0.016		
	BDE-209	0.087	0.083-0.090		
Norway			**Range (pg/m^3)**	Thomsen et al. (2001a)	Samples were taken by adsorption to glass at ordinary laboratory circulation and by pumping air through a SPE column. BDE47 and BDE-99 were the most abundant and these ranges are estimate concentrations that are consistent with concentrations
Laboratory Air	BDE-47		12.0-59.0		
	BDE-99		7.0-20.0		
	BDE-100		<4.5		
	BDE-153		<4.5		
	BDE-154		<4.5		

Environmental Levels in Dust in the Office

Levels in Dust in the Office					
Country	**Compound**	**Concentration**	**Range**	**Reference**	**Note**
Netherlands		**(mg/kg dust, ppb)**		Santillo et al. (2001)	Samples were taken from offices in Parliament Buildings in 8 countries; See page 9 of the study for a description of the location of dust samples collected
	BDE-28	<0.16			
	BDE-47	97			
	BDE-66	<0.16			
	BDE-71	<0.16			
	BDE-75	0.49			
	BDE-77	<0.17			
	BDE-85	7.4			
	BDE-99	130			
	BDE-100	30			
	BDE-119	<0.16			
	BDE-138	3.5			
	BDE-153	48			
	BDE-154	11			
	BDE-190	<0.16			
	BDE-209	800			
Finland				Santillo et al. (2001)	Samples were taken from offices in Parliament Buildings in 8 countries; See page 9 of the study for a description of the location of dust samples collected
	BDE-28	1.6			
	BDE-47	180			
	BDE-66	2.4			
	BDE-71	<0.60			
	BDE-75	<0.60			
	BDE-77	<0.62			
	BDE-85	7.5			
	BDE-99	160			
	BDE-100	36			
	BDE-119	<0.59			
	BDE-138	1.9			
	BDE-153	22			
	BDE-154	9.4			
	BDE-190	<0.60			
	BDE-209	1100			

Levels in Dust in the Office					
Country	**Compound**	**Concentration**	**Range**	**Reference**	**Note**
Sweden				Santillo et al. (2001)	Samples were taken from offices in Parliament Buildings in 8 countries; See page 9 of the study for a description of the location of dust samples collected
	BDE-28	0.95			
	BDE-47	78			
	BDE-66	1.6			
	BDE-71	<0.36			
	BDE-75	<0.36			
	BDE-77	<0.38			
	BDE-85	3.1			
	BDE-99	68			
	BDE-100	19			
	BDE-119	<0.36			
	BDE-138	<0.36			
	BDE-153	9.8			
	BDE-154	5			
	BDE-190	<0.36			
	BDE-209	700			
Italy 1				Santillo et al. (2001)	Samples were taken from offices in Parliament Buildings in 8 countries; See page 9 of the study for a description of the location of dust samples collected
	BDE-28	2.8			
	BDE-47	89			
	BDE-66	2.3			
	BDE-71	<0.26			
	BDE-75	<0.26			
	BDE-77	<0.27			
	BDE-85	3.3			
	BDE-99	59			
	BDE-100	15			
	BDE-119	<0.26			
	BDE-138	2.3			
	BDE-153	21			
	BDE-154	5.4			
	BDE-190	<0.26			
	BDE-209	6900			

Levels in Dust in the Office					
Country	**Compound**	**Concentration**	**Range**	**Reference**	**Note**
Italy 2				Santillo et al. (2001)	Samples were taken from offices in Parliament Buildings in 8 countries; See page 9 of the study for a description of the location of dust samples collected
	BDE-28	1.5			
	BDE-47	110			
	BDE-66	2.7			
	BDE-71	<0.20			
	BDE-75	<0.20			
	BDE-77	<0.21			
	BDE-85	11.2			
	BDE-99	170			
	BDE-100	23			
	BDE-119	<0.20			
	BDE-138	4.7			
	BDE-153	59			
	BDE-154	9.2			
	BDE-190	<.20			
	BDE-209	4600			
Denmark 1				Santillo et al. (2001)	Samples were taken from offices in Parliament Buildings in 8 countries; See page 9 of the study for a description of the location of dust samples collected
	BDE-28	0.47			
	BDE-47	21			
	BDE-66	0.48			
	BDE-71	<0.29			
	BDE-75	<0.29			
	BDE-77	<0.30			
	BDE-85	1.6			
	BDE-99	27			
	BDE-100	5			
	BDE-119	<0.28			
	BDE-138	<0.28			
	BDE-153	6.1			
	BDE-154	5.2			
	BDE-190	<0.29			
	BDE-209	470			

Levels in Dust in the Office					
Country	**Compound**	**Concentration**	**Range**	**Reference**	**Note**
Denmark 2				Santillo et al. (2001)	Samples were taken from offices in Parliament Buildings in 8 countries; See page 9 of the study for a description of the location of dust samples collected
	BDE-28	0.91			
	BDE-47	39			
	BDE-66	0.88			
	BDE-71	<0.26			
	BDE-75	<0.26			
	BDE-77	<0.27			
	BDE-85	2.2			
	BDE-99	40			
	BDE-100	8.3			
	BDE-119	<0.26			
	BDE-138	0.76			
	BDE-153	8.5			
	BDE-154	3			
	BDE-190	<0.26			
	BDE-209	330			
Netherlands				Santillo et al. (2001)	Samples were taken from offices in Parliament Buildings in 8 countries; See page 9 of the study for a description of the location of dust samples collected
	BDE-28	<0.16			
	BDE-47	15			
	BDE-66	0.58			
	BDE-71	<0.16			
	BDE-75	<0.16			
	BDE-77	<0.17			
	BDE-85	0.9			
	BDE-99	15			
	BDE-100	3.9			
	BDE-119	<0.16			
	BDE-138	0.89			
	BDE-153	17			
	BDE-154	2.3			
	BDE-190	<0.16			
	BDE-209	490			

Levels in Dust in the Office					
Country	**Compound**	**Concentration**	**Range**	**Reference**	**Note**
Netherlands				Santillo et al. (2001)	Samples were taken from offices in Parliament Buildings in 8 countries; See page 9 of the study for a description of the location of dust samples collected
	BDE-28	<0.17			
	BDE-47	10			
	BDE-66	0.5			
	BDE-71	<0.17			
	BDE-75	<0.17			
	BDE-77	<0.18			
	BDE-85	<0.06			
	BDE-99	10			
	BDE-100	2.5			
	BDE-119	<0.17			
	BDE-138	<0.17			
	BDE-153	6.3			
	BDE-154	<0.43			
	BDE-190	<0.17			
	BDE-209	330			
Netherlands				Santillo et al. (2001)	Samples were taken from offices in Parliament Buildings in 8 countries; See page 9 of the study for a description of the location of dust samples collected
	BDE-28	<0.12			
	BDE-47	17			
	BDE-66	0.69			
	BDE-71	<0.12			
	BDE-75	<0.12			
	BDE-77	<0.12			
	BDE-85	0.99			
	BDE-99	14			
	BDE-100	3.4			
	BDE-119	<0.12			
	BDE-138	0.49			
	BDE-153	13			
	BDE-154	1			
	BDE-190	<0.12			
	BDE-209	260			

Levels in Dust in the Office					
Country	**Compound**	**Concentration**	**Range**	**Reference**	**Note**
Austria 1				Santillo et al. (2001)	Samples were taken from offices in Parliament Buildings in 8 countries; See page 9 of the study for a description of the location of dust samples collected
	BDE-28	2.8			
	BDE-47	66			
	BDE-66	2.3			
	BDE-71	<0.03			
	BDE-75	<0.04			
	BDE-77	<0.04			
	BDE-85	5.5			
	BDE-99	68			
	BDE-100	26			
	BDE-119	<0.03			
	BDE-138	1.6			
	BDE-153	26			
	BDE-154	11			
	BDE-190	<0.08			
	BDE-209	340			
Austria 2				Santillo et al. (2001)	Samples were taken from offices in Parliament Buildings in 8 countries; See page 9 of the study for a description of the location of dust samples collected
	BDE-28	3			
	BDE-47	64			
	BDE-66	<0.04			
	BDE-71	<0.04			
	BDE-75	<0.04			
	BDE-77	<0.04			
	BDE-85	5.5			
	BDE-99	72			
	BDE-100	23			
	BDE-119	<0.04			
	BDE-138	<0.04			
	BDE-153	18			
	BDE-154	9.4			
	BDE-190	<0.09			
	BDE-209	510			

Levels in Dust in the Office					
Country	**Compound**	**Concentration**	**Range**	**Reference**	**Note**
Germany 1				Santillo et al. (2001)	Samples were taken from offices in Parliament Buildings in 8 countries; See page 9 of the study for a description of the location of dust samples collected
	BDE-28	6.9			
	BDE-47	80			
	BDE-66	17			
	BDE-71	<0.04			
	BDE-75	<0.04			
	BDE-77	<0.04			
	BDE-85	2.9			
	BDE-99	50			
	BDE-100	14			
	BDE-119	<0.04			
	BDE-138	<0.04			
	BDE-153	17			
	BDE-154	6.3			
	BDE-190	<0.09			
	BDE-209	1500			
Germany 2				Santillo et al. (2001)	Samples were taken from offices in Parliament Buildings in 8 countries; See page 9 of the study for a description of the location of dust samples collected
	BDE-28	<0.03			
	BDE-47	8.6			
	BDE-66	<0.03			
	BDE-71	<0.03			
	BDE-75	<0.03			
	BDE-77	<0.03			
	BDE-85	0.87			
	BDE-99	12			
	BDE-100	3.4			
	BDE-119	<0.03			
	BDE-138	<0.03			
	BDE-153	4.8			
	BDE-154	<0.07			
	BDE-190	<0.06			
	BDE-209	290			

Levels in Dust in the Office					
Country	**Compound**	**Concentration**	**Range**	**Reference**	**Note**
UK 1				Santillo et al. (2001)	Samples were taken from offices in Parliament Buildings in 8 countries; See page 9 of the study for a description of the location of dust samples collected
	BDE-28	16			
	BDE-47	320			
	BDE-66	36			
	BDE-71	<0.09			
	BDE-75	<0.09			
	BDE-77	<0.10			
	BDE-85	6.6			
	BDE-99	92			
	BDE-100	22			
	BDE-119	<0.09			
	BDE-138	<0.09			
	BDE-153	31			
	BDE-154	8.9			
	BDE-190	<0.2			
	BDE-209	4500			
UK 2				Santillo et al. (2001)	Samples were taken from offices in Parliament Buildings in 8 countries; See page 9 of the study for a description of the location of dust samples collected
	BDE-28	<0.08			
	BDE-47	19			
	BDE-66	<0.08			
	BDE-71	<0.08			
	BDE-75	<0.08			
	BDE-77	<0.08			
	BDE-85	2.2			
	BDE-99	29			
	BDE-100	8.2			
	BDE-119	<0.08			
	BDE-138	<0.08			
	BDE-153	11			
	BDE-154	<0.19			
	BDE-190	<0.17			
	BDE-209	550			

Environmental Levels in Dust in the Home

Levels in Dust in the Home				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Germany		**ng/g**	Knoth et al. (2002)	
Sample #S040	Total PBDE	1326.7		
S041	Total PBDE	1328.9		
S042	Total PBDE	4302.1		
S043	Total PBDE	204.6		
S045	Total PBDE	490.2		
S046	Total PBDE	943.8		
S047	Total PBDE	309.9		
S048	Total PBDE	666.8		
S049	Total PBDE	145		
S050	Total PBDE	208.1		
S051	Total PBDE	837.2		
S052	Total PBDE	451.2		
S053	Total PBDE	286.6		
S054	Total PBDE	271.2		
S055	Total PBDE	282.2		
S056	Total PBDE	694		
S057	Total PBDE	451.1		
S058	Total PBDE	19124.2		
S059	Total PBDE	624.7		
S060	Total PBDE	16.3		
S061	Total PBDE	302.5		
S062	Total PBDE	6774.2		
S063	Total PBDE	2707.8		
S064	Total PBDE	233.9		
S065	Total PBDE	309		

Environmental Levels in Consumer Products

Levels in Consumer Products					
Country	**Compound**	**Concentration**	**Consumable**	**Reference**	**Note**
USA		**ug/kg wet weight**		Hale et. al. (2002)	Hale et al exposed frogs and crickets to polyurethane foam (BDE-47, -99, -100, -153, -153)
Frog 1	Total BDE	10100			
Frog 2	Total BDE	9240			
Frog 3	Total BDE	9850			
Frog 4	Total BDE	8340			
Frog 5	Total BDE	9980			
Frog 6	Total BDE	13000			
Foam exposed crickets	Total BDE	14400			
Unexposed crickets	Total BDE	ND			
Europe		**Mean (Range) (ng/g lipid)**		Hagmar and Bergman (2001)	
(Finland) General Population	BDE-47	6.2 (3.1-17)	fat		
(Spain) General Population	BDE-47	1.0 (0.2-5.8)	fat		
(Finland) General Population	BDE-99	1.4 (0.74-5.5)	fat		

Environmental Levels in Indoor Air

Levels in Indoor Air					
Country	**Compound**	**Concentration**	**Range**	**Reference**	**Note**
Sweden				Sjodin et al. (2001a)	Total air concentration of particle-associated and semivolatile BFR; Only two samples were taken (n=2)
In an office with	BDE-47		<0.10 ng/m3		
computers	BDE-85		<0.006 ng/m3		
	BDE-99		<0.06 ng/m3		
	BDE-100		<0.009 ng/m3		
	BDE-153		<0.004 ng/m3		
	BDE-154		<0.002 ng/m3		
	BDE-183	0.0082 ng/m3	0.0046-0.012 ng/m3		
	BDE-209	0.083 ng/m3	<0.04-0.087 ng/m3		
In a teaching hall	BDE-47	0.72;0.80 ng/m3		Sjodin et al. (2001a)	Total air concentration of particle-associated and semivolatile BFR; Only two samples collected (n=2) - both concentrations are listed
	BDE-85	0.0085;0.011 ng/m3			
	BDE-99	0.35;0.41 ng/m3			
	BDE-100	0.053;0.059 ng/m3			
	BDE-153	0.022;0.023 ng/m3			
	BDE-154	0.012;0.013 ng/m3			
	BDE-183	0.011;0.012 ng/m3			
	BDE-209	<0.04;0.17 ng/m3			

