

Emerald InnovationTM 3000

Polymeric flame retardant for polystyrene foams

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HBCD Alternatives Information Session

UNEP POPRC9

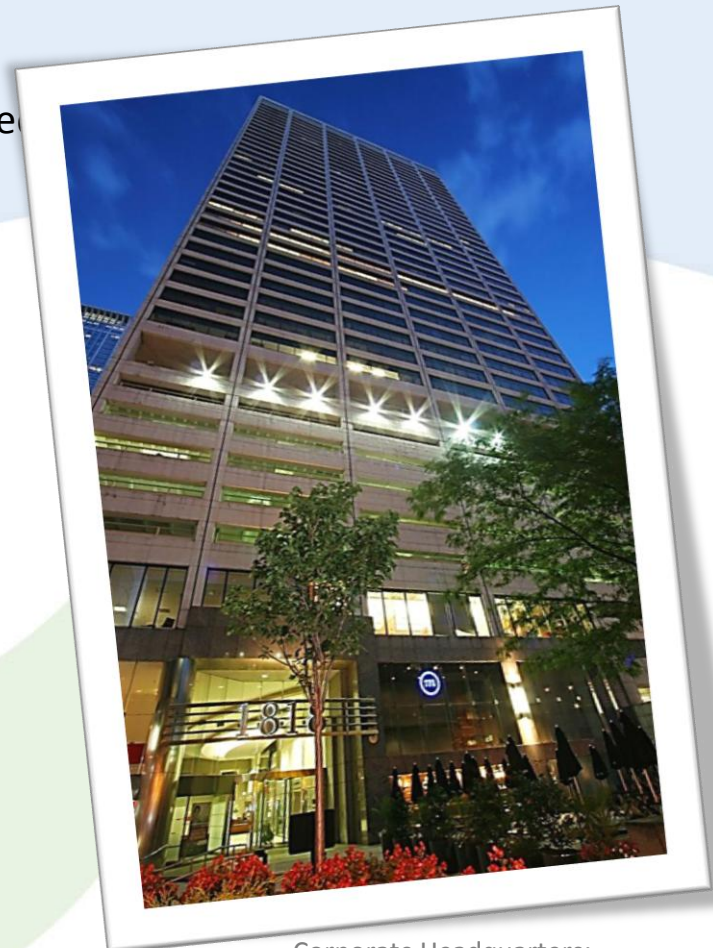
October 14, 2013

Outline

- Introduction to Chemtura
- Regional Demand for an HBCD Alternative
- The Challenge to Provide an Alternative
- Emerald Innovation™ 3000
 - Product Technology
 - Flammability
 - Hazard Assessment
 - Notification Status
 - Availability
 - Affordability
- Conclusion

Chemtura Today

- ♦ NYSE/Euronext: CHMT
- ♦ 2012 sales of \$2.6 billion (reflects discontinued operations treatment for the sale of Chemtura's plastic antioxidants business)
- ♦ Roughly 4,000 employees worldwide
- ♦ Manufactures in 13 countries and sells products in over 100 countries
- ♦ Global headquarters in Philadelphia, Pennsylvania
- ♦ Regional centers in:
 - ♦ Middlebury, CT
 - ♦ Manchester, UK
 - ♦ Sao Paulo, Brazil
 - ♦ Shanghai, China