Environmental Levels in Human Adipose Tissue

Levels in Human Adipose Tissue				
Country	**Compound**	**Concentration**	**Reference**	**Note**
San Francisco, USA		**Range**	She et al. (2002)	Breast adipose tissue was sampled from 23 women ranging in age from 28-62 years old with a mean of 47 years old; Percent fat in sample ranged from 9.9-93.6 with a mean of 72.2; A correlation was found b/w breast and abdominal tissue so that these types can be used interchageably in future studies
	BDE-47	7.01-196.0 ng/g fat		
	BDE-99	2.17-72.2 ng/g fat		
	BDE-100	0.77-60.6 ng/g fat		
	BDE-153	1.52-124.0 ng/g fat		
	BDE-154	2.86-70.5 ng/g fat		
	Total PBDE	17.2-462.0 ng/g fat		
		Mean		
	BDE-47	33.3 ng/g fat		
	BDE-99	10.7 ng/g fat		
	BDE-100	9.1 ng/g fat		
	BDE-153	16.2 ng/g fat		
	BDE-154	16.5 ng/g fat		
	Total PBDE	85.7 ng/g fat		
Spain		**Mean (Range) (ng/g)**	Meneses et al. (1999)	13 persons were sampled, 3 women and 10 men aging from 28-83 years old with a mean age of 57 years
	BDE-47	1.36 (0.2-5.8)		
	BDE-99	0.42 (<0.07-2.1)		
	BDE-153	1.83 (0.67-4.2)		
Sweden		**Concentration (ng/g lipid)**	Haglund et al. (1997)	% lipid = 90%
	BDE-47	8.8		
	BDE-85	1.8		
	BDE-99	1.1		
	BDE-153	1.7		

Environmental Levels in Breast Milk

Levels in Breast Milk				
Country	**Compound**	**Concentration**	**Reference**	**Note**
United States			Päple et al. (2001)	Composite sample - Samples were collected in Austing and Denver, USA, and sent to a laboratory in Hamburg, Münster, and Stockholm;Other congeners detected, but not individually reported are BDE-17 and BDE-138
Hamburg Laboratory results				
using LRMS, NCI	BDE-28	2.92		
	BDE-47	112		
	BDE-66	0.92		
	BDE-85	3.18		
	BDE-99	29.9		
	BDE-100	23.6		
	BDE-153	14.2		
	BDE-154	3.4		
	BDE-183	0.17		
	Total PBDE	190.6		
using HRMS, EI	BDE-28	3.14		
	BDE-47	124		
	BDE-66	0.53		
	BDE-85	----		
	BDE-99	35.4		
	BDE-100	25.1		
	BDE-153	14.1		
	BDE-154	1.6		
	BDE-183	0.16		
	Total PBDE	204.1		
Münster Laboratory results - using HRMS, EI	BDE-28	5.4		
	BDE-47	122		
	BDE-66	1.2		
	BDE-85	2.6		
	BDE-99	21.7		
	BDE-100	24.7		
	BDE-153	17.2		
	BDE-154	1.4		
	BDE-183	0.2		
	Total PBDE	196.4		
Stockholm Laboratory results - using HRMS,EI	BDE-28	5		
	BDE-47	150		
	BDE-66	0.5		
	BDE-85	3		
	BDE-99	23		
	BDE-100	21		
	BDE-153	14		
	BDE-154	1		
	BDE-183	0.1		
	Total PBDE	217.6		
Vancouver, Canada		**(µg/kg lipid)**	Ryan et al. (2002)	Congeners consist of BDE-28, -47, -99, -100, -153, -154, -183; n=20 samples taken between 2001-2002
	Total PBDE (mean)	42.8		
	Total PBDE (range)	0.9-281.9		

Levels in Breast Milk				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Canada		**mean (µg/kg lipid)**	Ryan and Patry (2001)	n=10, samples collected in 1992 from Ontario and Quebec; other congeners were present but in lesser concentrations were BDE-15,66,77,85,138,and 154; No % lipid was reported.
	BDE-28	0.22		
	BDE-47	3.39		
	BDE-99	1.19		
	BDE-100	0.44		
	BDE-153	0.41		
	BDE-183	0.15		
	Sum of congeners	5.79		
Sweden		**(ng/g lipid)**	Meironyte et al. (1999)	Data from 1997 - BDE's in human breast milk (ng/g lipid); % lipid = 3.1%
	BDE-28	0.19		
	BDE-47	2.28		
	BDE-66	0.07		
	BDE-100	0.42		
	BDE-99	0.48		
	BDE-85	0.07		
	BDE-154	0.05		
	BDE-153	0.46		
	Sum of congeners	4.02		
Sweden		**(ng/g lipid)**	Meironyté-Guvenius and Norén (2001)	Study found levels in Breast Milk to be tappering off.
1998	BDE-28	0.1		
	BDE-47	2.29		
	BDE-66	0.03		
	BDE-100	0.31		
	BDE-99	0.6		
	BDE-85	0.06		
	BDE-154	0.02		
	BDE-153	0.47		
	BDE-183	0.02		
	Sum of congeners	3.88		
1999	BDE-28	0.1		
	BDE-47	1.97		
	BDE-66	0.03		
	BDE-100	0.24		
	BDE-99	0.43		
	BDE-85	0.05		
	BDE-154	0.04		
	BDE-153	0.54		
	BDE-183	0.07		
	Sum of congeners	3.46		
2000	BDE-28	0.08		
	BDE-47	1.7		
	BDE-66	0.02		
	BDE-100	0.22		
	BDE-99	0.23		
	BDE-85	0.03		
	BDE-154	0.02		
	BDE-153	0.45		
	BDE-183	0.05		
	Sum of congeners	2.79		

Levels in Breast Milk				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Stockholm, Sweden		**Mean (Range) (ng/g lipid)**		samples were collected in 2000-2001 from 15 mothers ranging in age from 28-38 years old.
	BDE-17	<0.01 (<0.01)	Meironyté-Guvenius et al. (2003)	
	BDE-28	0.06 (0.02-0.18)		
	BDE-47	1.15 (0.26-4.01)		
	BDE-66	0.02 (<0.01-0.07)		
	BDE-85	0.04 (<0.01-0.17)		
	BDE-99	0.21 (0.07-2.2)		
	BDE-100	0.14 (<0.01-0.69)		
	BDE-153	0.32 (0.03-1.16)		
	BDE-154	0.02 (<0.01-0.14)		
	BDE-183	0.01 (<0.01-0.14)		
	Total PBDE	2.14 (0.56-7.72)		
Sweden		**Mean (Range) (ng/g lipid)**	Hagmar and Bergman (2001)	*samples of milk
Pooled samples from 40 primiparas	BDE-47	1.7		
Primiparous women	BDE-47	1.8 (0.3-16)		
Pooled samples from 40 primiparas	BDE-99	0.23		
Primiparous women	BDE-99	0.44 (0.18-4.5)		
Sweden		**Mean (pg/g fat)**	Darnerud et al. (1998)	
	BDE-47	2516		
	BDE-99	717		
	BDE-100	475		
	BDE-153	648		
	BDE-154	70		
	Sum of PBDE	4452		
		Range (pg/g fat)		
	BDE-47	331-16100		
	BDE-99	181-4470		
	BDE-100	60-5140		
	BDE-153	255-4320		
	BDE-154	30-270		
	Sum of PBDE	1139-28170		
		Mean (pg/g fresh weight)		
	BDE-47	77		
	BDE-99	24		
	BDE-100	14		
	BDE-153	19		
	BDE-154	2.1		
	Sum of PBDE	137		
		Range (pg/g fresh weight)		
	BDE-47	8-358		
	BDE-99	4-222		
	BDE-100	1.5-114		
	BDE-153	8.0-96		
	BDE-154	1.5-6		
	Sum of PBDE	26-626		

Levels in Breast Milk				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Sweden		**Concentration (ng/g lipid)**	Meironyte et al. (1999)	Samples were collected in 1997 % lipid = 3.1%
	BDE-28	0.19		
	BDE-47	2.28		
	BDE-66	0.07		
	BDE-100	0.42		
	BDE-99	0.48		
	BDE-85	0.07		
	BDE-154	0.05		
	BDE-153	0.46		
	Total PBDEs	4.02		
	BDE-28	0.12	Meironyte et al. (1999)	Samples were collected in 1996 % lipid = 3.6%
	BDE-47	2.08		
	BDE-66	0.05		
	BDE-100	0.15		
	BDE-99	0.41		
	BDE-85	0.05		
	BDE-154	0.01		
	BDE-153	0.24		
	Total PBDEs	3.11		
	BDE-28	0.13	Meironyte et al. (1999)	Samples were collected in 1994 % lipid = 3.6%
	BDE-47	1.48		
	BDE-66	0.04		
	BDE-100	0.09		
	BDE-99	0.26		
	BDE-85	nd		
	BDE-154	0.02		
	BDE-153	0.15		
	Total PBDEs	2.17		
	BDE-28	0.03	Meironyte et al. (1999)	Samples were collected in 1990 % lipid = 2.5%
	BDE-47	0.81		
	BDE-66	0.02		
	BDE-100	0.06		
	BDE-99	0.15		
	BDE-85	nd		
	BDE-154	0.04		
	BDE-153	0.1		
	Total PBDEs	1.21		
	BDE-28	0.03	Meironyte et al. (1999)	Samples were collected in 1984/1985 % lipid = 3.3%
	BDE-47	0.49		
	BDE-66	nd		
	BDE-100	0.06		
	BDE-99	0.08		
	BDE-85	nd		
	BDE-154	0.02		
	BDE-153	0.05		
	Total PBDEs	0.73		

Levels in Breast Milk				
Country	Compound	Concentration	Reference	Note
	BDE-28	0.03	Meironyte et al. (1999)	Samples were collected in 1980 % lipid = 2.9%
	BDE-47	0.28		
	BDE-66	nd		
	BDE-100	0.04		
	BDE-99	0.09		
	BDE-85	nd		
	BDE-154	0.01		
	BDE-153	0.03		
	Total PBDEs	0.48		
	BDE-28	0.04	Meironyte et al. (1999)	Samples were collected in 1976 % lipid = 2.8%
	BDE-47	0.18		
	BDE-66	0.01		
	BDE-100	0.05		
	BDE-99	0.04		
	BDE-85	nd		
	BDE-154	0.01		
	BDE-153	0.02		
	Total PBDEs	0.35		
	BDE-28	nd	Meironyte et al. (1999)	Samples were collected in 1972 % lipid = 2.9%
	BDE-47	0.06		
	BDE-66	nd		
	BDE-100	nd		
	BDE-99	nd		
	BDE-85	nd		
	BDE-154	nd		
	BDE-153	0.01		
	Total PBDEs	0.07		
Finland			Strandman et al. (2000)	Human milk and placenta samples were analyzed from eleven (n=11) donors from an ongoing epidemiological study at the National Public Health Institute in Finland; Sample collected was between the years 1994-1998 and the age of the donors varied from 25-42 years with a median of 34 years old; 6 samples were from donors of their first childbirth, 1 from a donor of her second, 1 from a donor of her third, 2 from donors of their fourth chilbirth, and 1 was unknown; The mean placental samples were similar to the breast milk concentrations; 0.14 ng/g lw for BDE-28, 1.09 ng/g lw for BDE-47, 0.42 ng/g lw for BDE-99, and 0.42 ng/g lw for BDE-153
Mean	BDE-28	0.16		
	BDE-47	1.31		
	BDE-99	0.39		
	BDE-153	0.39		
Range	BDE-28	0.04-0.59		
	BDE-47	0.30-4.25		
	BDE-99	0.14-0.94		
	BDE-153	0.19-0.72		

Environmental Levels in Blood

Levels in Blood				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Illinois, USA		**Median (pmol/g lipid)**	Sjodin et al. (2001b)	Samples were collected in 1988 from blood donors; Samples were complared in the study to the female cleaner data taken in 1997; Octa and NonaBDE are structurally unidentified - concetration estimated emplying the response factor of BDE=203.
	BDE-47	1.3		
	BDE-99	0.56		
	BDE-100	0.3		
	BDE-153	0.54		
	BDE-183	0.24		
	BDE-203	<0.1		
	BDE-209	<1		
	OctaBDE	0.16		
	OctaBDE	0.96		
	OctaBDE	0.12		
	NonaBDE	<0.1		
	NonaBDE	0.44		
	NonaBDE	<0.1		
		Range (pmol/g lipid)		
	BDE-47	<0.8-49		
	BDE-99	<0.4-6.6		
	BDE-100	<0.2-42		
	BDE-153	0.13-3.1		
	BDE-183	0.12-1.8		
	BDE-203	<0.1-0.2		
	BDE-209	<1-35		
	OctaBDE	<0.1-0..4		
	OctaBDE	0.21-2.1		
	OctaBDE	<0.1-0.18		
	NonaBDE	<0.1-0.42		
	NonaBDE	0.12-2.4		
	NonaBDE	<0.1-0.32		
San Francisco, USA		**(ng/g lipid weight)**	Petreas et al. (2003)	samples were collected from 1997-1999 from 50 Laotian immigrant women between the ages of 19 and 40 years old from a study on organochlorine exposures and menstrual cycle function. Samples between 1959-1967 were collected from 420 pregnant women and used for historic comparison
1997-1999 Mean	BDE-47	50.6 ± 94.6		
1997-1999 Median	BDE-47	10		
1997-1999 Range	BDE-47	<10-511		
1959-1967 Mean	BDE-47	--		
1959-1967 Median (Range	BDE-47	<10		
Japan		**Mean (Range) (ng/g lipid)**	Nagayama et al. (2001)	Levels were found in 54 Japanese adults aging from 37-49 years old with a mean of 43.9 yrs. Old
	BDE-37	32.0 (ND-100.0)		
	BDE-47	520.0 (100.0-2000.0)		
	BDE-77	Non-detectable		
	BDE-99	1200.0 (390.0-2500.0)		
	BDE-153	2300.0 (ND-6400.0)		
	Total PBDE	4500.0 (1200.0-18000.0)		

Levels in Blood				
Country	**Compound**	**Concentration**	**Reference**	**Note**
Sweden		**Median (pmol/g lipid)**	Bergman et al. (1999)	Human samples taken in 1991; For BDE-47, 153, and 183- the limit quantification was defined as twice the blank sample amount; For BDE-209- the limit of quantification was defined as <0.7 pmol/g lipid and the limit of detection was <0.3 pmol/g lipid and also defined as the signal to noise ratio of 5 and 10, repectively.
No fish Intake	BDE-47	0.83		
	BDE-153	Not analyzed		
	BDE-183	Not analyzed		
	BDE-209	Not analyzed		
High fish Intake	BDE-47	4.4		Human samples taken in 1991
	BDE-153	Not analyzed		
	BDE-183	Not analyzed		
	BDE-209	Not analyzed		
Cleaners	BDE-47	3.2		Human samples taken in 1997
	BDE-153	0.89		
	BDE-183	0.16		
	BDE-209	<0.7		
Clerks	BDE-47	3		Human samples taken in 1997
	BDE-153	1.3		
	BDE-183	0.24		
	BDE-209	<0.7		
Dismantling Electronics	BDE-47	5.9		Human samples taken in 1997
	BDE-153	7		
	BDE-183	11		
	BDE-209	5		
Norway		**Mean Concentration (ng/g lipid)**	Hagmar and Bergman (2001)	*all samples are taken in Norway unless otherwise stated; Laboratory Personnel, Circuit Board producers, and electronic dismantlers are the only worker categories listed for BDE-99. Other worker jobs are listed for other congen.
Laboratory Personnel	BDE-47	1.5		
	BDE-99	0.4		
	BDE-153	0.54		
	BDE-183	----		
	BDE-209	----		
Circuit Board Producers	BDE-47	1.6		
	BDE-99	0.32		
	BDE-153	0.95		
	BDE-183	----		
	BDE-209	----		
Electronics dismantlers	BDE-47	4		
(Sweden)	BDE-47	2.9		
	BDE-99	0.97		
	BDE-153	1.7		
(Sweden)	BDE-153	4.5		
	BDE-183	0.33		
(Sweden)	BDE-183	3.2		
(Sweden)	BDE-183	7.8		
	BDE-209	4.8		

Levels in Blood				
Country	**Compound**	**Concentration**	**Reference**	**Note**
		Range (ng/g lipid)	Hagmar and Bergman (2001)	
Laboratory Personnel	BDE-47	1.0-3.0		
	BDE-99	0.17-0.73		
	BDE-153	0.43-0.63		
	BDE-183	----		
	BDE-209	----		
Circuit Board Producers	BDE-47	0.4-3.4		
	BDE-99	ND-0.77		
	BDE-153	0.5-1.8		
	BDE-183	----		
	BDE-209	----		
Electronics dismantlers	BDE-47	0.9-15		
(Sweden)	BDE-47	<0.5-23		
	BDE-99	0.18-3.6		
	BDE-153	1.2-2.3		
(Sweden)	BDE-153	2.1-12		
	BDE-183	0.09-1.1		
(Sweden)	BDE-183	2.5-12		
(Sweden)	BDE-183	2.3-20		
	BDE-209	<0.3-9.5		
Sweden		**Median (pmol/g lipid)**	Jakobsson et al. (2002)	Within an information technology unit in a hospital, 19 computer technicians (n=19) blood was sampled - Installing and testing of 700 computers and some hundreds of computers were dismantled; Data from Hospital Cleaners and Computer Clerks were cited for comparison from another study (Sjodin et al., 1999); [a]the limit of quantification was 5x the level in the blank sample - [b]the limit of quantification was defined as signal to noise ration of 10 - [c]the limit of detection is defined as the signal to noise ratio of 3 - [d]Nine subjects only; 20 Hospital cleaners were sampled (n=20); 20 computer clerks were sampled (n=20)
Computer Technicians	BDE-47	2.7		
	BDE-153	4.1		
	BDE-154	0.93		
	BDE-183	1.3		
	BDE-209	1.6[d]		
Hospital Cleaners	BDE-47	3.2		
	BDE-153	0.89		
	BDE-154	0.59		
	BDE-183	0.16		
	BDE-209	<0.7[a]		
Computer Clerks	BDE-47	3		
	BDE-153	1.3		
	BDE-154	0.79		
	BDE-183	0.24		
	BDE-209	<0.7[a]		

Levels in Blood				
Country	**Compound**	**Concentration**	**Reference**	**Note**
		Range (pmol/g lipid)	Jakobsson et al. (2002)	Within an information technology unit in a hospital, 19 computer technicians (n=19) blood was sampled - Installing and testing of 700 computers and some hundreds of computers were dismantled; Data from Hospital Cleaners and Computer Clerks were cited for comparison from another study (Sjodin et al., 1999); [a]the limit of quantification was 5x the level in the blank sample - [b]the limit of quantification was defined as signal to noise ration of 10 - [c]the limit of detection is defined as the signal to noise ratio of 3 - [d]Nine subjects only; 20 Hospital cleaners were sampled (n=20); 20 computer clerks were sampled (n=20)
Computer Technicians	BDE-47	<2[a]-28		
	BDE-153	<2[a]-9.0		
	BDE-154	0.35-1.9		
	BDE-183	0.24-6.4		
	BDE-209	<[c]-7.1		
Hospital Cleaners	BDE-47	<1-34		
	BDE-153	0.64-7.6		
	BDE-154	0.25-1.4		
	BDE-183	0.025-0.39		
	BDE-209	<0.3[c]-3.9		
Computer Clerks	BDE-47	<1[a]-10		
	BDE-153	0.8-5.1		
	BDE-154	0.43-1.5		
	BDE-183	<0.02[a]-1.4		
	BDE-209	<0.3[c]-8.0		
Norway		**Mean (ng/g lipid)**	Thomsen et al.(2001b)	Total PBDEs consist of BDE-28,47,99,100,153,154,183,TriBP, and TBBPA.
electronics dismantlers	BDE-47	----		
	Total PBDE	8.8		
Circuit board producers	BDE-47	----		
	Total PBDE	3.9		
Laboratory Personnel	BDE-47	----		
	Total PBDE	3		
		Range (ng/g lipid)		
electronics dismantlers	BDE-47	0.43-14.6		
	Total PBDE	----		
Circuit board producers	BDE-47	0.43-14.6		
	Total PBDE	----		
Laboratory Personnel	BDE-47	0.43-14.6		
	Total PBDE	----		

Voluntary Children's Chemical Evaluation Program Pilot (VCCEPP)

Tier 1 Assessment Of The Potential Health Risks To Children Associated With Exposure To The Commercial Pentabromodiphenyl Ether Product

Appendix VI: Exposure Assessment Calculations

Calculations for Hypothetical Exposure of Workers to Commercial PentaBDE Product

Hypothetical Exposure of Workers to the Commercial PentaBDE Product

Inhalation of Vapor

NON-CANCER

CDI = SVC * Fsvc * CF * InR * AFi * 1/BW

HI = CDI / RfDi

Receptor	SVC Saturated Vapor Concentration µg/m3	Fsvc Fraction of SV in workplace air unitless	CF Conversion Factor mg/µg	InR Inhalation Rate m3/day	AFi Absorption Factor, Inhalation Route unitless	BW Body Weight kg	CDI Chronic Daily Intake mg/kg-day
Primary Production Drummer, Male	18	0.5	1.E-03	12.8	1	78.1	1.11E-03
Primary Production Drummer, Female	18	0.5	1.E-03	12.8	0.75	65.4	1.32E-03
Primary Production Cleaner, Male	18	0.5	1.E-03	12.8	0.75	78.1	1.11E-03
Primary Production Cleaner, Female	18	0.5	1.E-03	12.8	0.75	65.4	1.32E-03
Foam Manufacture Mixer, Male	18	0.5	1.E-03	12.8	0.75	78.1	1.11E-03
Foam Manufacture Mixer, Female	18	0.5	1.E-03	12.8	0.75	65.4	1.32E-03
Foam Manufacture Cutter, Male	18	0.5	1.E-03	12.8	0.75	78.1	1.11E-03
Foam Manufacture Cutter, Female	18	0.5	1.E-03	12.8	0.75	65.4	1.32E-03
Mattress Manufacturer, Male	18	0.5	1.E-03	12.8	0.75	78.1	1.11E-03
Mattress Manufacturer, Female	18	0.5	1.E-03	12.8	0.75	65.4	1.32E-03
Cushion Manufacturer, Male	18	0.5	1.E-03	12.8	0.75	78.1	1.11E-03
Cushion Manufacturer, Female	18	0.5	1.E-03	12.8	0.75	65.4	1.32E-03
Furniture Manufacturer, Male	18	0.5	1.E-03	12.8	0.75	78.1	1.11E-03
Furniture Manufacturer, Female	18	0.5	1.E-03	12.8	0.75	65.4	1.32E-03
Carpet Pad Manufacturer, Male	18	0.5	1.E-03	12.8	0.75	78.1	1.11E-03
Carpet Pad Manufacturer, Female	18	0.5	1.E-03	12.8	0.75	65.4	1.32E-03
Carpet Installer, Male	18	0.5	1.E-03	12.8	0.75	78.1	1.11E-03
Carpet Installer, Female	18	0.5	1.E-03	12.8	0.75	65.4	1.32E-03
Distributor Covered, Male	18	0.5	1.E-03	12.8	0.75	78.1	1.11E-03
Distributor Covered, Female	18	0.5	1.E-03	12.8	0.75	65.4	1.32E-03
Distributor Uncovered, Male	18	0.5	1.E-03	12.8	0.75	78.1	1.11E-03
Distributor Uncovered, Female	18	0.5	1.E-03	12.8	0.75	65.4	1.32E-03
Recycler, Male	18	0.5	1.E-03	12.8	0.75	78.1	1.11E-03
Recycler, Female	18	0.5	1.E-03	12.8	0.75	65.4	1.32E-03

Hypothetical Exposure of Workers to the Commercial PentaBDE Product

Dermal Contact

NON-CANCER

CDI = SAt * SAh * ARskin * Fip * AFd * FWD * 1/BW

HI = CDI / RfDo

Receptor	**SAt** Exposed Skin Surface Area, Total Body	**SAh** Exposed Skin Surface Area, Palms of Hands	**ARskin** Adherence Rate of Commercial Product on Skin	**Fip** Fraction of Handled Item that is Commercial Product	**AFd** Absorption Factor, Dermal Route	**FWD** Fraction of Work Day Spent Around Commercial Product	**BW** Body Weight	**CDI** Chronic Daily Intake
	cm2	unitless	mg/cm2-day	unitless	unitless	unitless	kg	mg/kg-day
Primary Production Drummer, Male	19400	0.026	0.1	0.75	0.0313	0.33	78.1	5.00E-03
Primary Production Drummer, Female	16900	0.024	0.1	0.75	0.0313	0.33	65.4	4.80E-03
Primary Production Cleaner, Male	19400	0.026	0.1	0.75	0.0313	0.33	78.1	5.00E-03
Primary Production Cleaner, Female	16900	0.024	0.1	0.75	0.0313	0.33	65.4	4.80E-03
Foam Manufacture Mixer, Male	19400	0.026	0.1	0.75	0.0313	0.33	78.1	5.00E-03
Foam Manufacture Mixer, Female	16900	0.024	0.1	0.75	0.0313	0.33	65.4	4.80E-03
Foam Manufacture Cutter, Male	19400	0.026	1	0.0375	0.0313	1	78.1	7.58E-03
Foam Manufacture Cutter, Female	16900	0.024	1	0.0375	0.0313	1	65.4	7.28E-03
Mattress Manufacturer, Male	19400	0.026	1	0.0225	0.0313	1	78.1	4.55E-03
Mattress Manufacturer, Female	16900	0.024	1	0.0225	0.0313	1	65.4	4.37E-03
Cushion Manufacturer, Male	19400	0.026	1	0.0375	0.0313	1	78.1	7.58E-03
Cushion Manufacturer, Female	16900	0.024	1	0.0375	0.0313	1	65.4	7.28E-03
Furniture Manufacturer, Male	19400	0.026	1	0.0375	0.0313	1	78.1	7.58E-03
Furniture Manufacturer, Female	16900	0.024	1	0.0375	0.0313	1	65.4	7.28E-03
Carpet Pad Manufacturer, Male	19400	0.026	1	0.0375	0.0313	1	78.1	7.58E-03
Carpet Pad Manufacturer, Female	16900	0.024	1	0.0375	0.0313	1	65.4	7.28E-03
Carpet Installer, Male	19400	0.026	1	0.0375	0.0313	1	78.1	7.58E-03
Carpet Installer, Female	16900	0.024	1	0.0375	0.0313	1	65.4	7.28E-03
Distributor Covered, Male	19400	0.026	1	0.0375	0.0313	1	78.1	7.58E-03
Distributor Covered, Female	16900	0.024	1	0.0375	0.0313	1	65.4	7.28E-03
Distributor Uncovered, Male	19400	0.026	1	0.0375	0.0313	1	78.1	7.58E-03
Distributor Uncovered, Female	16900	0.024	1	0.0375	0.0313	1	65.4	7.28E-03
Recycler, Male	19400	0.026	1	0.0375	0.0313	1	78.1	7.58E-03
Recycler, Female	16900	0.024	1	0.0375	0.0313	1	65.4	7.28E-03