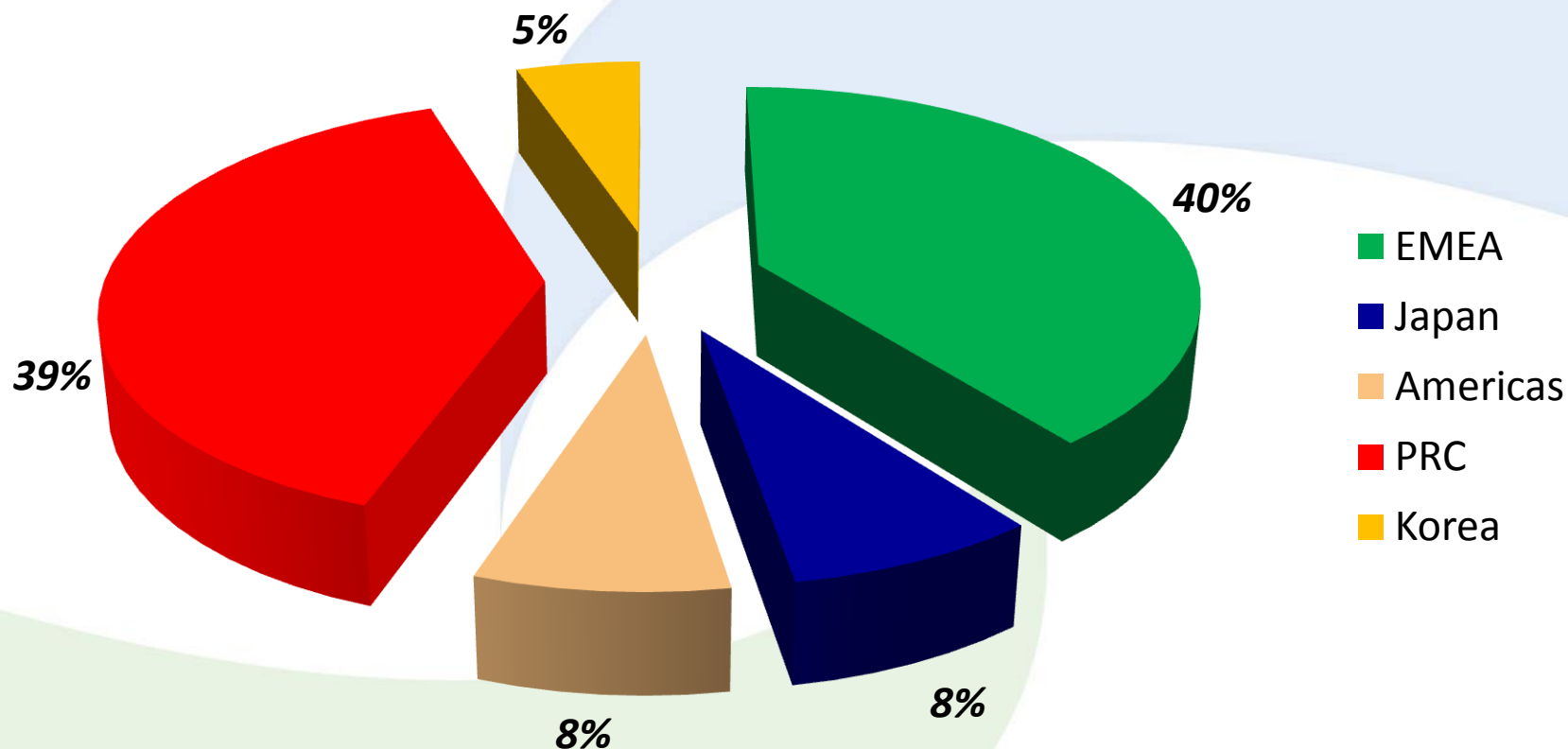


Corporate Headquarters:
Philadelphia, Pennsylvania, USA



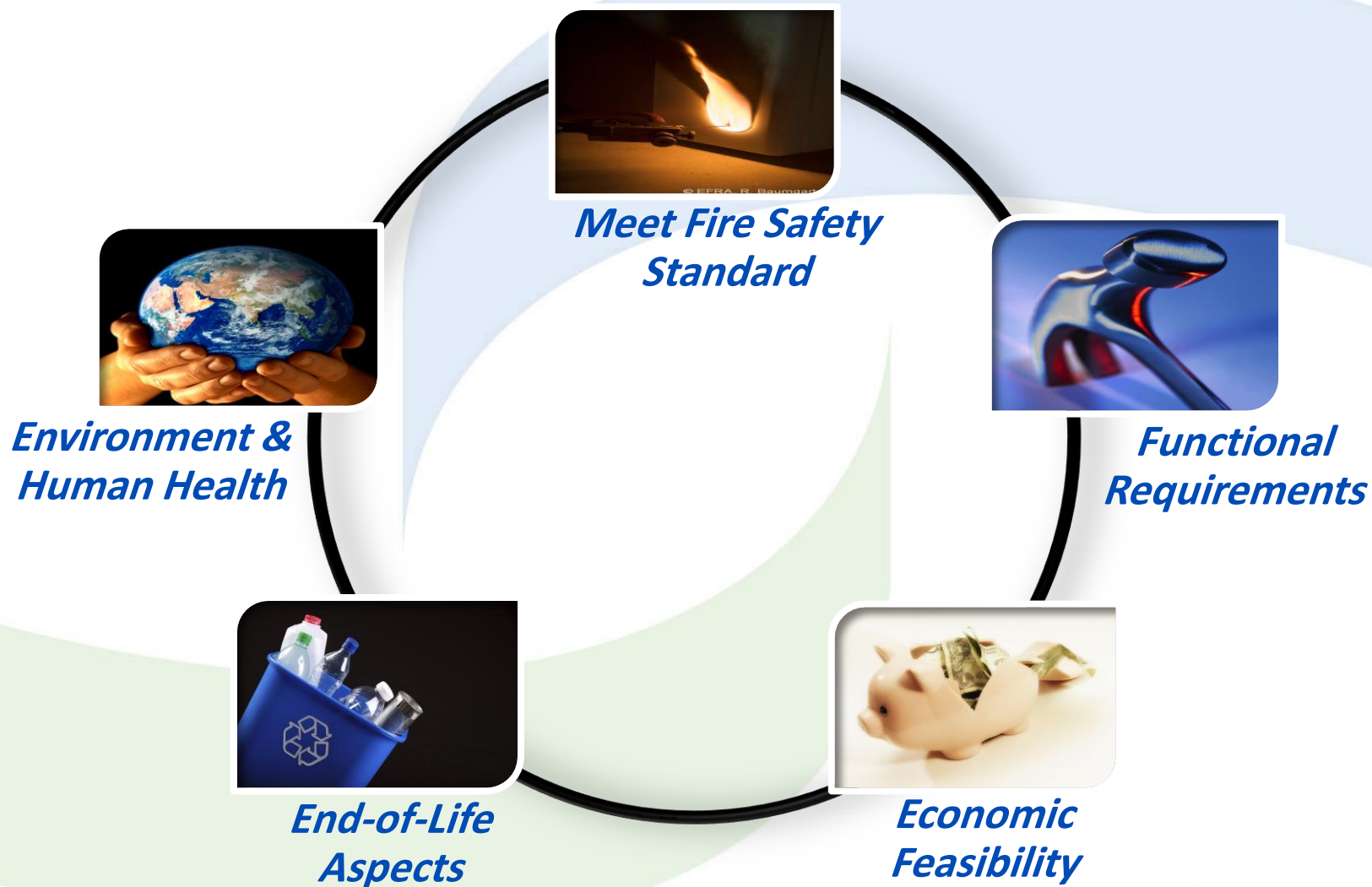
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Regional Distribution of HBCD Demand