Hypothetical Exposure of Workers to the Commercial PentaBDE Product

Incidental Ingestion from Hand-to-Mouth Contact

NON-CANCER

CDI = SAt * FSAftip * ARskin * Fip * AFo * FWD * 1/BW

HI = CDI / RfDo

Receptor	**SAt** Exposed Skin Surface Area, Total Body	**FSAftip** Fraction of Skin Surface Area that Contacts Mouth	**ARskin** Adherence Rate of Commercial Product on Skin	**Fip** Fraction of Handled Item that is Commercial Product	**AFo** Absorption Factor, Oral Route	**FWD** Fraction of Work Day Spent Around Commercial Product	**BW** Body Weight	**CDI** Chronic Daily Intake
	cm2	unitless	mg/cm2	unitless	unitless	unitless	kg	mg/kg-day
Primary Production Drummer, Male	19400	0.002	0.1	0.75	0.9	0.33	78.1	1.11E-02
Primary Production Drummer, Female	16900	0.002	0.1	0.75	0.9	0.33	65.4	1.15E-02
Primary Production Cleaner, Male	19400	0.002	0.1	0.75	0.9	0.33	78.1	1.11E-02
Primary Production Cleaner, Female	16900	0.002	0.1	0.75	0.9	0.33	65.4	1.15E-02
Foam Manufacture Mixer, Male	19400	0.002	0.1	0.75	0.9	0.33	78.1	1.11E-02
Foam Manufacture Mixer, Female	16900	0.002	0.1	0.75	0.9	0.33	65.4	1.15E-02
Foam Manufacture Cutter, Male	19400	0.002	1	0.0375	0.9	1	78.1	1.68E-02
Foam Manufacture Cutter, Female	16900	0.002	1	0.0375	0.9	1	65.4	1.74E-02
Mattress Manufacturer, Male	19400	0.002	1	0.0225	0.9	1	78.1	1.01E-02
Mattress Manufacturer, Female	16900	0.002	1	0.0225	0.9	1	65.4	1.05E-02
Cushion Manufacturer, Male	19400	0.002	1	0.0375	0.9	1	78.1	1.68E-02
Cushion Manufacturer, Female	16900	0.002	1	0.0375	0.9	1	65.4	1.74E-02
Furniture Manufacturer, Male	19400	0.002	1	0.0375	0.9	1	78.1	1.68E-02
Furniture Manufacturer, Female	16900	0.002	1	0.0375	0.9	1	65.4	1.74E-02
Carpet Pad Manufacturer, Male	19400	0.002	1	0.0375	0.9	1	78.1	1.68E-02
Carpet Pad Manufacturer, Female	16900	0.002	1	0.0375	0.9	1	65.4	1.74E-02
Carpet Installer, Male	19400	0.002	1	0.0375	0.9	1	78.1	1.68E-02
Carpet Installer, Female	16900	0.002	1	0.0375	0.9	1	65.4	1.74E-02
Distributor Covered, Male	19400	0.002	1	0.0375	0.9	1	78.1	1.68E-02
Distributor Covered, Female	16900	0.002	1	0.0375	0.9	1	65.4	1.74E-02
Distributor Uncovered, Male	19400	0.002	1	0.0375	0.9	1	78.1	1.68E-02
Distributor Uncovered, Female	16900	0.002	1	0.0375	0.9	1	65.4	1.74E-02
Recycler, Male	19400	0.002	1	0.0375	0.9	1	78.1	1.68E-02
Recycler, Female	16900	0.002	1	0.0375	0.9	1	65.4	1.74E-02

Hypothetical Exposure of Workers to the Commercial PentaBDE Product

Dermal Contact with Dirty Laundry

NON-CANCER

CDI = SAt * Sah * FSAl * ARskin * FCLdy * AFd * EFL * CF2 * 1/BW

HI = CDI / RfDo

Receptor	**SAt** Exposed Skin Surface Area, Total Body	**SAh** Exposed Skin Surface Area, Palms of Hands	**FSAl** Fraction of Skin Surface Area Exposed while Doing Laundry	**ARskin** Adherence Rate of Commercial Product on Skin	**FCLdy** Fraction of Laundry that Contains the Commercial Product	**AFd** Absorption Factor, Dermal Route	**EFL** Exposure Frequency, Doing Laundry	**CF2** Conversion Factor	**BW** Body Weight	**CDI** Chronic Daily Intake
	cm2	unitless	unitless	mg/cm2-day	unitless	unitless	hr/day	day/hr	kg	mg/kg-day
Primary Production Drummer, Male	19400	0.026	1	0.1	0.25	0.0313	0.22	0.0417	78.1	4.63E-05
Primary Production Drummer, Female	16900	0.024	1	0.1	0.25	0.0313	0.22	0.0417	65.4	4.45E-05
Primary Production Cleaner, Male	19400	0.026	1	0.1	0.25	0.0313	0.22	0.0417	78.1	4.63E-05
Primary Production Cleaner, Female	16900	0.024	1	0.1	0.25	0.0313	0.22	0.0417	65.4	4.45E-05
Foam Manufacture Mixer, Male	19400	0.026	1	0.1	0.25	0.0313	0.22	0.0417	78.1	4.63E-05
Foam Manufacture Mixer, Female	16900	0.024	1	0.1	0.25	0.0313	0.22	0.0417	65.4	4.45E-05
Foam Manufacture Cutter, Male	19400	0.026	1	1	0.25	0.0313	0.22	0.0417	78.1	4.63E-04
Foam Manufacture Cutter, Female	16900	0.024	1	1	0.25	0.0313	0.22	0.0417	65.4	4.45E-04
Mattress Manufacturer, Male	19400	0.026	1	1	0.25	0.0313	0.22	0.0417	78.1	4.63E-04
Mattress Manufacturer, Female	16900	0.024	1	1	0.25	0.0313	0.22	0.0417	65.4	4.45E-04
Cushion Manufacturer, Male	19400	0.026	1	1	0.25	0.0313	0.22	0.0417	78.1	4.63E-04
Cushion Manufacturer, Female	16900	0.024	1	1	0.25	0.0313	0.22	0.0417	65.4	4.45E-04
Furniture Manufacturer, Male	19400	0.026	1	1	0.25	0.0313	0.22	0.0417	78.1	4.63E-04
Furniture Manufacturer, Female	16900	0.024	1	1	0.25	0.0313	0.22	0.0417	65.4	4.45E-04
Carpet Pad Manufacturer, Male	19400	0.026	1	1	0.25	0.0313	0.22	0.0417	78.1	4.63E-04
Carpet Pad Manufacturer, Female	16900	0.024	1	1	0.25	0.0313	0.22	0.0417	65.4	4.45E-04
Carpet Installer, Male	19400	0.026	1	1	0.25	0.0313	0.22	0.0417	78.1	4.63E-04
Carpet Installer, Female	16900	0.024	1	1	0.25	0.0313	0.22	0.0417	65.4	4.45E-04
Distributor Covered, Male	19400	0.026	1	1	0.25	0.0313	0.22	0.0417	78.1	4.63E-04
Distributor Covered, Female	16900	0.024	1	1	0.25	0.0313	0.22	0.0417	65.4	4.45E-04
Distributor Uncovered, Male	19400	0.026	1	1	0.25	0.0313	0.22	0.0417	78.1	4.63E-04
Distributor Uncovered, Female	16900	0.024	1	1	0.25	0.0313	0.22	0.0417	65.4	4.45E-04
Recycler, Male	19400	0.026	1	1	0.25	0.0313	0.22	0.0417	78.1	4.63E-04
Recycler, Female	16900	0.024	1	1	0.25	0.0313	0.22	0.0417	65.4	4.45E-04

Hypothetical Exposure of Workers to the Commercial PentaBDE Product

Incidental Ingestion from Hand-to-Mouth Contact while Doing Laundry

NON-CANCER

CDI = SAt * FSAftip * ARskin * FCLdy * AFo * EFL * CF2 * 1/BW

HI = CDI / RfDo

Receptor	**SAt** Exposed Skin Surface Area, Total Body	**FSAftip** Fraction of Skin Surface Area that Contacts Mouth	**ARskin** Adherence Rate of Commercial Product on Skin	**FCLdy** Fraction of Laundry that Contains the Commercial Product	**AFo** Absorption Factor, Oral Route	**EFL** Exposure Frequency, Doing Laundry	**CF2** Conversion Factor	**BW** Body Weight	**CDI** Chronic Daily Intake
	cm2	unitless	mg/cm2-day	unitless	unitless	hr/day	day/hr	kg	mg/kg-day
Primary Production Drummer, Male	19400	0.002	0.1	0.25	0.9	0.22	0.0417	78.1	1.02E-04
Primary Production Drummer, Female	16900	0.002	0.1	0.25	0.9	0.22	0.0417	65.4	1.07E-04
Primary Production Cleaner, Male	19400	0.002	0.1	0.25	0.9	0.22	0.0417	78.1	1.02E-04
Primary Production Cleaner, Female	16900	0.002	0.1	0.25	0.9	0.22	0.0417	65.4	1.07E-04
Foam Manufacture Mixer, Male	19400	0.002	0.1	0.25	0.9	0.22	0.0417	78.1	1.02E-04
Foam Manufacture Mixer, Female	16900	0.002	0.1	0.25	0.9	0.22	0.0417	65.4	1.07E-04
Foam Manufacture Cutter, Male	19400	0.002	1	0.25	0.9	0.22	0.0417	78.1	1.02E-03
Foam Manufacture Cutter, Female	16900	0.002	1	0.25	0.9	0.22	0.0417	65.4	1.07E-03
Mattress Manufacturer, Male	19400	0.002	1	0.25	0.9	0.22	0.0417	78.1	1.02E-03
Mattress Manufacturer, Female	16900	0.002	1	0.25	0.9	0.22	0.0417	65.4	1.07E-03
Cushion Manufacturer, Male	19400	0.002	1	0.25	0.9	0.22	0.0417	78.1	1.02E-03
Cushion Manufacturer, Female	16900	0.002	1	0.25	0.9	0.22	0.0417	65.4	1.07E-03
Furniture Manufacturer, Male	19400	0.002	1	0.25	0.9	0.22	0.0417	78.1	1.02E-03
Furniture Manufacturer, Female	16900	0.002	1	0.25	0.9	0.22	0.0417	65.4	1.07E-03
Carpet Pad Manufacturer, Male	19400	0.002	1	0.25	0.9	0.22	0.0417	78.1	1.02E-03
Carpet Pad Manufacturer, Female	16900	0.002	1	0.25	0.9	0.22	0.0417	65.4	1.07E-03
Carpet Installer, Male	19400	0.002	1	0.25	0.9	0.22	0.0417	78.1	1.02E-03
Carpet Installer, Female	16900	0.002	1	0.25	0.9	0.22	0.0417	65.4	1.07E-03
Distributor Covered, Male	19400	0.002	1	0.25	0.9	0.22	0.0417	78.1	1.02E-03
Distributor Covered, Female	16900	0.002	1	0.25	0.9	0.22	0.0417	65.4	1.07E-03
Distributor Uncovered, Male	19400	0.002	1	0.25	0.9	0.22	0.0417	78.1	1.02E-03
Distributor Uncovered, Female	16900	0.002	1	0.25	0.9	0.22	0.0417	65.4	1.07E-03
Recycler, Male	19400	0.002	1	0.25	0.9	0.22	0.0417	78.1	1.02E-03
Recycler, Female	16900	0.002	1	0.25	0.9	0.22	0.0417	65.4	1.07E-03

Hypothetical Exposure of Workers to the Commercial PentaBDE Product

Dermal Contact with Floor Surfaces Containing the Commercial Product Brought Home on Worker's Shoes

NON-CANCER

CDI = ((SAs * ARshoe) / FSA) * SAt * FSAf * AFd * EFF * CF2 * 1/BW

HI = CDI / RfDo

	Cfloor Concentration									
	SAs	**ARshoe**	**FSA**	**SAt**	**FSAf**	**AFd**	**EFF**	**CF2**	**BW**	**CDI**
Receptor	Fraction of Skin Surface Area that is Shoes	Adherence Rate of Commercial Product on Shoes	Floor Surface Area	Exposed Skin Surface Area, Total Body	Fraction of Skin Surface Area Exposed to Floor	Absorption Factor, Dermal Route	Exposure Frequency, Contact with Floors	Conversion Factor	Body Weight	Chronic Daily Intake
	cm2	mg/cm2-day	cm2	cm2	unitless	unitless	hr/day	day/hr	kg	mg/kg-day
Primary Production Drummer, Male	613	0.1	756644	19400	0.391	0.0313	3	0.0417	78.1	3.08E-05
Primary Production Drummer, Female	613	0.1	756644	16900	0.305	0.0313	3	0.0417	65.4	2.50E-05
Primary Production Cleaner, Male	613	0.1	756644	19400	0.391	0.0313	3	0.0417	78.1	3.08E-05
Primary Production Cleaner, Female	613	0.1	756644	16900	0.305	0.0313	3	0.0417	65.4	2.50E-05
Foam Manufacture Mixer, Male	613	0.1	756644	19400	0.391	0.0313	3	0.0417	78.1	3.08E-05
Foam Manufacture Mixer, Female	613	0.1	756644	16900	0.305	0.0313	3	0.0417	65.4	2.50E-05
Foam Manufacture Cutter, Male	613	1	756644	19400	0.391	0.0313	3	0.0417	78.1	3.08E-04
Foam Manufacture Cutter, Female	613	1	756644	16900	0.305	0.0313	3	0.0417	65.4	2.50E-04
Mattress Manufacturer, Male	613	1	756644	19400	0.391	0.0313	3	0.0417	78.1	3.08E-04
Mattress Manufacturer, Female	613	1	756644	16900	0.305	0.0313	3	0.0417	65.4	2.50E-04
Cushion Manufacturer, Male	613	1	756644	19400	0.391	0.0313	3	0.0417	78.1	3.08E-04
Cushion Manufacturer, Female	613	1	756644	16900	0.305	0.0313	3	0.0417	65.4	2.50E-04
Furniture Manufacturer, Male	613	1	756644	19400	0.391	0.0313	3	0.0417	78.1	3.08E-04
Furniture Manufacturer, Female	613	1	756644	16900	0.305	0.0313	3	0.0417	65.4	2.50E-04
Carpet Pad Manufacturer, Male	613	1	756644	19400	0.391	0.0313	3	0.0417	78.1	3.08E-04
Carpet Pad Manufacturer, Female	613	1	756644	16900	0.305	0.0313	3	0.0417	65.4	2.50E-04
Carpet Installer, Male	613	1	756644	19400	0.391	0.0313	3	0.0417	78.1	3.08E-04
Carpet Installer, Female	613	1	756644	16900	0.305	0.0313	3	0.0417	65.4	2.50E-04
Distributor Covered, Male	613	1	756644	19400	0.391	0.0313	3	0.0417	78.1	3.08E-04
Distributor Covered, Female	613	1	756644	16900	0.305	0.0313	3	0.0417	65.4	2.50E-04
Distributor Uncovered, Male	613	1	756644	19400	0.391	0.0313	3	0.0417	78.1	3.08E-04
Distributor Uncovered, Female	613	1	756644	16900	0.305	0.0313	3	0.0417	65.4	2.50E-04
Recycler, Male	613	1	756644	19400	0.391	0.0313	3	0.0417	78.1	3.08E-04
Recycler, Female	613	1	756644	16900	0.305	0.0313	3	0.0417	65.4	2.50E-04