- Global production estimated as 31,000 mt in 2011 per UNEP/POPS/POPRC.8/4 report October 2012

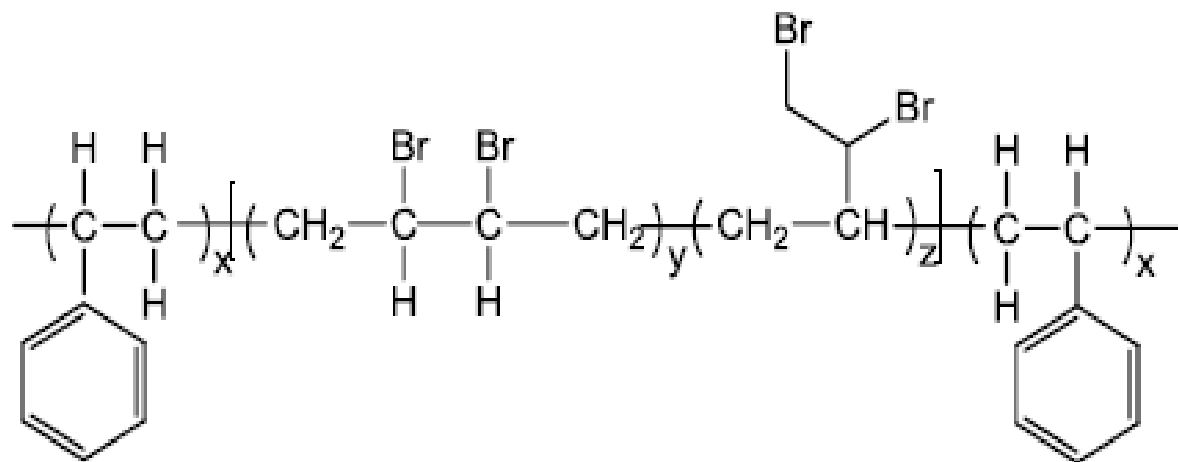
The commercial challenge for new flame retardants