Hypothetical Exposure of Workers to the Commercial PentaBDE Product

Incidental Ingestion from Hand-to-Mouth Contact with Floor Surfaces Containing the Commercial Product Brought Home on Worker's Shoes

NON-CANCER

CDI = ((SAs * ARshoe) / FSA) * SAt * FSAftip * AFo * EFF * CF2 * 1/BW

HI = CDI / RfDo

	Cfloor Concentration									
	SAs	**ARshoe**	**FSA**	**SAt**	**FSAftip**	**AFo**	**EFF**	**CF2**	**BW**	**CDI**
Receptor	Fraction of Skin Surface Area that is Shoes	Adherence Rate of Commercial Product on Shoes	Floor Surface Area	Exposed Skin Surface Area, Total Body	Fraction of Skin Surface Area that Contacts Mouth	Absorption Factor, Oral Route	Exposure Frequency, Contact with Floors	Conversion Factor	Body Weight	Chronic Daily Intake
	cm2	mg/cm2-day	cm2	cm2	unitless	unitless	hr/day	day/hr	kg	mg/kg-day
Primary Production Drummer, Male	613	0.1	756644	19400	0.002	0.9	3	0.0417	78.1	4.53E-06
Primary Production Drummer, Female	613	0.1	756644	16900	0.002	0.9	3	0.0417	65.4	4.71E-06
Primary Production Cleaner, Male	613	0.1	756644	19400	0.002	0.9	3	0.0417	78.1	4.53E-06
Primary Production Cleaner, Female	613	0.1	756644	16900	0.002	0.9	3	0.0417	65.4	4.71E-06
Foam Manufacture Mixer, Male	613	0.1	756644	19400	0.002	0.9	3	0.0417	78.1	4.53E-06
Foam Manufacture Mixer, Female	613	0.1	756644	16900	0.002	0.9	3	0.0417	65.4	4.71E-06
Foam Manufacture Cutter, Male	613	1	756644	19400	0.002	0.9	3	0.0417	78.1	4.53E-05
Foam Manufacture Cutter, Female	613	1	756644	16900	0.002	0.9	3	0.0417	65.4	4.71E-05
Mattress Manufacturer, Male	613	1	756644	19400	0.002	0.9	3	0.0417	78.1	4.53E-05
Mattress Manufacturer, Female	613	1	756644	16900	0.002	0.9	3	0.0417	65.4	4.71E-05
Cushion Manufacturer, Male	613	1	756644	19400	0.002	0.9	3	0.0417	78.1	4.53E-05
Cushion Manufacturer, Female	613	1	756644	16900	0.002	0.9	3	0.0417	65.4	4.71E-05
Furniture Manufacturer, Male	613	1	756644	19400	0.002	0.9	3	0.0417	78.1	4.53E-05
Furniture Manufacturer, Female	613	1	756644	16900	0.002	0.9	3	0.0417	65.4	4.71E-05
Carpet Pad Manufacturer, Male	613	1	756644	19400	0.002	0.9	3	0.0417	78.1	4.53E-05
Carpet Pad Manufacturer, Female	613	1	756644	16900	0.002	0.9	3	0.0417	65.4	4.71E-05
Carpet Installer, Male	613	1	756644	19400	0.002	0.9	3	0.0417	78.1	4.53E-05
Carpet Installer, Female	613	1	756644	16900	0.002	0.9	3	0.0417	65.4	4.71E-05
Distributor Covered, Male	613	1	756644	19400	0.002	0.9	3	0.0417	78.1	4.53E-05
Distributor Covered, Female	613	1	756644	16900	0.002	0.9	3	0.0417	65.4	4.71E-05
Distributor Uncovered, Male	613	1	756644	19400	0.002	0.9	3	0.0417	78.1	4.53E-05
Distributor Uncovered, Female	613	1	756644	16900	0.002	0.9	3	0.0417	65.4	4.71E-05
Recycler, Male	613	1	756644	19400	0.002	0.9	3	0.0417	78.1	4.53E-05
Recycler, Female	613	1	756644	16900	0.002	0.9	3	0.0417	65.4	4.71E-05

Calculations for Hypothetical Exposure of Worker's Children to Commercial PentaBDE Product

Hypothetical Exposure of Worker's Children to the Commercial PentaBDE Product

Dermal Contact with Floor Surfaces Containing the Commercial Product Brought Home on Worker's Shoes

NON-CANCER

Cfloor = [(SAs * ARshoe)/FSA] from worker calculation for the highest theoretically exposed worker FPUF Cutter Worker)

CDI = Cfloor * SAt * FSAf * AFd * EFF * CF2 * 1/BW

HI = CDI / RfDo

Receptor	**Cfloor** Floor Concentration mg/cm2-day	**SAt** Exposed Skin Surface Area, Total Body cm2	**FSAf** Fraction of Skin Surface Area Exposed to Floor unitless	**AFd** Absorption Factor, Dermal Route unitless	**EFF** Exposure Frequency, Contact with Floors hr/day	**CF2** Conversion Factor day/hr	**BW** Body Weight kg	**CDI** Chronic Daily Intake mg/kg-day
<1 yr Child	8.10E-04	5910	0.3374	0.0313	3	0.0417	9.1	6.95E-04
1-2 yr Child	8.10E-04	5910	0.3415	0.0313	3	0.0417	11.3	5.66E-04
3-5 yr Child	8.10E-04	7200	0.3785	0.0313	3	0.0417	16.35	5.28E-04
6-8 yr Child	8.10E-04	9250	0.361	0.0313	3	0.0417	23.75	4.46E-04
9-11 yr Male Child	8.10E-04	11600	0.374	0.0313	3	0.0417	33.75	4.07E-04
9-11 yr Female Child	8.10E-04	11600	0.374	0.0313	3	0.0417	34	4.04E-04
12-14 yr Male Child	8.10E-04	14900	0.3825	0.0313	3	0.0417	47.05	3.84E-04
12-14 yr Female Child	8.10E-04	14800	0.383	0.0313	3	0.0417	48.65	3.69E-04
15-18 yr Male Child	8.10E-04	17500	0.403	0.0313	3	0.0417	64.93	3.44E-04
15-18 yr Female Child	8.10E-04	16000	0.403	0.0313	3	0.0417	57.6	3.55E-04

Hypothetical Exposure of Worker's Children to the Commercial PentaBDE Product

Incidental Ingestion from Hand-to-Mouth Contact with Floor Surfaces Containing the Commercial Product Brought Home on Worker

NON-CANCER

Cfloor = [(SAs * ARshoe)/FSA] from worker calculation for the highest theoretically exposed worker FPUF Cutter Worker)
CDI = Cfloor * SAt * FSAftip * AFo * EFF * CF2 * 1/BW
HI = CDI / RfDo

Receptor	**Cfloor** Floor Concentration	**SAt** Exposed Skin Surface Area, Total Body	**FSAftip** Fraction of Skin Surface Area that Contacts Mouth	**AFo** Absorption Factor, Oral Route	**EFF** Exposure Frequency, Contact with Floors	**CF2** Conversion Factor	**BW** Body Weight	**CDI** Chronic Daily Intake
	mg/cm2-day	cm2	unitless	unitless	hr/day	day/hr	kg	mg/kg-day
<1 yr Child	8.10E-04	5910	0.0030	0.9	3	0.0417	9.1	1.78E-04
1-2 yr Child	8.10E-04	5910	0.0030	0.9	3	0.0417	11.3	1.43E-04
3-5 yr Child	8.10E-04	7200	0.0030	0.9	3	0.0417	16.35	1.20E-04
6-8 yr Child	8.10E-04	9250	0.0030	0.9	3	0.0417	23.75	1.06E-04
9-11 yr Male Child	8.10E-04	11600	0.0030	0.9	3	0.0417	33.75	9.40E-05
9-11 yr Female Child	8.10E-04	11600	0.0030	0.9	3	0.0417	34	9.33E-05
12-14 yr Male Child	8.10E-04	14900	0.0030	0.9	3	0.0417	47.05	8.66E-05
12-14 yr Female Child	8.10E-04	14800	0.0030	0.9	3	0.0417	48.65	8.32E-05
15-18 yr Male Child	8.10E-04	17500	0.0020	0.9	3	0.0417	64.93	4.91E-05
15-18 yr Female Child	8.10E-04	16000	0.0020	0.9	3	0.0417	57.6	5.06E-05

Calculations for Hypothetical Exposure of Consumers to Commercial PentaBDE Product at Home

Hypothetical Exposure to the Commercial PentaBDE Product at Home

Inhalation of Respirable Particulates

NON-CANCER

CDI = AirP * CF1 * Fresp * InR * AFi * EFh * CF2 * 1/BW

HI = CDI / RfDi

Receptor	**AirP** Product Concentration in Particulate Phase at Home, School and Office	**CF1** Conversion Factor	**Fresp** Fraction of Particulate Phase that is Respirable	**InR** Inhalation Rate	**AFi** Absorption Factor, Inhalation Route	**EFh** Exposure Frequency at Home	**CF2** Conversion Factor	**BW** Body Weight	**CDI** Chronic Daily Intake
	ng/m3	mg/ng	unitless	m3/day	unitless	hr/day	day/hr	kg	mg/kg-day
<1 yr Child	1.3	1.E-06	0.5	4.5	0.75	24	0.0417	9.1	2.41E-07
1-2 yr Child	1.3	1.E-06	0.5	6.8	0.75	24	0.0417	11.3	2.93E-07
3-5 yr Child	1.3	1.E-06	0.5	8.3	0.75	20	0.0417	16.35	2.06E-07
6-8 yr Child	1.3	1.E-06	0.5	10	0.75	17	0.0417	23.75	1.45E-07
9-11 yr Male Child	1.3	1.E-06	0.5	14	0.75	17	0.0417	33.75	1.43E-07
9-11 yr Female Child	1.3	1.E-06	0.5	13	0.75	17	0.0417	34	1.32E-07
12-14 yr Male Child	1.3	1.E-06	0.5	15	0.75	17	0.0417	47.05	1.10E-07
12-14 yr Female Child	1.3	1.E-06	0.5	12	0.75	17	0.0417	48.65	8.52E-08
15-18 yr Male Child	1.3	1.E-06	0.5	17	0.75	17	0.0417	64.93	9.04E-08
15-18 yr Female Child	1.3	1.E-06	0.5	12	0.75	17	0.0417	57.6	7.19E-08
Adult Male (Prospective Parent)	1.3	1.E-06	0.5	15.2	0.75	24	0.0417	78.1	9.49E-08
Adult Female (Prospective Parent)	1.3	1.E-06	0.5	11.3	0.75	24	0.0417	65.4	8.42E-08

Hypothetical Exposure to the Commercial PentaBDE Product at Home

Ingestion of Particulates Inhaled and Swallowed

NON-CANCER

CDI = AirP * CF1 * (1 - Fresp) * InR * AFo * EFh * CF2 * 1/BW

HI = CDI / RfDo

Receptor	**AirP** Product Concentration in Particulate Phase at Home, School and Office	**CF1** Conversion Factor	**Fresp** Fraction of Particulate Phase that is Respirable	**InR** Inhalation Rate	**AFo** Absorption Factor, Oral Route	**EFh** Exposure Frequency at Home	**CF2** Conversion Factor	**BW** Body Weight	**CDI** Chronic Daily Intake
	ng/m3	mg/ng	unitless	m3/day	unitless	hr/day	day/hr	kg	mg/kg-day
<1 yr Child	1.3	1.E-06	0.5	4.5	0.9	24	0.0417	9.1	2.89E-07
1-2 yr Child	1.3	1.E-06	0.5	6.8	0.9	24	0.0417	11.3	3.52E-07
3-5 yr Child	1.3	1.E-06	0.5	8.3	0.9	20	0.0417	16.35	2.47E-07
6-8 yr Child	1.3	1.E-06	0.5	10	0.9	17	0.0417	23.75	1.74E-07
9-11 yr Male Child	1.3	1.E-06	0.5	14	0.9	17	0.0417	33.75	1.72E-07
9-11 yr Female Child	1.3	1.E-06	0.5	13	0.9	17	0.0417	34	1.58E-07
12-14 yr Male Child	1.3	1.E-06	0.5	15	0.9	17	0.0417	47.05	1.32E-07
12-14 yr Female Child	1.3	1.E-06	0.5	12	0.9	17	0.0417	48.65	1.02E-07
15-18 yr Male Child	1.3	1.E-06	0.5	17	0.9	17	0.0417	64.93	1.08E-07
15-18 yr Female Child	1.3	1.E-06	0.5	12	0.9	17	0.0417	57.6	8.63E-08
Adult Male (Prospective Parent)	1.3	1.E-06	0.5	15.2	0.9	24	0.0417	78.1	1.14E-07
Adult Female (Prospective Parent)	1.3	1.E-06	0.5	11.3	0.9	24	0.0417	65.4	1.01E-07