Requirements for an Appropriate HBCD replacement

- **Environmentally Sound**
 - Not **P**ersistent, **B**ioaccumulative, and **T**oxic (not a PBT)
 - Not **very P**ersistent, Not **very B**ioaccumulative (not vPvB)
- **Provides Required Fire Safety and Mechanical Performance**
 - Maintain PS foam properties including fire performance
 - No negative impact on product performance
- **Compatible with Existing Manufacturing Processes**
 - Extruded Polystyrene (XPS) melt processing
 - Expandable Polystyrene (EPS) polymerization
 - Compatible with current production systems

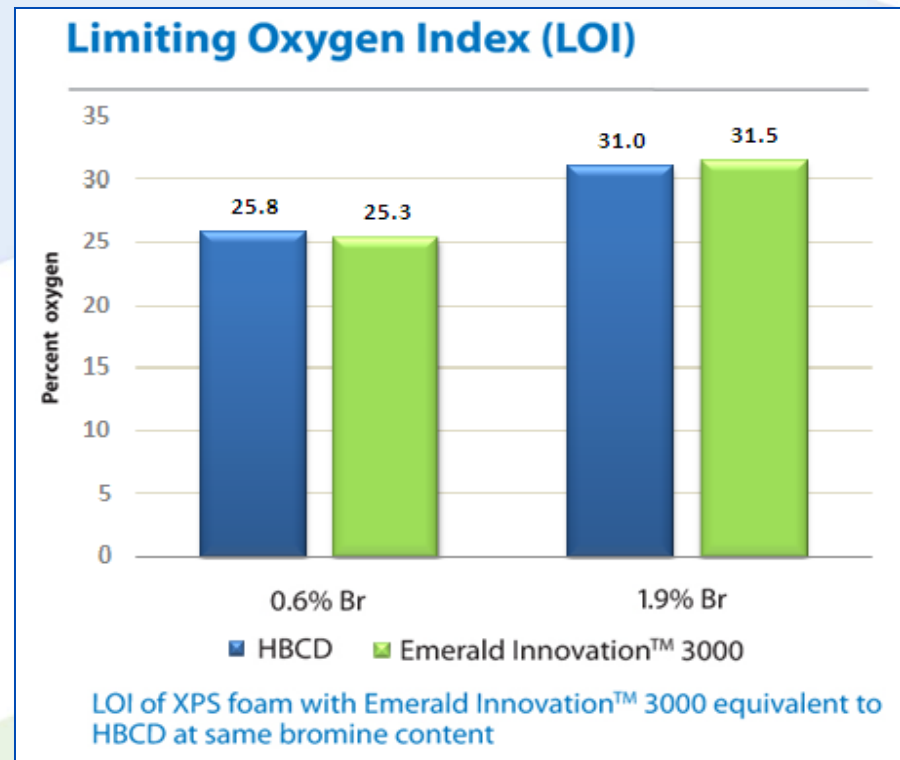
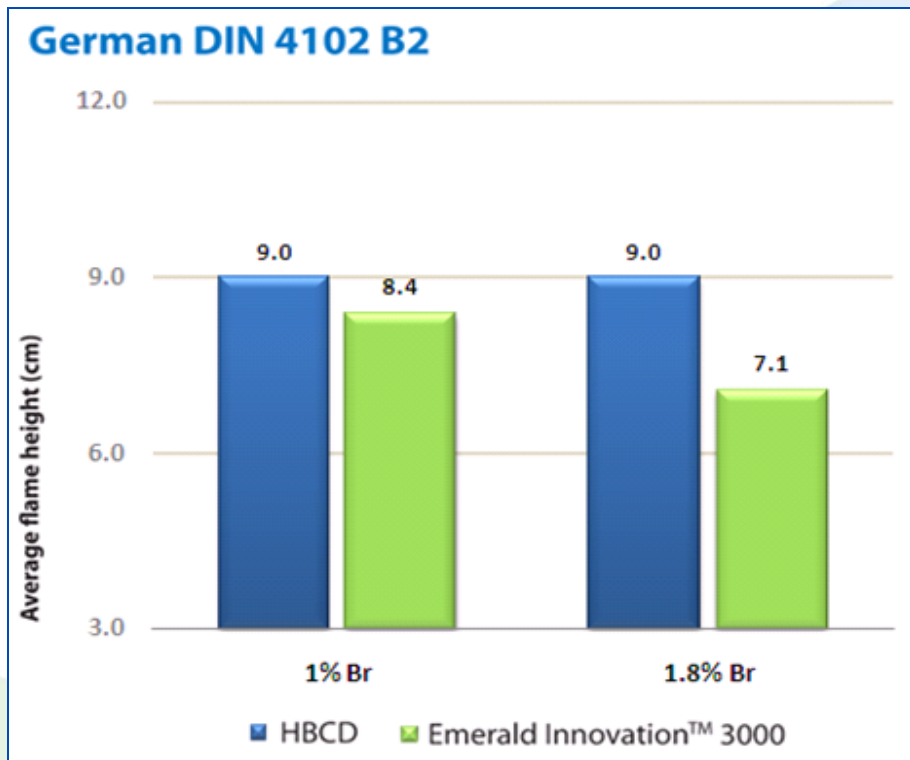
Emerald Innovation™ 3000



Brominated Styrene-Butadiene Block Copolymer
CAS No. 1195978-93-8

- Commercial Product Based on Licensed Technology from Dow Chemical Company
- Award winning innovation
- Chemtura is the First of Three Announced Licensees
- Engineered for Use in Polystyrene Foam
- High Molecular Weight Polymer for Favorable Hazard Profile
 - Mw > 100,000 g/mole

Meets Flammability Requirements



Demonstrates comparable fire retardant efficiency versus HBCD at similar bromine levels

Great Lakes
SOLUTIONS

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Appropriate EHS profile

DRAFT – September 2013

ES-1 Screening Level Toxicology Hazard Summary for HBCD and Alternatives

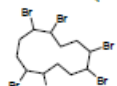
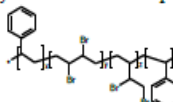
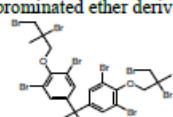
This table only contains information regarding the inherent hazards of flame retardant chemicals. Evaluation of risk considers both the hazard and exposure associated with substance including combustion and degradation by-products.

The caveats listed in the legend and footnote sections must be taken into account when interpreting the hazard information in the table.

VL = Very Low hazard **L** = Low hazard **M** = Moderate hazard **H** = High hazard **VH** = Very High hazard — Endpoints in colored text (**VL**, **L**, **M**, **H**, and **VH**) were assigned based on empirical data. Endpoints in black italics (*VL*, *L*, *M*, *H*, and *VH*) were assigned using values from predictive models and/or professional judgment.

^d This hazard designation would be assigned MODERATE for a potential for lung overloading if >5% of the particles are in the respirable range as a result of dust forming operations.

§ Based on analogy to experimental data for a structurally similar compound.

Chemical (for full chemical name and relevant trade names see the individual profiles in Section 4.8)	CAS RN	Human Health Effects											Aquatic Toxicity		Environmental Fate	
		Acute Toxicity	Carcinogenicity	Genotoxicity	Reproductive	Developmental	Neurological	Repeated Dose	Skin Sensitization	Respiratory Sensitization ¹	Eye Irritation	Dermal Irritation	Acute	Chronic	Persistence	Bioaccumulation
Hexabromocyclododecane (HBCD) 	25637-99-4; 3194-55-6	L	M	L	M	H	M	M	L		VL	VL	VH	VH	H	VH
Butadiene styrene brominated copolymer 	1195978-93-8	L	L	L	L	L	L	L ^d	L		L	L	L	L	VH	L
TBBPA-bis brominated ether derivative 	97416-84-7	L [§]	M [§]	M [§]	M [§]	M [§]	L	M [§]	L [§]		L	L	L	L	H	H

¹ At this time, there are no standard test methods for respiratory sensitization; as a result there was no designation for this endpoint.