Hypothetical Exposure to the Commercial PentaBDE Product at Home

Dermal Contact with Indoor Dust

NON-CANCER

CDI = Cdust * CF1 * ARdust * SAt * FSAf * AFd * EFh * CF3 * 1/BW

HI = CDI / RfDo

Receptor	**Cdust** Product Concentration in Dust at Home, School and Office	**CF1** Conversion Factor	**ARdust** Adherence Rate of Dust to Skin	**SAt** Exposed Skin Surface Area, Total Body	**FSAf** Fraction of Skin Surface Area Exposed to Floor	**AFd** Absorption Factor, Dermal Route	**EFh** Exposure Frequency at Home	**CF3** Conversion Factor	**BW** Body Weight	**CDI** Chronic Daily Intake
	ng/g	g/ng	mg/cm2-day	cm2	unitless	unitless	hr/day	day/hr	kg	mg/kg-day
<1 yr Child	784	1.E-09	0.05	5910	0.337	0.0313	24	0.0417	9.1	2.69E-07
1-2 yr Child	784	1.E-09	0.05	5910	0.342	0.0313	24	0.0417	11.3	2.19E-07
3-5 yr Child	784	1.E-09	0.05	7200	0.379	0.0313	20	0.0417	16.35	1.70E-07
6-8 yr Child	784	1.E-09	0.07	9250	0.361	0.0313	17	0.0417	23.75	1.71E-07
9-11 yr Male Child	784	1.E-09	0.07	11600	0.374	0.0313	17	0.0417	33.75	1.56E-07
9-11 yr Female Child	784	1.E-09	0.07	11600	0.374	0.0313	17	0.0417	34	1.55E-07
12-14 yr Male Child	784	1.E-09	0.07	14900	0.383	0.0313	17	0.0417	47.05	1.47E-07
12-14 yr Female Child	784	1.E-09	0.07	14800	0.383	0.0313	17	0.0417	48.65	1.42E-07
15-18 yr Male Child	784	1.E-09	0.07	17500	0.403	0.0313	17	0.0417	64.93	1.32E-07
15-18 yr Female Child	784	1.E-09	0.07	16000	0.403	0.0313	17	0.0417	57.6	1.36E-07
Adult Male (Prospective Parent)	784	1.E-09	0.07	19400	0.319	0.0313	24	0.0417	78.1	1.36E-07
Adult Female (Prospective Parent)	784	1.E-09	0.07	16900	0.305	0.0313	24	0.0417	65.4	1.35E-07

Hypothetical Exposure to the Commercial PentaBDE Product at Home

Incidental Ingestion of Indoor Dust from Hand-to-Mouth Contact

NON-CANCER

CDI = Cdust * CF1 * DIR * AFo * EFh * CF2 * 1/BW

HI = CDI / RfDo

Receptor	**Cdust** Product Concentration in Dust at Home, School and Office	**CF1** Conversion Factor	**DIR** Indoor Dust Ingestion Rate	**AFo** Absorption Factor, Oral Route	**EFh** Exposure Frequency at Home	**CF2** Conversion Factor	**BW** Body Weight	**CDI** Chronic Daily Intake
	ng/g	g/ng	mg/day	unitless	hr/day	day/hr	kg	mg/kg-day
<1 yr Child	784	1.E-09	10	0.9	24	0.0417	9.1	7.75E-07
1-2 yr Child	784	1.E-09	10	0.9	24	0.0417	11.3	6.24E-07
3-5 yr Child	784	1.E-09	10	0.9	20	0.0417	16.35	3.60E-07
6-8 yr Child	784	1.E-09	3	0.9	17	0.0417	23.75	6.31E-08
9-11 yr Male Child	784	1.E-09	3	0.9	17	0.0417	33.75	4.44E-08
9-11 yr Female Child	784	1.E-09	3	0.9	17	0.0417	34	4.41E-08
12-14 yr Male Child	784	1.E-09	3	0.9	17	0.0417	47.05	3.19E-08
12-14 yr Female Child	784	1.E-09	3	0.9	17	0.0417	48.65	3.08E-08
15-18 yr Male Child	784	1.E-09	3	0.9	17	0.0417	64.93	2.31E-08
15-18 yr Female Child	784	1.E-09	3	0.9	17	0.0417	57.6	2.60E-08
Adult Male (Prospective Parent)	784	1.E-09	0.56	0.9	24	0.0417	78.1	5.06E-09
Adult Female (Prospective Parent)	784	1.E-09	0.56	0.9	24	0.0417	65.4	6.04E-09

Hypothetical Exposure to the Commercial PentaBDE Product at Home

Ingestion from Mouthing a FPUF Cushion Treated with the Commercial PentaBDE Product

NON-CANCER

CDI = WS * Vs * CF1 * CF2 * FR * AFo * EFmouth * 1/BW

HI = CDI / RfDo

Receptor	WS	Vs	CF1	CF2	FR	AFo	EFmouth	BW	CDI
	Water Solubility Limit	Salivary Flow-rate in the Child's Mouth	Conversion Factor	Conversion Factor	Fractional Rate of Extraction by Saliva	Absorption Factor, Oral Route	Exposure Frequency Mouthing All Items	Body Weight	Chronic Daily Intake
	µg/L	ml/minute	mg/µg	L/ml	unitless	unitless	minutes/day	kg	mg/kg-day
<1 yr Child	14	0.038	0.001	0.001	0.038	0.9	9	9.1	1.80E-08
1-2 yr Child	14	0.038	0.001	0.001	0.038	0.9	6	11.3	8.86E-09
3-5 yr Child	14	0.038	0.001	0.001	0.038	0.9	2	16.35	2.23E-09

Calculations for Hypothetical Exposure of Consumers to Commercial PentaBDE Product at School

Hypothetical Exposure to the Commercial PentaBDE Product at School

Inhalation of Respirable Particulates

NON-CANCER

CDI = AirP * CF1 * Fresp * InR * AFi * EFs * CF2 * 1/BW

HI = CDI / RfDi

Receptor	**AirP** Product Concentration in Particulate Phase at Home, School and Office	**CF1** Conversion Factor	**Fresp** Fraction of Particulate Phase that is Respirable	**InR** Inhalation Rate	**AFi** Absorption Factor, Inhalation Route	**EFs** Exposure Frequency at School	**CF2** Conversion Factor	**BW** Body Weight	**CDI** Chronic Daily Intake
	ng/m3	mg/ng	unitless	m3/day	unitless	hr/day	day/hr	kg	mg/kg-day
<1 yr Child	1.3	1.E-06	0.5	4.5	0.75	0	0.0417	9.1	0
1-2 yr Child	1.3	1.E-06	0.5	6.8	0.75	0	0.0417	11.3	0
3-5 yr Child	1.3	1.E-06	0.5	8.3	0.75	4	0.0417	16.35	4.12E-08
6-8 yr Child	1.3	1.E-06	0.5	10	0.75	7	0.0417	23.75	5.99E-08
9-11 yr Male Child	1.3	1.E-06	0.5	14	0.75	7	0.0417	33.75	5.90E-08
9-11 yr Female Child	1.3	1.E-06	0.5	13	0.75	7	0.0417	34	5.44E-08
12-14 yr Male Child	1.3	1.E-06	0.5	15	0.75	7	0.0417	47.05	4.53E-08
12-14 yr Female Child	1.3	1.E-06	0.5	12	0.75	7	0.0417	48.65	3.51E-08
15-18 yr Male Child	1.3	1.E-06	0.5	17	0.75	7	0.0417	64.93	3.72E-08
15-18 yr Female Child	1.3	1.E-06	0.5	12	0.75	7	0.0417	57.6	2.96E-08
Adult Male (Prospective Parent)	1.3	1.E-06	0.5	15.2	0.75	8	0.0417	78.1	3.16E-08
Adult Female (Prospective Parent)	1.3	1.E-06	0.5	11.3	0.75	8	0.0417	65.4	2.81E-08

Hypothetical Exposure to the Commercial PentaBDE Product at School

Ingestion of Particulates Inhaled and Swallowed

NON-CANCER

CDI = AirP * CF1 * (1 - Fresp) * InR * AFo * EFs * CF2 * 1/BW

HI = CDI / RfDo

Receptor	AirP Product Concentration in Particulate Phase at Home, School and Office ng/m3	CF1 Conversion Factor mg/ng	Fresp Fraction of Particulate Phase that is Respirable unitless	InR Inhalation Rate m3/day	AFo Absorption Factor, Oral Route unitless	EFs Exposure Frequency at School hr/day	CF2 Conversion Factor day/hr	BW Body Weight kg	CDI Chronic Daily Intake mg/kg-day
<1 yr Child	1.3	1.E-06	0.5	4.5	0.9	0	0.0417	9.1	0
1-2 yr Child	1.3	1.E-06	0.5	6.8	0.9	0	0.0417	11.3	0
3-5 yr Child	1.3	1.E-06	0.5	8.3	0.9	4	0.0417	16.35	4.95E-08
6-8 yr Child	1.3	1.E-06	0.5	10	0.9	7	0.0417	23.75	7.18E-08
9-11 yr Male Child	1.3	1.E-06	0.5	14	0.9	7	0.0417	33.75	7.08E-08
9-11 yr Female Child	1.3	1.E-06	0.5	13	0.9	7	0.0417	34	6.52E-08
12-14 yr Male Child	1.3	1.E-06	0.5	15	0.9	7	0.0417	47.05	5.44E-08
12-14 yr Female Child	1.3	1.E-06	0.5	12	0.9	7	0.0417	48.65	4.21E-08
15-18 yr Male Child	1.3	1.E-06	0.5	17	0.9	7	0.0417	64.93	4.47E-08
15-18 yr Female Child	1.3	1.E-06	0.5	12	0.9	7	0.0417	57.6	3.55E-08
Adult Male (Prospective Parent)	1.3	1.E-06	0.5	15.2	0.9	8	0.0417	78.1	3.80E-08
Adult Female (Prospective Parent)	1.3	1.E-06	0.5	11.3	0.9	8	0.0417	65.4	3.37E-08

Hypothetical Exposure to the Commercial PentaBDE Product at School

Dermal Contact with Indoor Dust

NON-CANCER

CDI = Cdust * CF1 * ARdust * SAt * FSAs * AFd * EFs * CF3 * 1/BW

HI = CDI / RfDo

Receptor	**Cdust** Product Concentration in Dust at Home, School and Office	**CF1** Conversion Factor	**ARdust** Adherence Rate of Dust to Skin	**SAt** Exposed Skin Surface Area, Total Body	**FSAs** Fraction of Skin Surface Area Exposed at School	**AFd** Absorption Factor, Dermal Route	**EFs** Exposure Frequency at School	**CF3** Conversion Factor	**BW** Body Weight	**CDI** Chronic Daily Intake
	ng/g	g/ng	mg/cm2-day	cm2	unitless	unitless	hr/day	day/hr	kg	mg/kg-day
<1 yr Child	784	1.E-09	0.05	5910	0.272	0.0313	0	0.0417	9.1	0
1-2 yr Child	784	1.E-09	0.05	5910	0.279	0.0313	0	0.0417	11.3	0
3-5 yr Child	784	1.E-09	0.05	7200	0.306	0.0313	4	0.0417	16.35	2.76E-08
6-8 yr Child	784	1.E-09	0.07	9250	0.289	0.0313	7	0.0417	23.75	5.64E-08
9-11 yr Male Child	784	1.E-09	0.07	11600	0.301	0.0313	7	0.0417	33.75	5.18E-08
9-11 yr Female Child	784	1.E-09	0.07	11600	0.301	0.0313	7	0.0417	34	5.15E-08
12-14 yr Male Child	784	1.E-09	0.07	14900	0.308	0.0313	7	0.0417	47.05	4.88E-08
12-14 yr Female Child	784	1.E-09	0.07	14800	0.308	0.0313	7	0.0417	48.65	4.69E-08
15-18 yr Male Child	784	1.E-09	0.07	17500	0.332	0.0313	7	0.0417	64.93	4.48E-08
15-18 yr Female Child	784	1.E-09	0.07	16000	0.332	0.0313	7	0.0417	57.6	4.62E-08
Adult Male (Prospective Parent)	784	1.E-09	0.07	19400	0.251	0.0313	8	0.0417	78.1	3.57E-08
Adult Female (Prospective Parent)	784	1.E-09	0.07	16900	0.238	0.0313	8	0.0417	65.4	3.52E-08

Hypothetical Exposure to the Commercial PentaBDE Product at School

Incidental Ingestion of Indoor Dust from Hand-to-Mouth Contact

NON-CANCER

CDI = Cdust * CF1 * DIR * AFo * EFs * CF2 * 1/BW

HI = CDI / RfDo

Receptor	**Cdust** Product Concentration in Dust at Home, School and Office	**CF1** Conversion Factor	**DIR** Indoor Dust Ingestion Rate	**AFo** Absorption Factor, Oral Route	**EFs** Exposure Frequency at School	**CF2** Conversion Factor	**BW** Body Weight	**CDI** Chronic Daily Intake
	ng/g	g/ng	mg/day	unitless	hr/day	day/hr	kg	mg/kg-day
<1 yr Child	784	1.E-09	10	0.9	0	0.0417	9.1	0
1-2 yr Child	784	1.E-09	10	0.9	0	0.0417	11.3	0
3-5 yr Child	784	1.E-09	10	0.9	4	0.0417	16.35	7.19E-08
6-8 yr Child	784	1.E-09	3	0.9	7	0.0417	23.75	2.60E-08
9-11 yr Male Child	784	1.E-09	3	0.9	7	0.0417	33.75	1.83E-08
9-11 yr Female Child	784	1.E-09	3	0.9	7	0.0417	34	1.82E-08
12-14 yr Male Child	784	1.E-09	3	0.9	7	0.0417	47.05	1.31E-08
12-14 yr Female Child	784	1.E-09	3	0.9	7	0.0417	48.65	1.27E-08
15-18 yr Male Child	784	1.E-09	3	0.9	7	0.0417	64.93	9.51E-09
15-18 yr Female Child	784	1.E-09	3	0.9	7	0.0417	57.6	1.07E-08
Adult Male (Prospective Parent)	784	1.E-09	0.56	0.9	8	0.0417	78.1	1.69E-09
Adult Female (Prospective Parent)	784	1.E-09	0.56	0.9	8	0.0417	65.4	2.01E-09