Source: "Flame Retardant Alternatives for Hexabromocyclododecane (HBCD) (PDF)", Draft for Public Comment, Sep. 2013; <http://earth1.epa.gov/oppt/dfe/pubs/projects/hbcd/about.htm>

Appropriate EHS profile

HBBCD

Design for the Environment : [Alternative Assessment](#)
 Cyclododecane, hexabromo-; Hexabromocyclododecane; HBBCD
 25637-99-4
 Version: Draft
 Date: August 2013

Human Health	
Acute toxicity	L
Carcinogenicity	M*
Mutagenicity/Genetic toxicity	L
Reproductive toxicity	M
Developmental toxicity	H
Neurological toxicity	M*
Repeated dose toxicity	M
Skin sensitization	L
Eye irritation	VL
Dermal irritation	VL
Ecotoxicity	
Acute aquatic toxicity	VH
Chronic aquatic toxicity	VH
Environmental fate	
Persistence	H
Bioaccumulation/ Bioconcentration	VH

TBBPA-BDPE

Design for the Environment : [Alternative Assessment](#)
 Tetrabromobisphenol A Bis (2,3-dibromopropyl) Ether
 21850-44-2
 Version: Draft
 Date: July 2012

Human Health	
Acute toxicity	L
Carcinogenicity	M*
Mutagenicity/Genetic toxicity	M
Reproductive toxicity	M*
Developmental toxicity	M*
Neurological toxicity	L*
Repeated dose toxicity	M
Skin sensitization	M*
Eye irritation	L*
Dermal irritation	L*
Ecotoxicity	
Acute aquatic toxicity	L*
Chronic aquatic toxicity	L*
Environmental fate	
Persistence	VH
Bioaccumulation/ Bioconcentration	H*

Emerald Innovation™ 3000

Design for the Environment : [Alternative Assessment](#)
 Benzene, ethenyl-, polymer with 1,3 butadiene, brominated
 1195978-93-8
 Version: Draft
 Date: August 2013

Human Health	
Acute toxicity	L
Carcinogenicity	L*
Mutagenicity/Genetic toxicity	L
Reproductive toxicity	L
Developmental toxicity	L
Neurological toxicity	L*
Repeated dose toxicity	L
Skin sensitization	L
Eye irritation	L
Dermal irritation	L
Ecotoxicity	
Acute aquatic toxicity	L
Chronic aquatic toxicity	L*
Environmental fate	
Persistence	VH
Bioaccumulation/ Bioconcentration	L*

Source: U.S. EPA ChemView, <http://java.epa.gov/chemview>

* Endpoints assigned using values from predictive models and/or professional judgment.

vL= very Low, L= Low, vH= veryHigh, NE= no evidence

Persistent by Design, Required for Service Life & Stability
Low to Very Low in All Health and Environmental Effects



For a Better Tomorrow

Availability

- Nearly one year of commercial production and sales
- At least 10,000/mt per year of nameplate capacity
- Capable of expansion
- Stocked in all major consuming regions
- ***Ongoing commercial sales for use in both EPS and XPS in NAFTA, Asia-Pacific and EU***
- Additional licensees have announced production coming on stream

Approved territories for supply of EI 3000

Chemical Inventory Approvals

- United States, TSCA Inventory
- European Union, REACH
- Republic of Korea
- Taiwan
- China
- Japan
- Canada, DSL
- Philippines
- New Zealand



Additional Areas Where Supply is Permitted

- Israel
- CIS
- Ukraine



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Manufacturing Plant in El Dorado, Arkansas, USA



Emerald
Innovation™ 3000

Affordability

- No major capital investment required by users
- Only a few % increase on material cost of final PS products
- Multiple licensees create global competition to supply products based on the Dow technology
- Capacity utilization increasing

Cost effective replacement for HBCD



For a Better Tomorrow

The Polymeric FR Technology Provides an HBCD Alternative that is:

Appropriate:

- Requires minimal adjustments to production processes in EPS and XPS
- Meets performance requirements for foam boards
- Favorable environmental profile

Available:

- Full commercial production on-line
- Additional licensees announced

Affordable:

- Marginal increase in final product costs
- Major capital investments by users not required



For a Better Tomorrow