Calculations for Hypothetical Exposure of Consumers to Commercial PentaBDE Product at Office

Hypothetical Exposure to the Commercial PentaBDE Product in Office Environments

Inhalation of Respirable Particulates

NON-CANCER

CDI = AirP * CF1 * Fresp * InR * AFi * EFo * CF2 * 1/BW

HI = CDI / RfDi

Receptor	**AirP** Product Concentration in Particulate Phase at Home, School and Office	**CF1** Conversion Factor	**Fresp** Fraction of Particulate Phase that is Respirable	**InR** Inhalation Rate	**AFi** Absorption Factor, Inhalation Route	**EFo** Exposure Frequency at Office	**CF2** Conversion Factor	**BW** Body Weight	**CDI** Chronic Daily Intake
	ng/m3	mg/ng	unitless	m3/day	unitless	hr/day	day/hr	kg	mg/kg-day
<1 yr Child	1.3	1.E-06	0.5	4.5	0.75	0	0.0417	9.1	0
1-2 yr Child	1.3	1.E-06	0.5	6.8	0.75	0	0.0417	11.3	0
3-5 yr Child	1.3	1.E-06	0.5	8.3	0.75	0	0.0417	16.4	0
6-8 yr Child	1.3	1.E-06	0.5	10	0.75	0	0.0417	23.8	0
9-11 yr Male Child	1.3	1.E-06	0.5	14	0.75	0	0.0417	33.8	0
9-11 yr Female Child	1.3	1.E-06	0.5	13	0.75	0	0.0417	34.0	0
12-14 yr Male Child	1.3	1.E-06	0.5	15	0.75	0	0.0417	47.1	0
12-14 yr Female Child	1.3	1.E-06	0.5	12	0.75	0	0.0417	48.7	0
15-18 yr Male Child	1.3	1.E-06	0.5	17	0.75	0	0.0417	64.9	0
15-18 yr Female Child	1.3	1.E-06	0.5	12	0.75	0	0.0417	57.6	0
Adult Male (Prospective Parent)	1.3	1.E-06	0.5	15.2	0.75	8	0.0417	78.1	3.16E-08
Adult Female (Prospective Parent)	1.3	1.E-06	0.5	11.3	0.75	8	0.0417	65.4	2.81E-08

Hypothetical Exposure to the Commercial PentaBDE Product in Office Environments

Ingestion of Particulates Inhaled and Swallowed

NON-CANCER

CDI = AirP * CF1 * (1 - Fresp) * InR * AFo * EFo * CF2 * 1/BW

HI = CDI / RfDo

Receptor	AirP Product Concentration in Particulate Phase at Home, School and Office ng/m3	CF1 Conversion Factor mg/ng	Fresp Fraction of Particulate Phase that is Respirable unitless	InR Inhalation Rate m3/day	AFo Absorption Factor, Oral Route unitless	EFo Exposure Frequency at Office hr/day	CF2 Conversion Factor day/hr	BW Body Weight kg	CDI Chronic Daily Intake mg/kg-day
<1 yr Child	1.3	1.E-06	0.5	4.5	0.9	0	0.0417	9.1	0
1-2 yr Child	1.3	1.E-06	0.5	6.8	0.9	0	0.0417	11.3	0
3-5 yr Child	1.3	1.E-06	0.5	8.3	0.9	0	0.0417	16.4	0
6-8 yr Child	1.3	1.E-06	0.5	10	0.9	0	0.0417	23.8	0
9-11 yr Male Child	1.3	1.E-06	0.5	14	0.9	0	0.0417	33.8	0
9-11 yr Female Child	1.3	1.E-06	0.5	13	0.9	0	0.0417	34.0	0
12-14 yr Male Child	1.3	1.E-06	0.5	15	0.9	0	0.0417	47.1	0
12-14 yr Female Child	1.3	1.E-06	0.5	12	0.9	0	0.0417	48.7	0
15-18 yr Male Child	1.3	1.E-06	0.5	17	0.9	0	0.0417	64.9	0
15-18 yr Female Child	1.3	1.E-06	0.5	12	0.9	0	0.0417	57.6	0
Adult Male (Prospective Parent)	1.3	1.E-06	0.5	15.2	0.9	8	0.0417	78.1	3.80E-08
Adult Female (Prospective Parent)	1.3	1.E-06	0.5	11.3	0.9	8	0.0417	65.4	3.37E-08

Hypothetical Exposure to the Commercial PentaBDE Product in Office Environments

Dermal Contact with Indoor Dust

NON-CANCER

CDI = Cdust * CF1 * ARdust * SAt * FSAo * AFd * EFo * CF3 * 1/BW

HI = CDI / RfDo

Receptor	**Cdust** Product Concentration in Dust at Home, School and Office	**CF1** Conversion Factor	**ARdust** Adherence Rate of Dust to Skin	**SAt** Exposed Skin Surface Area, Total Body	**FSAo** Fraction of Skin Surface Area Exposed at Office	**AFd** Absorption Factor, Dermal Route	**EFo** Exposure Frequency at Office	**CF3** Conversion Factor	**BW** Body Weight	**CDI** Chronic Daily Intake
	ng/g	g/ng	mg/cm2-day	cm2	unitless	unitless	hr/day	day/hr	kg	mg/kg-day
<1 yr Child	784	1.E-09	0.05	5910	--	0.0313	0	0.0417	9.1	0
1-2 yr Child	784	1.E-09	0.05	5910	--	0.0313	0	0.0417	11.3	0
3-5 yr Child	784	1.E-09	0.05	7200	--	0.0313	0	0.0417	16.4	0
6-8 yr Child	784	1.E-09	0.07	9250	--	0.0313	0	0.0417	23.8	0
9-11 yr Male Child	784	1.E-09	0.07	11600	--	0.0313	0	0.0417	33.8	0
9-11 yr Female Child	784	1.E-09	0.07	11600	--	0.0313	0	0.0417	34.0	0
12-14 yr Male Child	784	1.E-09	0.07	14900	--	0.0313	0	0.0417	47.1	0
12-14 yr Female Child	784	1.E-09	0.07	14800	--	0.0313	0	0.0417	48.7	0
15-18 yr Male Child	784	1.E-09	0.07	17500	--	0.0313	0	0.0417	64.9	0
15-18 yr Female Child	784	1.E-09	0.07	16000	--	0.0313	0	0.0417	57.6	0
Adult Male (Prospective Parent)	784	1.E-09	0.07	19400	0.119	0.0313	8	0.0417	78.1	1.69E-08
Adult Female (Prospective Parent)	784	1.E-09	0.07	16900	0.109	0.0313	8	0.0417	65.4	1.61E-08

Hypothetical Exposure to the Commercial PentaBDE Product in Office Environments

Incidental Ingestion of Indoor Dust from Hand-to-Mouth Contact

NON-CANCER

CDI = Cdust * CF1 * DIR * AFo * EFo * CF2 * 1/BW

HI = CDI / RfDo

Receptor	**Cdust** Product Concentration in Dust at Home, School and Office	**CF1** Conversion Factor	**DIR** Indoor Dust Ingestion Rate	**AFo** Absorption Factor, Oral Route	**EFo** Exposure Frequency at Office	**CF2** Conversion Factor	**BW** Body Weight	**CDI** Chronic Daily Intake
	ng/g	g/ng	mg/day	unitless	hr/day	day/hr	kg	mg/kg-day
<1 yr Child	784	1.E-09	10	0.9	0	0.0417	9.1	0
1-2 yr Child	784	1.E-09	10	0.9	0	0.0417	11.3	0
3-5 yr Child	784	1.E-09	10	0.9	0	0.0417	16.35	0
6-8 yr Child	784	1.E-09	3	0.9	0	0.0417	23.75	0
9-11 yr Male Child	784	1.E-09	3	0.9	0	0.0417	33.75	0
9-11 yr Female Child	784	1.E-09	3	0.9	0	0.0417	34	0
12-14 yr Male Child	784	1.E-09	3	0.9	0	0.0417	47.05	0
12-14 yr Female Child	784	1.E-09	3	0.9	0	0.0417	48.65	0
15-18 yr Male Child	784	1.E-09	3	0.9	0	0.0417	64.93	0
15-18 yr Female Child	784	1.E-09	3	0.9	0	0.0417	57.6	0
Adult Male (Prospective Parent)	784	1.E-09	0.56	0.9	8	0.0417	78.1	1.69E-09
Adult Female (Prospective Parent)	784	1.E-09	0.56	0.9	8	0.0417	65.4	2.01E-09

Calculations for Hypothetical Exposure in Ambient Environments to Commercial PentaBDE Product

Hypothetical Exposure to the Commercial PentaBDE Product in Ambient Environments

Inhalation of Respirable Particulates

NON-CANCER

CDI = AirP * CF * Fresp * InR * AFi * 1/BW

HI = CDI / RfDi

Receptor	**AirP** Air Concentration of Product in Particulate Phase	**CF** Conversion Factor	**Fresp** Fraction of Particulate Phase that is Respirable	**InR** Inhalation Rate	**AFi** Absorption Factor, Inhalation Route	**BW** Body Weight	**CDI** Chronic Daily Intake
	pg/m3	mg/pg	unitless	m3/day	unitless	kg	mg/kg-day
<1 yr Child	52	1.E-09	0.5	4.5	0.75	9.1	9.64E-09
1-2 yr Child	52	1.E-09	0.5	6.8	0.75	11.3	1.17E-08
3-5 yr Child	52	1.E-09	0.5	8.3	0.75	16.35	9.90E-09
6-8 yr Child	52	1.E-09	0.5	10	0.75	23.75	8.21E-09
9-11 yr Male Child	52	1.E-09	0.5	14	0.75	33.75	8.09E-09
9-11 yr Female Child	52	1.E-09	0.5	13	0.75	34	7.46E-09
12-14 yr Male Child	52	1.E-09	0.5	15	0.75	47.05	6.22E-09
12-14 yr Female Child	52	1.E-09	0.5	12	0.75	48.65	4.81E-09
15-18 yr Male Child	52	1.E-09	0.5	17	0.75	64.93	5.11E-09
15-18 yr Female Child	52	1.E-09	0.5	12	0.75	57.6	4.06E-09
Adult Male (Prospective Parent)	52	1.E-09	0.5	15.2	0.75	78.1	3.80E-09
Adult Female (Prospective Parent)	52	1.E-09	0.5	11.3	0.75	65.4	3.37E-09

Hypothetical Exposure to the Commercial PentaBDE Product in Ambient Environments

Ingestion of Particulates Inhaled and Swallowed

NON-CANCER

CDI = AirP * CF * (1 - Fresp) * InR * AFo * 1/BW

HI = CDI / RfDo

Receptor	**AirP** Air Concentration of Product in Particulate Phase	**CF** Conversion Factor	**Fresp** Fraction of Particulate Phase that is Respirable	**InR** Inhalation Rate	**AFo** Absorption Factor, Oral Route	**BW** Body Weight	**CDI** Chronic Daily Intake
	pg/m3	mg/pg	unitless	m3/day	unitless	kg	mg/kg-day
<1 yr Child	52	1.E-09	0.5	4.5	0.9	9.1	1.16E-08
1-2 yr Child	52	1.E-09	0.5	6.8	0.9	11.3	1.41E-08
3-5 yr Child	52	1.E-09	0.5	8.3	0.9	16.35	1.19E-08
6-8 yr Child	52	1.E-09	0.5	10	0.9	23.75	9.85E-09
9-11 yr Male Child	52	1.E-09	0.5	14	0.9	33.75	9.71E-09
9-11 yr Female Child	52	1.E-09	0.5	13	0.9	34	8.95E-09
12-14 yr Male Child	52	1.E-09	0.5	15	0.9	47.05	7.46E-09
12-14 yr Female Child	52	1.E-09	0.5	12	0.9	48.65	5.77E-09
15-18 yr Male Child	52	1.E-09	0.5	17	0.9	64.93	6.13E-09
15-18 yr Female Child	52	1.E-09	0.5	12	0.9	57.6	4.88E-09
Adult Male (Prospective Parent)	52	1.E-09	0.5	15.2	0.9	78.1	4.55E-09
Adult Female (Prospective Parent)	52	1.E-09	0.5	11.3	0.9	65.4	4.04E-09

Hypothetical Exposure to the Commercial PentaBDE Product in Ambient Environments

Dermal Contact with Soil

NON-CANCER

CDI = Csoil * CF1 * SAR * SAt * FSAout * AFd * 1/BW

HI = CDI / RfDo

Receptor	**Csoil** Concentration in Soil	**CF1** Conversion Factor	**SAR** Soil Adherence to Skin Rate	**SAt** Exposed Skin Surface Area, Total Body	**FSAout** Fraction of Skin Surface Area Exposed Outdoors	**AFd** Absorption Factor, Dermal Route	**BW** Body Weight	**CDI** Chronic Daily Intake
	µg/kg	kg/µg	mg/cm2-day	cm2	unitless	unitless	kg	mg/kg-day
<1 yr Child	76	1.E-09	0.2	5910	0.337	0.0313	9.1	1.04E-07
1-2 yr Child	76	1.E-09	0.2	5910	0.342	0.0313	11.3	8.50E-08
3-5 yr Child	76	1.E-09	0.2	7200	0.379	0.0313	16.35	7.93E-08
6-8 yr Child	76	1.E-09	0.07	9250	0.361	0.0313	23.75	2.34E-08
9-11 yr Male Child	76	1.E-09	0.07	11600	0.374	0.0313	33.75	2.14E-08
9-11 yr Female Child	76	1.E-09	0.07	11600	0.374	0.0313	34	2.12E-08
12-14 yr Male Child	76	1.E-09	0.07	14900	0.383	0.0313	47.05	2.02E-08
12-14 yr Female Child	76	1.E-09	0.07	14800	0.383	0.0313	48.65	1.94E-08
15-18 yr Male Child	76	1.E-09	0.07	17500	0.403	0.0313	64.93	1.81E-08
15-18 yr Female Child	76	1.E-09	0.07	16000	0.403	0.0313	57.6	1.86E-08
Adult Male (Prospective Parent)	76	1.E-09	0.07	19400	0.319	0.0313	78.1	1.32E-08
Adult Female (Prospective Parent)	76	1.E-09	0.07	16900	0.305	0.0313	65.4	1.31E-08

Hypothetical Exposure to the Commercial PentaBDE Product in Ambient Environments

Incidental Ingestion of Soil from Hand-to-Mouth Contact

NON-CANCER

CDI = Csoil * CF * SIR * AFo * 1/BW

HI = CDI / RfDo

Receptor	**Csoil** Concentration in Soil	**CF** Conversion Factor	**SIR** Soil Ingestion Rate	**AFo** Absorption Factor, Oral Route	**BW** Body Weight	**CDI** Chronic Daily Intake
	µg/kg	kg/µg	mg/day	unitless	kg	mg/kg-day
<1 yr Child	76	1.E-09	200	0.9	9.1	1.50E-06
1-2 yr Child	76	1.E-09	200	0.9	11.3	1.21E-06
3-5 yr Child	76	1.E-09	200	0.9	16.35	8.37E-07
6-8 yr Child	76	1.E-09	200	0.9	23.75	5.76E-07
9-11 yr Male Child	76	1.E-09	200	0.9	33.75	4.05E-07
9-11 yr Female Child	76	1.E-09	200	0.9	34	4.02E-07
12-14 yr Male Child	76	1.E-09	200	0.9	47.05	2.91E-07
12-14 yr Female Child	76	1.E-09	200	0.9	48.65	2.81E-07
15-18 yr Male Child	76	1.E-09	200	0.9	64.93	2.11E-07
15-18 yr Female Child	76	1.E-09	200	0.9	57.6	2.38E-07
Adult Male (Prospective Parent)	76	1.E-09	100	0.9	78.1	8.76E-08
Adult Female (Prospective Parent)	76	1.E-09	100	0.9	65.4	1.05E-07

Hypothetical Exposure to the Commercial PentaBDE Product in Ambient Environments

Consumption of Fish

NON-CANCER

CDI = Cfish * CF * CRfish * AFo * 1/BW

HI = CDI / RfDo

Receptor	**Cfish** Concentration in Fish	**CF** Conversion Factor	**CRfish** Fish Consumption Rate	**AFo** Absorption Factor, Oral Route	**BW** Body Weight	**CDI** Chronic Daily Intake
	ng/g wet wt	mg/ng	g/day	unitless	kg	mg/kg-day
<1 yr Child	71.67	1.E-06	1.001	0.9	9.1	7.10E-06
1-2 yr Child	71.67	1.E-06	4.181	0.9	11.3	2.39E-05
3-5 yr Child	71.67	1.E-06	5.232	0.9	16.35	2.06E-05
6-8 yr Child	71.67	1.E-06	6.175	0.9	23.75	1.68E-05
9-11 yr Male Child	71.67	1.E-06	8.775	0.9	33.75	1.68E-05
9-11 yr Female Child	71.67	1.E-06	8.84	0.9	34	1.68E-05
12-14 yr Male Child	71.67	1.E-06	9.41	0.9	47.05	1.29E-05
12-14 yr Female Child	71.67	1.E-06	9.73	0.9	48.65	1.29E-05
15-18 yr Male Child	71.67	1.E-06	12.986	0.9	64.93	1.29E-05
15-18 yr Female Child	71.67	1.E-06	11.52	0.9	57.6	1.29E-05
Adult Male (Prospective Parent)	71.67	1.E-06	20.1	0.9	78.1	1.66E-05
Adult Female (Prospective Parent)	71.67	1.E-06	20.1	0.9	65.4	1.98E-05
Recreational Marine Angler Adult Male	71.67	1.E-06	7.2	0.9	78.1	5.95E-06
Recreational Marine Angler Adult Female	71.67	1.E-06	7.2	0.9	65.4	7.10E-06
Recreational Freshwater Angler Adult Male	71.67	1.E-06	17	0.9	78.1	1.40E-05
Recreational Freshwater Angler Adult Female	71.67	1.E-06	17	0.9	65.4	1.68E-05

Hypothetical Exposure to the Commercial PentaBDE Product in Ambient Environments

Consumption of Meat (Beef, Poultry and Pork)

NON-CANCER

CDI = Cmeat * CF * CRmeat * AFo * 1/BW

HI = CDI / RfDo

Receptor	**Cmeat** Concentration in Meat (Beef, Poultry and Pork)	**CF** Conversion Factor	**CRmeat** Meat (Beef, Poultry and Pork) Consumption Rate	**AFo** Absorption Factor, Oral Route	**BW** Body Weight	**CDI** Chronic Daily Intake
	ng/g wet wt	mg/ng	g/day	unitless	kg	mg/kg-day
<1 yr Child	0.0458	1.E-06	53.69	0.9	9.1	2.43E-07
1-2 yr Child	0.0458	1.E-06	115.26	0.9	11.3	4.20E-07
3-5 yr Child	0.0458	1.E-06	153.69	0.9	16.35	3.87E-07
6-8 yr Child	0.0458	1.E-06	161.5	0.9	23.75	2.80E-07
9-11 yr Male Child	0.0458	1.E-06	229.5	0.9	33.75	2.80E-07
9-11 yr Female Child	0.0458	1.E-06	231.2	0.9	34	2.80E-07
12-14 yr Male Child	0.0458	1.E-06	230.545	0.9	47.05	2.02E-07
12-14 yr Female Child	0.0458	1.E-06	238.385	0.9	48.65	2.02E-07
15-18 yr Male Child	0.0458	1.E-06	318.157	0.9	64.93	2.02E-07
15-18 yr Female Child	0.0458	1.E-06	282.24	0.9	57.6	2.02E-07
Adult Male (Prospective Parent)	0.0458	1.E-06	398.31	0.9	78.1	2.10E-07
Adult Female (Prospective Parent)	0.0458	1.E-06	333.54	0.9	65.4	2.10E-07

Hypothetical Exposure to the Commercial PentaBDE Product in Ambient Environments

Consumption of Dairy

NON-CANCER

CDI = Cdairy * CF * CRdairy * AFo * 1/BW

HI = CDI / RfDo

Receptor	**Cdairy** Concentration in Dairy	**CF** Conversion Factor	**CRdairy** Dairy Consumption Rate	**AFo** Absorption Factor, Oral Route	**BW** Body Weight	**CDI** Chronic Daily Intake
	ng/g wet wt	mg/ng	g/day	unitless	kg	mg/kg-day
<1 yr Child	0.0182	1.E-06	2138.5	0.9	9.1	3.85E-06
1-2 yr Child	0.0182	1.E-06	1019.26	0.9	11.3	1.48E-06
3-5 yr Child	0.0182	1.E-06	797.88	0.9	16.35	7.99E-07
6-8 yr Child	0.0182	1.E-06	795.625	0.9	23.75	5.49E-07
9-11 yr Male Child	0.0182	1.E-06	1130.625	0.9	33.75	5.49E-07
9-11 yr Female Child	0.0182	1.E-06	1139	0.9	34	5.49E-07
12-14 yr Male Child	0.0182	1.E-06	837.49	0.9	47.05	2.92E-07
12-14 yr Female Child	0.0182	1.E-06	865.97	0.9	48.65	2.92E-07
15-18 yr Male Child	0.0182	1.E-06	1155.754	0.9	64.93	2.92E-07
15-18 yr Female Child	0.0182	1.E-06	1025.28	0.9	57.6	2.92E-07
Adult Male (Prospective Parent)	0.0182	1.E-06	2319.57	0.9	78.1	4.86E-07
Adult Female (Prospective Parent)	0.0182	1.E-06	1942.38	0.9	65.4	4.86E-07

Hypothetical Exposure to the Commercial PentaBDE Product in Ambient Environments

Consumption of Other Fats and Oils

NON-CANCER
CDI = Cfat * CF * CRfat * AFo * 1/BW
HI = CDI / RfDo

Receptor	**Cfat** Concentration in Other Fats and Oils	**CF** Conversion Factor	**CRfat** Other Fats and Oils Consumption Rate	**AFo** Absorption Factor, Oral Route	**BW** Body Weight	**CDI** Chronic Daily Intake
	ng/g wet wt	mg/ng	g/day	unitless	kg	mg/kg-day
<1 yr Child	0.158	1.E-06	3.3	0.9	9.1	5.16E-08
1-2 yr Child	0.158	1.E-06	16	0.9	11.3	2.01E-07
3-5 yr Child	0.158	1.E-06	22	0.9	16.35	1.91E-07
6-8 yr Child	0.158	1.E-06	30	0.9	23.75	1.80E-07
9-11 yr Male Child	0.158	1.E-06	30	0.9	33.75	1.26E-07
9-11 yr Female Child	0.158	1.E-06	30	0.9	34	1.25E-07
12-14 yr Male Child	0.158	1.E-06	49	0.9	47.05	1.48E-07
12-14 yr Female Child	0.158	1.E-06	49	0.9	48.65	1.43E-07
15-18 yr Male Child	0.158	1.E-06	49	0.9	64.93	1.07E-07
15-18 yr Female Child	0.158	1.E-06	49	0.9	57.6	1.21E-07
Adult Male (Prospective Parent)	0.158	1.E-06	118.28	0.9	78.1	2.15E-07
Adult Female (Prospective Parent)	0.158	1.E-06	76.52	0.9	65.4	1.66E-07

Hypothetical Exposure to the Commercial PentaBDE Product in Ambient Environments

Consumption of Eggs

NON-CANCER

CDI = Cegg * CF * CRegg * AFo * 1/BW

HI = CDI / RfDo

Receptor	**Cegg** Concentration in Eggs	**CF** Conversion Factor	**CRegg** Egg Consumption Rate	**AFo** Absorption Factor, Oral Route	**BW** Body Weight	**CDI** Chronic Daily Intake
	ng/g wet wt	mg/ng	g/day	unitless	kg	mg/kg-day
<1 yr Child	0.0425	1.E-06	38	0.9	9.1	1.60E-07
1-2 yr Child	0.0425	1.E-06	70	0.9	11.3	2.37E-07
3-5 yr Child	0.0425	1.E-06	63	0.9	16.35	1.47E-07
6-8 yr Child	0.0425	1.E-06	66	0.9	23.75	1.06E-07
9-11 yr Male Child	0.0425	1.E-06	66	0.9	33.75	7.48E-08
9-11 yr Female Child	0.0425	1.E-06	66	0.9	34	7.43E-08
12-14 yr Male Child	0.0425	1.E-06	88	0.9	47.05	7.15E-08
12-14 yr Female Child	0.0425	1.E-06	88	0.9	48.65	6.92E-08
15-18 yr Male Child	0.0425	1.E-06	88	0.9	64.93	5.18E-08
15-18 yr Female Child	0.0425	1.E-06	88	0.9	57.6	5.84E-08
Adult Male (Prospective Parent)	0.0425	1.E-06	83	0.9	78.1	4.08E-08
Adult Female (Prospective Parent)	0.0425	1.E-06	70	0.9	65.4	4.08E-08

Hypothetical Exposure to the Commercial PentaBDE Product in Ambient Environments

Consumption of Vegetable (fresh, canned, dried, and frozen)

NON-CANCER

CDI = Cveg * CF * CRveg * AFo * 1/BW

HI = CDI / RfDo

Receptor	**Cveg** Concentration in Vegetables	**CF** Conversion Factor	**CRveg** Vegetable Consumption Rate	**AFo** Absorption Factor, Oral Route	**BW** Body Weight	**CDI** Chronic Daily Intake
	ng/g wet wt	mg/ng	g/day	unitless	kg	mg/kg-day
<1 yr Child	0.134	1.E-06	220.22	0.9	9.1	2.92E-06
1-2 yr Child	0.134	1.E-06	263.29	0.9	11.3	2.81E-06
3-5 yr Child	0.134	1.E-06	299.205	0.9	16.35	2.21E-06
6-8 yr Child	0.134	1.E-06	320.625	0.9	23.75	1.63E-06
9-11 yr Male	0.134	1.E-06	455.625	0.9	33.75	1.63E-06
9-11 yr Female	0.134	1.E-06	459	0.9	34	1.63E-06
12-14 yr Male	0.134	1.E-06	437.565	0.9	47.05	1.12E-06
12-14 yr Female	0.134	1.E-06	452.445	0.9	48.65	1.12E-06
15-18 yr Male	0.134	1.E-06	603.849	0.9	64.93	1.12E-06
15-18 yr Female	0.134	1.E-06	535.68	0.9	57.6	1.12E-06
Adult Male (Prospective Parent)	0.134	1.E-06	781.00	0.9	78.1	1.21E-06
Adult Female (Prospective Parent)	0.134	1.E-06	654.00	0.9	65.4	1.21E-06

Hypothetical Exposure to the Commercial PentaBDE Product in Ambient Environments

Consumption of Breast Milk by < 1 year Old Child

NON-CANCER

CDI = Cbm * CF1 * Fbm * CRbm * CF2 * AFo * 1/BW

HI = CDI / RfDo

	Cbm	**CF1**	**Fbm**	**CRbm**	**CF2**	**AFo**	**BW**	**CDI**
Receptor	Concentration in Breast Milk	Conversion Factor	Fraction of Breast Milk that is Lipid	Breast Milk Consumption Rate	Conversion Factor	Absorption Factor, Oral Route	Body Weight	Chronic Daily Intake
	ng/g lipid	g/ng	unitless	mL/day	mg/mL	unitless	kg	mg/kg-day
<1 yr Child	42.8	1.E-09	0.04	980	1	0.9	9.1	1.66E-07